4. Beveridge M. C. M., Thilsted S. H., Phillips M. J., Metian M., Troell M., Hall S. J. Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture. *Journal of Fish Biology*. 2013. Vol. 83, No. 4. P. 1067–1084. DOI: 10.1111/jfb.12187.

5. Benson A., Craig R. K. Adaptive management and climate change. *Ecology Law Quarterly*. 2014. Vol. 41, No. 2. P. 439–498. DOI: 10.15779/Z38H98Z.

6. Bene C., Barange M., Subasinghe R., Pinstrup-Andersen P., Merino G., Hemre G. I., Williams M. Feeding 9 billion by 2050 – Putting fish back on the menu. *Food Security*. 2015. Vol. 7. P. 261–274. DOI: 10.1007/s12571-015-0427-z.

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REGIONAL SPECIFICITIES OF CHANGES IN FISHERIES DURING THE WAR: A COMPARISON OF SOUTHERN AND WESTERN UKRAINE

РЕГІОНАЛЬНІ ОСОБЛИВОСТІ ЗМІН У РИБНОМУ ГОСПОДАРСТВІ ПІД ЧАС ВІЙНИ: ПОРІВНЯННЯ ПІВДНЯ ТА ЗАХОДУ УКРАЇНИ

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The war in Ukraine has caused large-scale destruction in the fisheries sector, manifested in the loss of production capacities, degradation of natural water bodies, and a sharp decline in both exports and domestic production of aquaculture products [1]. Under these conditions, international assistance and humanitarian programs represent one of the key mechanisms for supporting the industry, aimed not only at compensating current losses but also at creating the foundation for post-war recovery and modernization [2]. An important feature of such support is its multi-level character: it encompasses financial, technical, infrastructural, and expert assistance, which makes it fundamental in overcoming the crisis in the fisheries sector [3].

International organizations, including the Food and Agriculture Organization of the United Nations (FAO), the European Union, the World Bank, and USAID programs, provide comprehensive support to Ukrainian fisheries [1; 2; 3; 4]. This concerns both the financing of reconstruction of destroyed facilities and the implementation of monitoring systems for water quality, the modernization of aquaculture enterprises, the development of recirculating aquaculture system (RAS) technologies, and the creation of logistic chains for the safe trade of fish products. Compared to the experience of other countries affected by armed conflicts, a certain pattern can be observed: international donors pay the greatest attention to food security and the supply of protein products to the population [2]. For instance, in Syria and Iraq, the main resources were directed at meeting the basic needs of the population, whereas in Ukraine, considerable emphasis is placed on combining humanitarian assistance with a long-term modernization strategy for the sector [3].

Table 1 presents an example of a comparison of forms of international assistance to the fisheries sector in Ukraine and in other states that have experienced armed conflicts.

Table 1

Comparison of international assistance in the fisheries sector (case of Ukraine and Syria)

Country	Main directions of assistance	Program focus	Long-term results
Ukraine	Financing the reconstruction of aquaculture enterprises; introduction of modern technologies (RAS, biofiltration); export recovery	Combination of humanitarian and recovery measures	Sector modernization, increased competitiveness in the global market
Syria	Provision of basic food packages, including fish products; limited support for local fisheries	Short-term food security	Lack of systemic changes, slow recovery of the sector

As can be seen from Table 1, assistance to Ukraine is more structured and oriented toward a long-term perspective. While in Syria the emphasis was exclusively on overcoming hunger and ensuring population survival, in the case of Ukraine the approach combines urgent humanitarian measures with modernization strategies aimed at developing competitive market mechanisms.

Another important aspect is the development of partnerships between Ukrainian scientific institutions and international research centers [4]. Such cooperation makes it possible to integrate innovative methods of water quality control, develop biosecurity protocols, and create conditions for the implementation of sustainable fisheries practices in line with EU standards. Particular attention is devoted to access to financing for small and medium-sized enterprises engaged in fish farming [5]. Grant and credit programs implemented by international organizations allow not only for the restoration of lost potential but also for the introduction of energy-efficient technologies and new types of products with high added value [3].

Table 2 provides an example of a comparison of the level of international investments in Ukrainian fisheries with other branches of the agricultural sector.

Table 2

Share of international investments in the recovery of Ukraine's agricultural sector (2022–2024)

Sector	Share of total international support, %	Main directions of investment
Agriculture (grain sector)	45	Reconstruction of elevators, export corridors, demining
Livestock	20	Farm restoration, veterinary support
Forestry	15	Reforestation, fire protection, combating illegal logging
Fisheries	20	Aquaculture, modernization of fish processing, introduction of RAS and biosecurity

As Table 2 shows, fisheries receive a relatively significant share of international support – on par with livestock and considerably more than the forestry sector. This is explained by the fact that fish products have strategic importance for ensuring food security, particularly in the context of reduced meat production and high dependence on imports.

International assistance and humanitarian programs thus play a systemic role in the recovery of Ukraine's fisheries during wartime. Their multi-level nature covers both short-term measures to eliminate the consequences of hostilities and long-term modernization programs. A comparative analysis

of the experience of Ukraine and other countries that have gone through armed conflicts demonstrates the uniqueness of the Ukrainian case: international support is focused not only on food security but also on building a competitive fisheries sector capable of integration into European and global markets.

A significant share of investments is directed to the restoration of aquaculture, the introduction of modern technologies (RAS, biofiltration systems), the improvement of water body biosecurity, and the modernization of processing facilities. This creates the conditions for transforming the industry from a traditionally resource-dependent model into a more innovative and crisis-resilient one.

Therefore, international assistance not only compensates for the losses caused by the war but also opens up new opportunities for the development of Ukraine's fisheries. Its comprehensive character, integration of scientific knowledge and international practices, and the combination of humanitarian and recovery strategies provide the foundation for a transition from crisis management to sustainable sectoral development in the post-war period.

At present, an important perspective is the integration of nature conservation principles with the tools of military meteorology. This approach would not only ensure the preservation of rare and native fish species in protected aquatic areas but also create a system for rapid response to environmental risks during wartime and in the post-war period.

Armed aggression against Ukraine has caused significant damage not only to fisheries infrastructure but also to protected areas. National parks, biosphere and nature reserves that safeguard unique fish communities and other aquatic organisms have suffered destruction and pollution. Hostilities, contamination of water bodies with fuel and lubricants as well as ammunition residues, and the destruction of coastal infrastructure have disrupted ecological balance. Particularly vulnerable are the protected aquatic zones of the Danube, Dniester, Black Sea, and Azov Sea, which serve as reproductive habitats for commercially valuable and rare fish species.

Integrating conservation issues into international support programs for fisheries is a prerequisite for sustainable recovery. This includes strengthening the protection of natural aquatic areas, introducing monitoring systems for fish populations, and restoring rare and endangered species. The development of biosecurity protocols within protected areas is of particular importance. A promising direction is the combination of aquaculture programs with biodiversity restoration projects in reserves and national parks, which would help harmonize production and ecological objectives.

Regarding the role of military meteorology in fisheries recovery, it should be noted that, originally aimed at providing highly accurate forecasts under extreme conditions, it can become an effective tool in the civilian sector. Its application in fisheries opens new opportunities for forecasting and risk management. The use of advanced weather prediction models, developed for military purposes, in water monitoring systems would make it possible to detect hazardous phenomena in advance – such as fish kills, eutrophication, abrupt changes in oxygen regimes, and flood waves.

The combination of military meteorology with civilian observation methods creates the foundation for an early warning system capable of protecting both commercial enterprises and protected aquatic areas. The use of satellite monitoring, drone technologies, radar systems, and specialized forecasting models ensures comprehensive control over the state of water bodies, even in hard-to-reach or hazardous regions. This could significantly increase the resilience of aquaculture to crisis phenomena and contribute to the sustainable development of the fisheries sector.

Bibliography:

1. FAO. The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome : Food and Agriculture Organization of the United Nations, 2022.

2. World Bank. Blue Economy Development Framework: Growing the Blue Economy to Combat Poverty and Accelerate Prosperity. Washington, DC : World Bank, 2017.

3. USAID. Ukraine Agriculture Resilience Initiative (AGRI-Ukraine) : Progress Report 2022–2023. Washington, 2023.

4. European Commission. EU Support to Ukraine: Agriculture and Fisheries Sector Recovery. Brussels : European Union, 2023.

5. Bohdanov H.I., Skyba Yu.A. Rybne hospodarstvo Ukrainy: suchasnyi stan ta perspektyvy rozvytku. *Naukovi dopovidi NUBiP Ukrainy*. 2021. № 5 (91).