

<sup>1</sup>*National University of Water and Environmental Engineering, Rivne*

## **MECHANISM OF USING WATER AND LAND RESOURCES TO ENSURE THE ENVIRONMENTAL AND ECONOMIC SECURITY OF AGRICULTURAL NATURAL USE**

The article highlights that the rapid development of scientific and technical progress provides ample opportunities for increasing the efficiency of agricultural nature management, but at the same time, leads to an increase in anthropogenic, technical, and technological load on the environment. It is grounded that inefficient use of water and land resources leads to a decrease in the ecological and economic security of the state. It is emphasized that the management of land and water resources is one of the priority areas for which it is necessary to implement transformations. The author proposed the organizational and economic mechanism for implementing the joint management of water and land resources to ensure the environmental and economic security of agricultural natural use. It has been substantiated that the proposed mechanism is oriented towards the application of management approaches, adequate use of land and water resources, joint financing of the renewal of the material and technical base of agricultural enterprises and water management organizations on a new, innovative basis that will ensure the socio-ecological and economic functioning of enterprises, efficient uninterrupted agricultural production and, as a result, the appropriate level of state's competitiveness and security.

**Keywords:** management; mechanism; environmental and economic security; innovation; agricultural natural use; competitiveness; water resources; land resources.

**Formulation of scientific problem and its significance.** The rapid development of scientific and technical progress provides ample opportunities for increasing the efficiency of agricultural nature management, at the same time, the use of the advantages of such progress leads to an increase in anthropogenic, technical, and technological load on the environment and is the cause of water pollution, degradation of agricultural land, reduction of forest plantations, etc. The situation is also complicated by global natural and climatic changes. Ignoring issues of environmental protection, and

making economic decisions without due attention to environmental safety requirements increases the likelihood of serious economic and social problems in the development of the agricultural sector of Ukraine. It is obvious that it is necessary to ensure such a format of its functioning, under which the solution of the tasks of socio-economic growth will not have a destructive effect on the state of the country's environment.

The volumes of human use of water and land for agricultural needs have not yet reached their peak, but all the facts point to a slowdown in the growth of agricultural productivity, rapid depletion of productive capacity, and damage to the surrounding natural environment. Increasing the scale of ecologically responsible and climate-optimized production can reverse trends in the deterioration of land and water resources and contribute to their inclusive growth. This approach is consistent with the objectives of the FAO Strategic Framework Program [1]: «improvement of production, improvement of nutrition quality, improvement of the environment and quality of life improvement».

Over the past decade, several important global policy mechanisms have emerged: the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Change, the Sendai Framework for Disaster Risk Reduction 2015-2030, the New Urban Development Agenda, etc. Within the framework of these mechanisms, the Sustainable Development Goals (SDGs), determined at the national level, the Nationally Determined Contributions, and the concept of the neutral balance of land degradation are implemented. In particular, special SDGs related to water resources and tasks related to land conservation and soil health have been defined. The implementation of these mechanisms is accompanied by global assessments of the state of natural resources, including soils, forests, and biodiversity, as well as the situation with devastation and climate change.

Management of land and water resources is one of the priority areas for which it is necessary to implement transformations. Caring for the land, water resources, and especially soil health in the long term is essential to ensure access to food in the face of ever-increasing demands on the food chain, to create guarantees for the ecological safety of production, and to promote justice in obtaining livelihoods and increasing resilience to the shocks and stresses associated with natural disasters and pandemics. And the beginning of everything is the issue of access to land and water resources and their management. Sustainable methods of managing land, soil, and water resources also contribute to the provision of a full and diverse diet and the creation of resource-

saving production and sales chains in the process of transition to sustainable consumption patterns.

**Analysis of recent research and publications** show that the topic of water and land resources management, especially its rational use, is in the field of view of foreign and domestic scientists. Scientists such as L. Kozhushko, V. Stashuk, M. Khvesyk, A. Yatsyk, O. Balatskyi, S. Doroguntsov, V. Mesel-Veseliak, P. Sabluk, M. Fedorov, Ashok Chapagain, Arjen Y. Hoekstra, Lu Zhang Feras Ziadat, Jan Szolgay, Lars Ribbe, and others made a significant contribution to the study of water and land resources management. Such domestic and foreign scientists such as L. Abalkin, O. Baranovskyi, M. Barna, T. Vasytseva, V. Vyhovska, O. Vlasyuk, A. Galchynskyi, Yu. Goncharova, O. Gordienko, B. Kirylenko, A. Mokii, S. Mocherny, M. Fleischuk, Yu. Kharazishvili, V. Shevchuk, V. Shlemko, and L. Yaremko comprehensively covered the theory and practice of ensuring economic security in their scientific works. However, these studies do not consider issues of integrated (complex, joint) management of water and land resources as a way of ensuring the state's sustainability and require a more detailed study.

**The purpose of the article** is to substantiate the organizational and economic mechanism for implementing the joint management of water and land resources to ensure the environmental and economic security of agricultural natural use.

**Presentation of the main material.** Land and water resources and how they are used are major factors in meeting the challenge of increasing food security in the world. Caring for land and water resources in the long term is crucial to ensure access to food in the face of ever-increasing demands on the food chain, to create guarantees for the ecological security of production, to promote equity in livelihoods, and to increase resilience to shocks and stresses, related to natural disasters. Demographic challenges, climate change, and increased competition for land and water resources in the face of food insecurity are likely to contribute to increasing insecurity.

The planet's population continues to grow. It is expected that by 2050, the current population (7 billion people) will increase to approximately 9 billion people. Until then, it will be necessary to annually produce an additional 1 billion tons of grain and 200 million tons of livestock products. The task of increasing agricultural production is most acute for developing countries, where the problem is not only producing food but also ensuring access to it by households in order to ensure their food security.

Water and land resources play an important role in the functioning of natural systems (the weighting factor reflecting the relative role of the ith component in the functioning of natural systems is 1 for soil and 0.95 for water resources [2]). And the ecological stability of natural systems and ecological and economic security depends on how efficiently water and land resources are used in various branches of the national economy, including agriculture. However, according to research, natural resources are used inefficiently in agriculture, especially in irrigated agriculture.

Almost all business entities in Ukraine have a tendency to deteriorate the condition of the land. In most of them, the soil cover, especially agricultural land, is prone to degradation and pollution, catastrophically loses its resistance to destruction, the ability to restore properties, reproduction of fertility due to exhausting, consumptive use of land, underestimation by authorities of the need to study the condition of the land and develop scientifically based comprehensive measures, their rational use. Among the dangerous negative processes in the territory of Ukraine, erosion, deflation, waterlogging, salinization, desertification, flooding, overgrowth of agricultural land with shrubs, and other processes are intensively developing, the consequence of which is the loss of fertility of agricultural land and its removal from economic circulation.

As a result of the reduction of the total area of agricultural lands, the reduction of the area of irrigated and drained lands, the deterioration of their meliorative condition and economic use, soil pollution with heavy metals, the stability and safety of natural systems is reduced. It is also worth noting that the methods used in agriculture favor, first of all, farmers who have productive land and access to water, unlike most small producers who, as before, cannot ensure high productivity of their activities, receiving permanent losses and suffering from extreme insecurity, land degradation, and climatic anomalies.

Institutions dealing with issues of land and water resources do not have time to respond to the growing intensity of economic use of river basins, the growing relationship between land and water resources, as well as to the growth of competition for their use. That is why more adaptive and flexible mechanisms are needed, which will allow us to effectively solve the problems of lack of natural resources and preservation of market potential.

According to FAO [1] forecasts, by 2050, population and income growth will require an increase in global food production by 70 percent, and in developing countries by 100 percent, compared to 2009 levels. However, the distribution of land and water resources does not favor

countries that need to increase production: in low-income countries, the availability of arable land per capita is on average more than half that of high-income countries and the suitability of arable land for growing crops is generally less. Some of the countries in which there is a rapidly growing demand for food are at the same time acutely experiencing a shortage of land and water resources. It is most likely that the growth of agricultural production will be achieved primarily due to the intensification of production on existing agricultural land. This requires the widespread adoption of sustainable land management practices and more efficient use of irrigation water by increasing the flexibility, reliability, and timeliness of irrigation water supply. A number of land and water systems are currently under threat of a gradual decline in their production potential due to excessive demographic pressure and unsustainable agricultural practices. Within these systems, external factors, including climate change, competition with other industries, and socio-economic changes, may be added to the physical limitations of the availability of land and water resources in some cases.

Today, there are a number of proven, cost-effective land management practices that reduce waste and ensure the rational use of water in agriculture, bringing additional benefits to the environment and increasing productivity in the long term. In particular, this is an increase in the availability/efficiency of water use (modernization of infrastructure, organic agriculture, collective irrigation management, rainwater harvesting, use of gray and wastewater, etc.); reduction of water demand (choice of agricultural crops, climate-optimized agriculture); support of landowners (insurance based on the index of weather conditions). However, such practices are not widely used. This is due to factors such as lack of labor or investment, as well as the presence of pseudo-incentives such as subsidies and legal regulations that do not encourage efficient use (Water resources, 2018). Although attempts to implement integrated water resources management have been made for decades, they have often not met with practical success due to sectoral interests, political and managerial barriers, and the failure to create a sense of collective responsibility. Managers in the field of water use have traditionally managed water resources in isolation, while efficiency largely depends on sustainable management of land resources [3].

One example is the seven-year Integrated Water Management Project in the Hai River Basin in China, which initiated water and land management reforms to improve water quality in the river and aquifers and reduce irrigation water use. The project clearly demonstrated some of the main elements of the national program for the protection and

rational use of water resources, including a central organization with comprehensive legislation on water resources; planning of land and water use at the level of the region and watershed; norms for making decisions based on long-term water supply and water consumption; relevant services for research, demonstration and dissemination of knowledge and experience; demand management system; equipment quality control; promotion of associations of water users; and, if necessary, land reform and agricultural loans for irrigation [4].

The participation of all owners at all levels of water and land management can significantly increase the productivity of water resources and reduce tensions in this sector by increasing the efficiency of their allocation between sectors and implementing technologies and management structures that promote efficient water use. Examples are collective shared irrigation or groundwater management. Cooperation in transboundary water management, starting at the technical level, can contribute to optimal multi-purpose investment of funds and sharing of benefits at the level of river basins. Today, approaches to the management of river basins reflect the best practice of decentralizing the management of water and land resources and transferring it to the lowest regional level and involving owners in the planning and decision-making process. In particular, the accounting of positive and negative factors will be necessary when solving issues related to the level and methods of intensification, protection and protection, the balance between commercial agriculture and the production of major agricultural crops, as well as between the growth and distribution of incomes, the level of national food security and the distribution of costs and income between urban and rural population.

Effective cooperation between institutions dealing with issues of water and land resources does not correspond to the structure of use and consumption. Despite the fact that water and land function as a single system, they are managed separately. While in the legal sphere the division of water and land resources is a purposeful action aimed at preventing their theft, due to which the intensity of the development of river basins increases, as well as the degree of interdependence of water and land resources and the struggle for them, there is a need to create more integrated, flexible bodies that could effectively fight the shortage of natural resources and respond to changes in the market situation. Even, institutions whose main task is the comprehensive management of a region or a river basin, mainly deal with water resources separately, or land resources separately and issues of their respective multi-purpose use, rather than water and land resources together.

Joint management of water and land resources is a scale-

dependent process that brings together different stakeholders and sectors. Accordingly, stakeholder participation should be at the heart of the entire process, while governance, policies, and institutions are factors that facilitate the implementation of water and land use plans. Political and institutional support is key at all levels to ensure alignment between national and sub-national economic, social and environmental objectives and the needs of stakeholders (public and private), and to help balance their interests. That is, in order to carry out effective joint management of water and land resources, it is necessary to create a commission (permanently operating) under the Ministry of Agrarian Policy and Food of Ukraine for leadership, which will enable the basin councils, together with territorial communities, to make decisions about the tools and mechanisms of water and land management resources on its territory together with land owners, and will also allow to redistribute functions and responsibilities, establish principles and rules of conduct.

For implementing the joint management of water and land resources, an adequate organizational and economic mechanism is necessary, which covers its main components and is oriented towards the application of management approaches, adequate use of land and water resources, joint financing of the renewal of the material and technical base of agricultural enterprises and water management organizations on a new, innovative basis that will ensure the socio-ecological and economic functioning of enterprises, efficient uninterrupted agricultural production and, as a result, the appropriate level of state's security.

So, this mechanism as a set of interacting organizational and economic components. At the same time, the organizational component of the mechanism is the structure that organizes the process and set of relations, as well as the forms, methods and regulations of managerial influences on the change in the state (development) of the system; and the economic components of the mechanism - a set of principles and rules for the implementation of relations, as well as methods and ways of achieving the goals of the system, i.e. the toolkit with the help of which relations are implemented and the process is carried out. Based on this, in our opinion, the organizational and economic mechanism of joint management of water and land resources should be understood as a set of institutions, principles, rules, approaches, as well as measures aimed at organizing effective agricultural and water management production, expanding their production and financial capabilities (Fig. 1).

In particular, the proposed mechanism includes the following components: organizational: formation and development of a specialized institute for joint management of water and land resources;

venture capital companies, as well as cluster associations at the regional level; economic: formation of market relations in agriculture and water management, pricing of agricultural products, tariff policy for water, cost of land lease, etc.; legislative and regulatory framework, which includes scientific, legal, personnel, technical, informational (socio-ecological-economic monitoring) support, which is the basis for the implementation of the water and land resources management process.

The main subjects are the Commission for Joint Management of Water and Land Resources, the State Water Agency, farmers, clusters, venture companies, etc.

The process of joint management of water and land resources involves the implementation of joint complex projects, as well as the introduction of economic incentives and sanctions in case of positive/negative dynamics of indicators of the use of water and land resources; planning the use of water and land resources through the negotiation process of interested parties, carrying out sizes assessments and monitoring the dynamics of changes in water and land footprints, forecasting the expediency and effectiveness of the use of water and land resources. The management process is carried out with the help of administrative, economic, and social methods and tools, as a result of which it is possible to achieve safety through economically efficient, socially necessary, and ecologically balanced functioning of water management and agricultural enterprises.

**Conclusions.** Thus, summarizing the results of the research, it can be stated that for the most effective and rational use of water and land resources in order to ensure the environmental and economic security of agricultural natural use, it is necessary to implement its joint management. With the joint use, first of all, of water and land resources, internal efficiency increases, costs, and business risks are reduced, the process of information exchange is improved, and enterprise management reaches a new, higher level, which allows significantly reduce transactional costs. Effective and inclusive management, as well as coordinated and integrated policy measures in various sectors, which will allow solving numerous tasks related to nature use, achieving the necessary compromises, and the state of relevant ecosystems and services, are necessary for the creation of effective mechanisms for the joint management of water and land resources. To ensure the effectiveness, efficiency, and inclusive nature of strategies in the field of land and water resources, multi-level governance mechanisms are necessary.



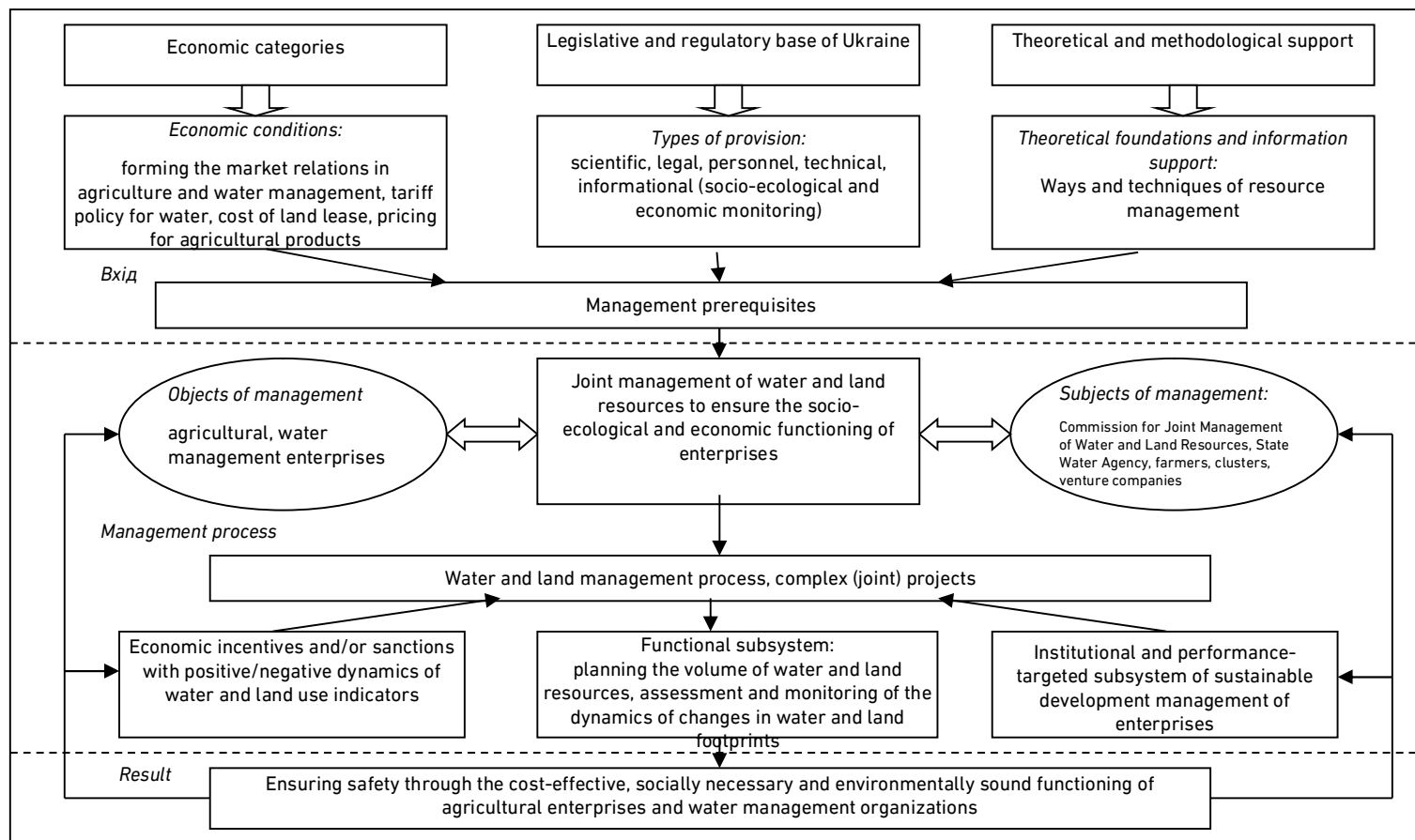


Figure. Organizational and economic mechanism for implementing the joint management of water and land resources (developed by the author)

1. FAO. The State of the World's Land and Water Resources for Food and Agriculture – Systems at breaking point. Main report. Rome. 2022. URL: <https://www.fao.org/3/cb9910en/cb9910en.pdf> (дата звернення: 01.12.2022).
2. Кундиус В. В. Эффективность использования водных и земельных ресурсов. *Природообустройство*. 2019. № 3. С. 123–126.
3. Bossio D., Geheb K., Critchley W. Managing water by managing land: Addressing land degradation to improve water productivity and rural livelihoods. *Agricultural Water Management*. 2010. Vol. 97. Pp. 536–542.
4. Song X., Ravesteijn W., Frostell B., and Wennersten R. Managing water resources for sustainable development: The case of integrated river basin management in China. *Water Science and Technology*. 2016. Vol. 61. Pp. 499–506.

## REFERENCES:

1. FAO. The State of the World's Land and Water Resources for Food and Agriculture – Systems at breaking point. Main report. Rome. 2022. URL: <https://www.fao.org/3/cb9910en/cb9910en.pdf> (data zvernennia: 01.12.2022).
2. Kundius V. V. Effektivnost ispolzovaniya vodnyih i zemelnyih resursov. *Prirodoobustroystvo*. 2019. № 3. S. 123–126.
3. Bossio D., Geheb K., Critchley W. Managing water by managing land: Addressing land degradation to improve water productivity and rural livelihoods. *Agricultural Water Management*. 2010. Vol. 97. Pp. 536–542.
4. Song X., Ravesteijn W., Frostell B., and Wennersten R. Managing water resources for sustainable development: The case of integrated river basin management in China. *Water Science and Technology*. 2016. Vol. 61. Pp. 499–506.

---

**Щербакова А. С.** [1: ORCID ID: 0000-0003-0972-821X],

к.е.н., доцент

<sup>1</sup>Національний університет водного господарства та природокористування, м. Рівне

## МЕХАНІЗМ ВИКОРИСТАННЯ ВОДНИХ ТА ЗЕМЕЛЬНИХ РЕСУРСІВ ДЛЯ ЗАБЕЗПЕЧЕННЯ ЕКОЛОГО-ЕКОНОМІЧНОЇ БЕЗПЕКИ АГРАРНОГО ПРИРОДОКОРИСТУВАННЯ

У статті наголошено, що стрімкий розвиток науково-технічного прогресу надає широкі можливості для підвищення ефективності сільськогосподарського природокористування, але водночас призводить до збільшення антропогенного, техніко-технологічного навантаження на довкілля. Обґрунтовано, що неефективне використання водних і земельних ресурсів призводить до зниження еколого-економічної безпеки держави. В статті підкреслено, що управління земельними та водними ресурсами є одним із пріоритетних напрямів, для якого необхідно здійснити перетворення. Автором запропоновано організаційно-економічний механізм реалізації спільного управління водними та земельними ресурсами для забезпечення еколого-економічної безпеки сільськогосподарського природокористування. Запропоновано під організаційно-економічним механізмом сумісного



управління водними та земельними ресурсами розуміти сукупність інституцій, принципів, правил, підходів, а також заходів, спрямованих на організацію ефективного аграрного та водогосподарського виробництва, розширення їх виробничих та фінансових можливостей. Обґрунтовано, що запропонований механізм включатиме складові: організаційні: формування і розвиток спеціалізованого інституту сумісного управління водними та земельними ресурсами; венчурних компаній, а також кластерних об'єднань на регіональному рівні; економічні: становлення ринкових відносин у сільському та водному господарстві, ціноутворення на сільськогосподарську продукцію, тарифну політику на воду, вартість оренди землі тощо; законодавчо-нормативна база, яка включає наукове, правове, кадрове, технічне, інформаційне (соціо-еколого-економічний моніторинг) забезпечення, що є підґрунтям для здійснення процесу управління водними та земельними ресурсами. Механізм орієнтований на запровадження управлінських підходів, раціональне використання земельних і водних ресурсів, спільне фінансування оновлення матеріально-технічної бази сільськогосподарських підприємств і водогосподарських організацій на новій, інноваційній основі, що забезпечить соціально-еколого-економічне функціонування підприємств, ефективне безперервне сільськогосподарське виробництво і, як наслідок, належний рівень конкурентоспроможності та безпеки держави.

**Ключові слова:** менеджмент; механізм; еколого-економічна безпека; інновації; аграрне природокористування; конкурентоспроможність; водні ресурси; земельні ресурси.

Отримано: 2 грудня 2022 року  
Прорецензовано: 7 грудня 2022 року  
Прийнято до друку: 23 грудня 2022 року