

**INNOVATIVE APPROACHES TO THE INTEGRATION OF
METEOROLOGICAL FORECASTS INTO STRATEGIES FOR THE
RATIONAL USE OF AQUATIC BIORESOURCES**

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In modern conditions, the management of aquatic bioresources and aquaculture requires a comprehensive approach that takes into account not only biological and economic aspects but also a wide range of natural and climatic factors. In particular, meteorological parameters have a significant impact on the ecological state of water bodies, the dynamics of fish and other aquatic organisms' populations, as well as the efficiency of aquaculture technologies. Traditionally, climatic conditions in fisheries practice were regarded as background factors; however, in recent decades, due to global climate change [3, 4], their influence has moved to the forefront. This necessitates the use of meteorological forecasts as an integral component of strategic management of aquatic bioresources.

An important task is the development of systems that combine hydrometeorological forecasts with ecological models. Such systems make it possible to predict not only changes in weather conditions but also their effects on water temperature and oxygen regimes, the development of phytoplankton and zooplankton, and the spawning activity of fish. The use of short-term and long-term forecasts increases the effectiveness of planning aquaculture production, especially in cases of

threats such as summer fish kills, floods, or prolonged droughts. For example, timely consideration of water temperature forecasts makes it possible to optimize feeding schedules and regulate the load on water bodies, minimizing the risks of excessive organic enrichment.

Military meteorology, characterized by high accuracy and specialized methods of data collection under complex conditions, is of particular importance. Its integration into civilian sectors may provide aquaculture with additional advantages, particularly in terms of rapid response to sudden weather changes or emergencies. This enables more effective management not only of production processes but also of biodiversity conservation, since the stability of natural conditions determines the survival of many native and commercially valuable fish species.

In practice, the creation of information platforms for farmers and managers is highly relevant, where meteorological data are integrated with fisheries analytics. This may include mobile applications providing recommendations on feed inputs, water quality control, or early warnings of risks. Such innovations increase the economic efficiency of the sector while simultaneously reducing ecological risks, in line with the principles of sustainable development [1, 2] (Table 1).

Table 1. Examples of potential applications of meteorological data in strategic aquaculture management

Meteorological factor	Impact on water body	Potential management decisions
Air and water temperature	Determines fish growth rates, phytoplankton development	Regulation of feeding intensity, selection of species for cultivation
Precipitation and floods	Changes in water level, siltation, eutrophication	Stocking planning, water quality control
Wind regimes	Aeration of water bodies, redistribution of plankton biomass	Monitoring oxygen regime, use of aerators
Atmospheric pressure	Fish behavior and activity	Adjustment of harvesting and feeding schedules
Prolonged droughts	Reduction of water volume, accumulation of toxic substances	Use of alternative water sources, regulation of pond loading

The integration of meteorological forecasts into aquatic bioresource management systems creates a new quality of planning economic activity. On the one hand, it increases the predictability of aquaculture production outcomes; on the other, it strengthens the environmental dimension, reducing negative impacts on ecosystems.

Integrating meteorological forecasts into aquaculture development strategies and aquatic bioresource management is an important direction for enhancing the sector's adaptability to climatic and environmental challenges. The use of data on temperature, precipitation, atmospheric pressure, and other environmental parameters makes it possible not only to forecast the productivity of water bodies but also to prevent crisis situations threatening fish populations.

The introduction of innovative approaches, including digital platforms, analytical systems, and mobile applications, ensures real-time communication between meteorological services and aquaculture producers. This creates conditions for increasing production efficiency, reducing economic losses, and promoting more rational use of natural resources.

Particular prospects are offered by the use of military meteorology methods, which are distinguished by high precision and rapid response. Their integration into civilian aquaculture practices opens new opportunities for monitoring and managing risks, including natural and technological emergencies. This contributes to the formation of a resilient development model for the industry, capable of withstanding the impacts of global climate change.

Thus, the combination of fisheries technologies with modern meteorological forecasting creates a synergistic effect. On the one hand, it ensures the preservation of biodiversity and ecological stability of natural water bodies; on the other, it guarantees the economic profitability and competitiveness of aquaculture on the market. In the future, interdisciplinary cooperation among biologists, ecologists, and meteorologists will be the key to forming a new paradigm of aquatic bioresource management based on scientific validity, innovation, and sustainable development.

References

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