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# CLIMATE SERVICES: SCIENCE AND EDUCATION

Proceedings of the Second International  
Research-to-Practice Conference



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16-18 April 2025

ODESA



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MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
ODESA I. I. MECHNIKOV NATIONAL UNIVERSITY  
FACULTY OF HYDROMETEOROLOGY AND ENVIRONMENTAL SCIENCE



## **CLIMATE SERVICES: SCIENCE AND EDUCATION**

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The Proceedings of the Second International Research-to-Practice Conference on 'Climate Services: Science and Education' are presented in the collected volume. The presented materials highlight the current challenges and achievements in the development and implementation of climate services in climate-sensitive sectors of the economy. Special attention is given to the growing role of education in building capacity for climate-informed decision-making through interdisciplinary learning and professional training. The reports also cover issues of climate risks and adaptation strategies implemented at regional and local levels. Published studies reflect the author's vision of the problems of climate change and climate service. Materials are submitted in the author's editorial office.

The publication is intended for applicants, pedagogical, scientific and scientific-pedagogical employees of educational and scientific institutions.

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МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
ОДЕСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ ІМЕНІ І. І. МЕЧНИКОВА  
ФАКУЛЬТЕТ ГІДРОМЕТЕОРОЛОГІЇ І ЕКОЛОГІЇ



## **КЛІМАТИЧНЕ ОБСЛУГОВУВАННЯ: НАУКА І ОСВІТА**

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## **USING TRITICALE IN ANIMAL FEEDING AS A MEANS OF ADAPTING LIVESTOCK FARMING TO GLOBAL CLIMATE CHANGES**

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The climate in Ukraine is undergoing significant changes, manifested through rising average annual temperatures, prolonged periods of drought, and uneven precipitation distribution. These phenomena are most pronounced in the southern and eastern regions of the country, where limited water resources pose serious challenges to traditional agricultural production.

Over the past decade, Ukrainian soils have undergone substantial changes caused by global climate processes. One of the key issues is the reduction in soil moisture due to intensified droughts, uneven rainfall distribution, and rising temperatures. This impacts the productivity of agricultural crops, particularly grains, creating risks for sustainable agricultural production.

The increasing frequency of extreme weather events, such as heavy rains, hail, and strong winds, has led to soil erosion in many regions of Ukraine. Simultaneously, soil exhaustion due to the continued use of intensive agricultural technologies, without adequate restorative measures, has resulted in declining fertility. In the southern and eastern regions, the problem of soil salinization is becoming pressing, driven by the rising levels of groundwater and active irrigation.

Climate change also influences the biological activity of soils. As temperatures rise, the rate of organic matter mineralization increases, leading to the loss of humus. This negatively affects soil structure and its ability to retain water and nutrients.

The reduction in soil moisture significantly decreases the yields of staple traditional forage crops, endangering food security stability. Key grain crops like wheat, corn, and barley are especially affected.

Climate change is driving the active implementation of modern agricultural technologies and the development of innovative strategies for agricultural production. Notably, the study of adapted grain crop varieties capable of withstanding harsh climatic conditions has become a vital direction. Drought-resistant crops, such as triticale, deserve particular attention. This unique crop, a hybrid of wheat and rye, combines high yields with resilience to adverse climatic conditions. Thanks to its biological traits, such as a well-developed root

system, triticale efficiently utilizes moisture and nutrients even under challenging growing conditions.

Triticale also stands out due to its high drought tolerance and ability to successfully adapt to different soil types, including less fertile ones. This makes it a promising crop for cultivation in areas with limited precipitation. Moreover, triticale has significant potential for livestock feeding, particularly in grain feed production. In countries with intensive livestock industries, this crop has long established itself as an effective and nutritious feed for various animal species.

Research confirms that triticale can replace traditional grain crops in compound feed formulations for many types of animals. For instance, it is recommended to include up to 50% triticale in the diet of heifers (Zobell et al., 1990), while for pigs, this crop can fully replace wheat or barley. For poultry, the permissible proportion of triticale grain in compound feed is up to 20% (Gaviley et al., 2024). The use of enzyme preparations and extrusion technologies, such as triticale-soy and triticale-sunflower extrudates, significantly increases this proportion while minimizing the impact of antinutritional substances.

Considering climatic challenges, the role of triticale in Ukraine's agriculture continues to grow. This crop not only ensures high yields even under adverse conditions but also opens new opportunities for stabilizing and optimizing the feed base of livestock farming. Its active use in strategies for adapting agriculture to climate change will contribute to ensuring the country's food security and the sustainable development of the industry.

## REFERENCES

1. Gaviley, O.V.; Katerynych, O.O.; Ionov, I.A.; Dekhtiarova, O.O.; Griffin, D.K.; Romanov, M.N. Triticale: A General Overview of Its Use in Poultry Production. *Encyclopedia* 2024, 4, 395-414. <https://doi.org/10.3390/encyclopedia4010027>
2. Zobell, D.R., Goonewar-Dene, L.A., Engstrom, D.F. 1990. Potential of triticale as a feed for finishing heifers. *Canadian Journal of Animal Science*. 70(1), 325-328. <https://doi.org/10.4141/cjas90-040>
3. Glamoclija, N., Glisic, M., Boskovic, M., Djordjevic, J., Markovic, R., Sefer, D., Baltic, M. 2018. The impact of triticale diet on production characteristics and meat quality in pigs. *Scientific Journal «Meat Technology»*, 58(2), 73-79.