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CHAPTER 4

STRATEGIC DIRECTIONS OF ECONOMIC AND ENVIRONMENTAL MANAGEMENT OF REGIONAL RESOURCES IN THE CONDITIONS OF CONTINUOUS DEVELOPMENT

ABSTRACT

In this chapter, the object of study is an innovative model of regional management of freshwater resources in the context of achieving environmental goals.

When solving the problems posed in the work, the methods of analysis and synthesis, comparative comparison and logical generalization were used. On their basis, an analysis of the main principles of adaptation of the world experience of regional management of freshwater resources in the context of the implementation of the European Union Water Framework Directive was carried out, environmental priorities for regional management of freshwater resources, their innovation and investment dominants, targets and a model of environmentally balanced management were determined.

According to the results of the study, it is noted that:

– effective management of freshwater resources is implemented through the appropriate management functions, which together contribute to the implementation of certain goals for the development of the water complex, ensuring a balance of interests of all subjects of water use;

– at the present stage of development of the national economy in the context of global trends, environmental forecasts and social challenges, the obvious and uncontested goal of managing freshwater resources is to ensure a balance between the three vectors of sustainable development (economic, environmental and social), which is the triune imperative of state and regional development policy and protection, distribution and use of public resources. The implementation of this goal requires the development of a unified strategy that defines the main imperatives of water policy, which are guidelines for decision-making at all levels, create framework conditions and criteria for using the available water potential, uniform rules for all participants in the water resources market;

– the main directions for improving the system of investment support for the innovative development of the region's water management systems include: improvement of regulatory and legal support and development of public-private partnerships, including in the form of ESCO contracts;

– the proposed model of sustainable socio-humanitarian and environmentally balanced management of freshwater resources at the regional level, taking into account innovative forms of

interaction in the field of water use, requires the transformation of the targets for the functioning of the water management complex in the direction of meeting the needs of present and future generations in freshwater resources.

Thanks to the results of the conducted studies, it is possible to more objectively and balanced assess the possible schemes and tools for managing the territory's freshwater resources. The conceptual approach presented in the chapter is a rather flexible tool with a free choice of elements of analysis depending on the goals and objects of management.

KEYWORDS

Freshwater resources, regional management, innovative model, balanced management, sustainable development, environmental protection.

Among the main goals of Sustainable Development is the provision of access to high-quality water, which is of great importance for people, nature and all economic activity. The importance of quality water for the health of the nation has been proven to all scientists and scholars. In addition, it should be noted that a large amount of water is required for energy production, crop production and the production of everyday goods. Today it is necessary to state the shortage of water resources. That is why the restoration of water resources to their natural state, the conservation and purification of freshwater resources is important.

In this context, innovation is the driving force behind the process of cleaning, conserving and restoring freshwater resources. That is why, in the context of the implementation of the Sustainable Development Goals, there is a need to study the level of financial support for innovative processes in environmental protection, which makes it possible to implement the tasks set. It is important to adapt the world experience in freshwater resources management for the regions of Ukraine in the context of the implementation of the Water Framework Directive. Certain issues require in-depth study.

The study reveals scientific approaches to the formation of an innovative model of freshwater management, characterizes the strategic vectors and key imperatives of an innovative model of freshwater management; the investment dominants for the implementation of an innovative model for the sustainable use of freshwater resources in the region are determined, the improvement of models for managing freshwater resources on an innovative basis in the context of sustainable development is outlined.

The practical significance of the results obtained lies in the possibility of introducing scientific and practical approaches to substantiate an innovative model for managing freshwater resources of territories in the context of sustainable development.

Based on the results of the study, an innovative model for managing freshwater resources and monitoring the implementation of strategic priorities at the national and regional levels has been developed.

4.1 STRATEGIC VECTORS AND KEY IMPERATIVES OF AN INNOVATIVE FRESHWATER MANAGEMENT MODEL

Freshwater resources on a global scale are becoming increasingly scarce, which is the result of an escalation in demand due to population growth and the need for increased food production, increased industrialization due to rising living standards, pollution due to various human activities and the impact of climate change [1]. Scientists predict that due to the scarcity and poor quality of fresh water, by 2050 at least one in four people is likely to live in a country with a shortage of fresh water. In this regard, ensuring the availability and sustainable management of water resources has been adopted as one of the Sustainable Development Goals by the United Nations until 2030.

According to the Ministry of Environmental Protection and Natural Resources of Ukraine, "In 2020, 9.6 cubic meters of fresh water were withdrawn from natural water bodies (90 % from surface and 10 % from underground sources). Over the past decade in Ukraine there has been a reduction (by 1.5 times) in the use of water resources (from 14.8 km^3 in 2010 to 9.6 km^3 in 2019) and the discharge of return water (from 7.8 km^3 in 2010 up to 5.2 km^3 in 2020), which is due to a decline in commercial production, a decrease in water use due to an increase in water supply tariffs and a slight reduction in its losses. In 2020, 60 % of fresh water was used for production needs, 21.4 % for irrigation needs, and 17.3 % for drinking and sanitary needs. Water losses during transportation reached 1.2 km^3, which accounted for 12 % of the total volume of withdrawn water. Starting from 2013, there has been a decrease in the total capacity of urban treatment facilities (only in 2019, its slight increase was recorded), and the share of polluted and insufficiently treated wastewater in relation to the total volume of return water disposal in 2020 amounted to 10 %" [2].

Despite certain positive trends, the main problems of an economic, environmental and social nature in the context of providing access to water resources, their use for domestic and industrial needs and the quality of surface waters remain. Against the backdrop of an inefficient water management policy for the use of water resources in industry and agriculture, improper state control over the level of danger of untreated water discharges, irrational land reclamation and drainage processes, the natural balance has been disrupted, which has led to gradual desertification in some regions, increased risks of droughts and floods.

It should be noted that the importance of effective management of freshwater resources both in the global and in the national context is confirmed by their role in the approved Sustainable Development Goals of Ukraine until 2030 as one of the priorities of state and regional management. As noted in [3]: "The national water strategy should ensure the achievement of a good state of water resources and lay the foundation for overcoming the significant disproportion in the access of the population to quality water supply and sanitation, formed between urban and rural areas".

To determine progress towards sustainable development in the context of the implementation of Goal 6 "Clean water and adequate sanitation", a number of indicators have been established, the achievement of which is analyzed both at the national and regional levels. **Table 4.1** shows the state of implementation of the goals of sustainable development of water resources in Ukraine.

Table 4.1 Dynamics of achievement of indicators of implementation of the Sustainable Development Goal 6 "Clean water and adequate sanitation" in Ukraine [4]

Indicators of achieving sustainable development goals	2015	2016	2017	2018	2019	2020	2025*	2030*
1. Safety and quality of drinking water in terms of microbiological indicators (by % of non-standard samples)								
1.1. By type of area								
urban area	3.1	4.3	4.6	5.1	5.7	–	**	**
countryside	7.6	10.4	11.2	11.8	11.4	–	**	**
1.2. By type of water supply								
centralized	4.6	6.4	6.7	7.7	8.2	–	**	**
decentralized	18	23.1	20.4	23.4	24.6	–	**	**
2. Share of rural population with access to centralized sewerage systems, %	3	2.5	2.5	2.5	–	2.4	10	46
3. Share of urban population with access to centralized sewerage systems, %	92	94	95	96.1	–	97	100	100
4. The volume of discharges of polluted (polluted without treatment and insufficiently treated) wastewater into water bodies, mln. m	875.1	698.3	997.3	952	737.2	725	557	279
5. The share of discharges of polluted (polluted without treatment and insufficiently treated) wastewater into water bodies in the total volume of discharges, %	16.38	12.93	21.15	18.27	13.72	13	10	5
6. Water intensity of GDP, m^3 of water for 1000 UAH GDP (at actual prices)	23.85	19.61	15.27	11.73	10.3	3.2	2.9	2.5
7. Current water intensity of GDP, % to the level of 2015	100	82.23	64.02	49.16	43.19	90	80	70

** – reference point;*
*** – indicator is specified*

As the data in the table show, over the past 5 years, positive changes in the management system of freshwater resources in the context of the main indicators of the sustainable development goals have been achieved for most indicators. In particular, in terms of the level of water intensity of GDP, both in general and in relation to the base year 2015, there is significant progress. Thus, in 2020, the level of GDP water intensity was 3.2 %, which is almost 20 % lower than in 2015.

The volume of discharges of polluted (polluted without treatment and insufficiently treated) wastewater into water bodies, as well as their share in the total volume of discharges, is decreasing. In particular, according to the monitoring report, the total volume of polluted wastewater discharges into surface water bodies in 2020 amounted to 725 million m^3, which is 12 % less than in 2015, and their share decreased by 6.8 %. At the same time, the current rate of reduction is not enough to achieve the final goals in 2030. It is necessary to continue the process of reforming the system with the involvement of international experience, to improve the technology of water intake, distribution and purification, to introduce resource-saving technologies in all systems of the national economy.

So, today freshwater resources are becoming one of the determining factors of the region's competitive advantages, a key factor in ensuring food security, economic development and demographic growth. That is why the management of such valuable natural resources requires the formation of a new concept based on an integral strategic approach, the main goal of which should be protection, balanced use and preservation for future generations.

In this context, the issues of defining and systematizing the features and main directions of the strategic management of water resources are being updated as a determining factor in the revival of the industry at a qualitatively new level.

In our opinion, in addition to those given in **Table 4.1** indicators, the main goal of freshwater resources management is to ensure a balance between the three vectors of sustainable development (economic, environmental and economic), which are the triune imperative of state and regional policy in the field of development and protection, distribution and use of national resources.

Specifically, with a focus on achieving a balance between the vectors of sustainable development, the development goals of regional systems should be developed. In this context, it should be noted that the focus on only one or two vectors leads to a significant reduction in the performance of the vector that was left without attention. For example, taking into account exclusively environmental factors in the management of freshwater resources will lead to a number of decisions that will limit the access of the population and business to the amount of resources necessary for the effective functioning, which will lead to a social crisis and a contraction of the economy. Focusing on social factors, without taking into account the other two, can lead to the deterioration of the ecological state of water bodies and related ecosystems, as well as financial opportunities for investing in the protection and reproduction of water resources. The priority provision of economic interests will lead to environmental degradation and social collapse.

The main vectors and tasks on the agenda for water resources management both at the national and regional levels in the context of ensuring the imperative of sustainable development are shown in **Fig. 4.1**. The development vectors of the freshwater management system determine the priority tasks that should be implemented within the management system at all levels (national, regional, territorial) and ensure a balance between the key imperatives of sustainable development.

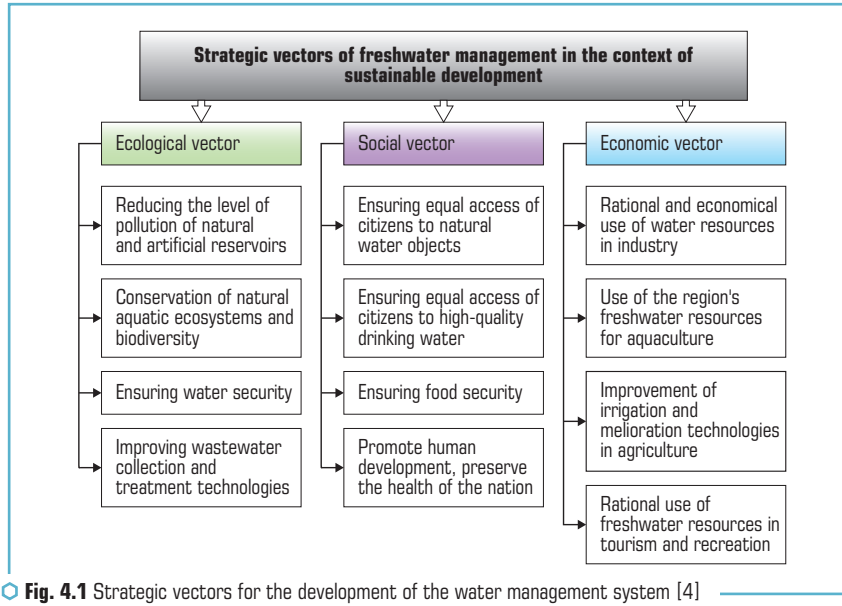

Fig. 4.1 Strategic vectors for the development of the water management system [4]

Let's agree with the opinion of Shyrokov, M. that "water management should be based on the theoretical foundations of management, taking into account the specific features of the management object and the balance of interests of all stakeholders. In this aspect, the national water management model can be considered as an open system, at the input of which the system receives information about needs, financing, human and energy resources, etc., and at the output-water management services, the state of natural and artificial reservoirs, energy, information, goods and services" [5].

Thus, the effective management of freshwater resources is implemented through the appropriate management functions, which together contribute to the achievement of certain goals for the development of the water complex, ensuring a balance of interests of all subjects of water use, as well as the sustainable use of the existing potential, both in the context of meeting the current needs of the population and the economy, and in long term.

The main functions of water management according to the classical approach include planning, organization, motivation, regulation and control. Coordination of functions is based on an effective system of communication and decision-making, the quality of which and the level of execution depend on an effective management structure.

Planning for the protection and efficient use of water resources involves the creation of science-based plans for the development of water basins, taking into account their potential to provide the population and the economy with quality water in the required quantity in accordance with the ability and predicted needs, identifying the discrepancy between the needs and potential

of water resources and making decisions to eliminate these problems; planning measures for the protection and purification of water bodies, ensuring water security, developing cost estimates necessary to fulfill these tasks. Work planning in the water resources management system is based on outdated approaches and covers mainly such areas as: flood protection of settlements, repair and modernization of individual water supply and sanitation infrastructure facilities, planning activities to monitor the state of individual water bodies. The current plans do not contain a clear definition of tasks, indicators of their implementation and sources of funding (as a rule, funding is carried out on a residual basis), and are also poorly oriented towards the introduction of innovative technologies. The disadvantage is also the lack of high-quality information and analytical support for the planning system, a clear systematization of indicators for different levels of management and areas of work.

The function of the organization is realized, first of all, through the creation of effective organizational structures for water resources management, a clear distribution of responsibilities, rights and powers of management and supervision bodies. Now the process of reforming the water resources management system is underway, the purpose of which is to create effective basin administrations. "The Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine on the Implementation of Integrated Approaches to Water Resources Management Based on the Basin Principle" initiated structural changes in the field of water resources management. Namely, river basin districts have been established, the creation of basin councils has been introduced, as well as a number of management tools: a river basin management plan, schemes for the use and protection of water and restoration of water resources, water management balances, water monitoring, typology of water bodies, etc. A new procedure for the implementation of state monitoring of waters has been determined, on the basis of which the preparation of monitoring programs for the areas of river basins specified by law has begun" [2]. Despite a certain beginning of reforms in the organization of water resources management, the old organizational model is still in effect, since the regulatory and legal field has not been formed, which will clearly determine the procedure for creating relevant institutions and granting them powers in the relevant areas of management; the responsibility of state bodies in the sphere of assistance to the processes of creation of basin administrations and their coordination is not defined; there are no mechanisms for covering the costs of providing water services, as well as covering the costs of the functioning of bodies at all levels.

Motivation as a function of managing the water management complex in general consists in the formation of a set of incentives and restrictions that will influence the behavior of economic entities, the population and water management personnel in the direction necessary to achieve sustainable development goals. So far, the system of motivation in the context of water resources management is not given significant importance. The implementation of this function in the context of ensuring the economical use of water resources is carried out by setting appropriate tariffs for water supply services for the population and businesses and the use of drainage systems. Also, sanctions mechanisms, quotas, etc. are used as a motivation for reducing pollutant emissions.

However, these mechanisms are not properly regulated. In our opinion, the motivational mechanism in the water management system needs to be improved by:

– implementation of economic incentives in the form of a reduced tax rate or preferential depreciation for enterprises and organizations that introduce new technologies aimed at water purification and its reuse in production processes; reduction of harmful emissions into surface water bodies; innovative irrigation systems;

– implementation of economic incentives in the form of state subsidies, preferential taxation or participation of the state in partial coverage of costs for utilities that provide water supply and sanitation services to the population and introduce innovative technologies;

– improvement of the personnel remuneration system in the system of management, distribution and control over the implementation of state policy in the field of water management.

The function of regulation and coordination consists in the distribution of powers for management and control at all levels, the establishment of effective communications between levels, links and subjects of the external environment. In accordance with the legislation of Ukraine, the central bodies that are entrusted with the functions of general management and supervision of compliance with the law, the implementation of state programs in the field of protection and reproduction of water resources, the planning and formation of legislative initiatives, include the Ministry of Environmental Protection and Natural Resources and the State Water Agency, UGS, SEI and others bodies defined by law.

In order to introduce integrated water resources management on the principle of the basin, 12 basin water resources administrations, as well as 13 basin councils, have been established. However, the issues of distribution of powers between the representation of the State Water Agency in the regions are represented by other government bodies, offices, etc., which causes duplication of powers.

Thus, the implementation of the functions of regulation and control is limited due to the lack of a unified water cadastre and water accounting system, "gaps" in the legal framework for the distribution of powers between different levels of management; duplication of supervision and control functions at the state and regional levels, lack of transparent mechanisms and rules of the game in the water market. The effective implementation of this function requires, first of all, the improvement of the organizational structure and the creation of legal support that defines the functions and also regulates the rights, powers and responsibilities of state institutions and officials in the management of water resources, the creation of a unified information system for accounting for surface, underground and other water bodies and standards for their evaluation; digitalization of management of the aqua sphere with the involvement of GIS technologies.

Thus, ensuring effective water resources management requires the improvement of organizational and economic mechanisms, namely:

1) distribution of legislative, executive and controlling functions in the field of water use, taking into account decentralization according to the basin criterion;

2) clear regulation of the powers, responsibilities and reporting procedures of the relevant water management bodies;

3) development of uniform standards for determining fair tariffs for water use for different categories of consumers and in the context of types of economic activity;

4) create a unified interactive database of water resources of Ukraine and regions;

5) formation of supervisory committees that control the implementation of programs in the field of water management with the participation of all stakeholders;

6) unification of procedures for registration, rehabilitation, provision of consulting services and strengthening of public-private partnership institutions in the field of water management.

Regional management of natural resources should be carried out in accordance with the basics of environmental management and be focused on the introduction of innovative technologies in the system of accounting, control, distribution and use of resources. According to Martienko, A. and Bondarenko, S. the main provisions of such management should be reflected in the form of a directed policy, a strategy for the development of territorial economic systems, regions, the state and will be implemented in the following areas:

– compliance with the level of environmental safety and the requirements of environmental legislation;

– continued harmonization of the legislative and regulatory framework and its use in all sectors of the economy, ecology, social sphere, licensing, environmental management, audit, standardization, certification, insurance;

– rationalization of the use of natural resources, taking into account their functions, significance, value as the natural capital of the state;

– creation of funds to support innovation activities (fundamental research, innovation programs, business support);

– allocating part of the funds from privatization to innovative investment in ensuring the R&D quality;

– ensuring the implementation of innovative programs, projects for the prevention and crisis situations in the production sector and in solving issues of regional management and environmental protection;

– systematization and harmonization of all monitoring systems for the collection, processing and exchange of information of an environmental and economic nature;

– addition and modernization of the existing systems of training and retraining of specialists;

– introduction of the institute of guarantees of the regional authorities for the R&D quality;

– systematization and creation of a unified database of investment projects;

– development of introduction into the practice of making managerial decisions in the investment sphere of "threshold" values of indicators of environmental and investment security, etc. [5].

Undoubtedly, the conceptual basis for the formation of an effective water resources management system is an appropriate strategy that defines the main imperatives of water policy, which are guidelines for decision-making at all levels, creates framework conditions and criteria for using the available water potential, uniform rules for all participants in the water resources market. The water strategy is also the basis for adapting the relevant legal framework, creating appropriate institutional and economic mechanisms for water management at all levels.

The strategic aspects of water management in Ukraine are defined in the draft water strategy of Ukraine, heard at a meeting of the Cabinet of Ministers on June 16, 2021. This strategy defines the main tasks in the field of management and protection of water resources for the period up to 2030 and provides for:

– preparation of the necessary changes in the legislative framework, in particular, in terms of the implementation of the basic norms that meet the terms of the Agreement on the "Association of Ukraine with the EU" and international standards in this area;

– formation of a system of modern monitoring of surface water quality using innovative technologies;

– reforming the organizational structure of water resources management on the basis of the basin principle and regulation of relations in this area;

– creation of river basin management plans.

The strategic goal and main goals of the Strategy are presented in **Fig. 4.2**.

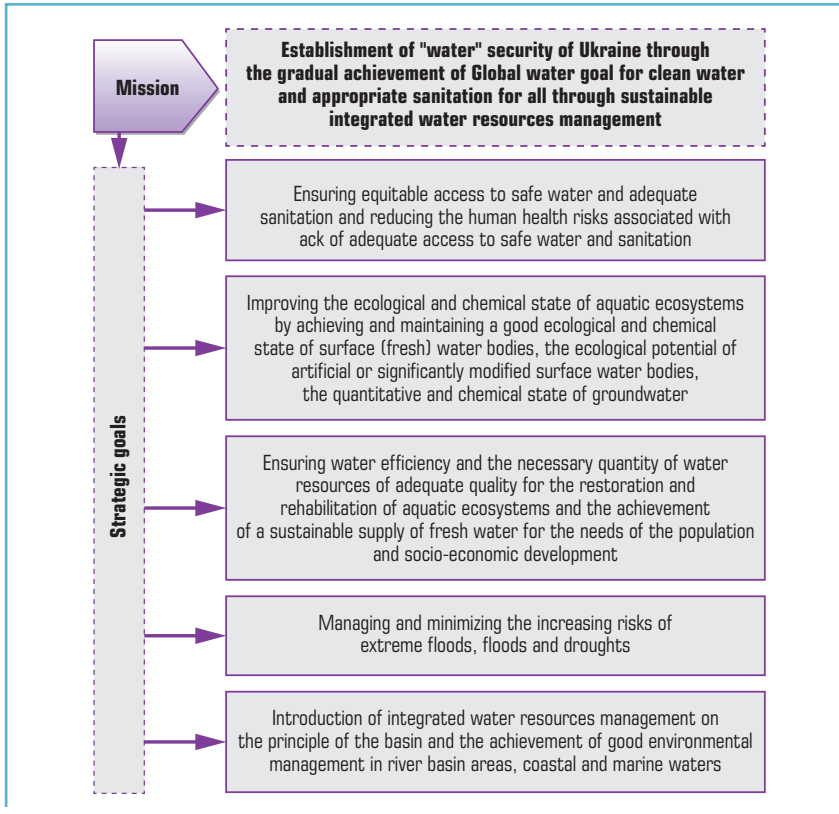

Fig. 4.2 Mission and goals of water resources management in Ukraine [2, 4]

The implementation of these goals requires the formation of appropriate resource and industry strategies. According to the classical definition, a strategy is a way to achieve goals, which is selected from alternative options, taking into account the available opportunities and limitations, and reflects the essence of the policy of an economic entity in this area as much as possible.

The National Water Strategy is developed on the basis of an analysis of the existing water potential, its territorial differentiation, development forecasts in accordance with climate change and other impact factors, as well as forecast needs in the context of the main types of water users; assessment of the ecological situation of water basins and trends in this direction; assessment of the technical condition of water intake structures, transportation, purification and drainage systems; impact on ensuring food, economic and environmental security of territories.

Separately, one can single out regional strategies characterized by a certain combination of resource and sectoral strategies at the level of individual administrative-territorial units. Regional strategies take into account, first of all, the level of provision of the region with freshwater resources, the structure of the economy in terms of types of economic activity, the size and structure of the population by type of settlements, as well as forecasts for the development of these indicators.

Due to the specific features of the water management complex, sectoral strategies are proposed to be developed according to the criterion of the subject of consumption of water resources and the ultimate goal of their use. So, a separate strategy is needed:

– primary water users, that is, state and municipal water supply and sewerage services that carry out centralized water intake, water distribution and drainage;

– secondary users – households, government agencies, enterprises of various industries.

The above subjects are differentiated depending on the volume of consumption, the goals and characteristics of use and the level of impact on the ecological situation of water bodies. Strategies in this context should contribute to the most equitable distribution of water resources between individual entities by differentiating the relevant tariffs, defining a list of restrictions on additional taxes for an insufficient level of purification of water discharged into the environment and promoting general re-equipment, modernization of technologies in the industry on an innovative basis.

Analyzing the intake and consumption of fresh water in the context of sectors of the national economy (**Table 4.2**), it should be noted that the largest share of consumption in 2020 (47.5 %) falls on water supply; sewerage, waste management, that is, housing and communal services. A significant share in the structure of water consumption is also occupied by the supply of electricity, gas, steam and conditioned air (30.2 %), as well as agriculture (24.1 %).

In the last ten years, there have been significant structural changes in the volume and structure of water consumption by type of economic activity, which must be taken into account when developing sectoral strategies for the rational use of water resources. In particular, over the period 2010–2020, the share of primary water users in the structure of fresh water consumption increased significantly, which increased by 27.6 %. Such an increase, taking into account the reduction in water consumption per person during the same period, indicates the irrational use of water and its significant costs during abstraction and transportation. This is primarily due

to the technical condition of water intake facilities, equipment and water supply systems, the average wear rate of which is 73 %.

Table 4.2 Structure and dynamics of fresh water consumption by industry

Industry	2010		2015		2020		Changes 2020/2010		Changes 2020/2015	
	million m^3	%	million m^3	%	million m^3	%	million m^3	%	million m^3	%
Total	9817	100	6608	100	9459	100	–358	0	2851	0
Agriculture, forestry and fisheries	2565	26.1	1595,0	24.1	1320,0	14.0	–1245	–12	–275	–10
Mining and quarrying	256	2.6	215,0	3.3	272,0	2.9	16	0.3	57	–0.4
Processing industry	1848	18.8	685,0	10.4	434,0	4.6	–1414	–14	–251	–5.8
Supply of electricity, gas, steam and air conditioning	3118	31.8	2848,0	43.1	2854,0	30.2	–264	–1.6	6	–13
Water supply; sewerage, waste management	1952	19.9	1255,0	19.0	4490,0	47.5	2538	27.6	3235	28.5
Other industries	78	0.8	10,0	0.2	89,0	0.9	11	0.1	79	0.79

A positive is reduction in the use of fresh water in agriculture against the background of an increase in the volume of cultivation of agricultural crops. Over the past 10 years, the volume of water consumption in agriculture has decreased by 270 million m^3, and the share of the industry in the structure of total water consumption has decreased by 12 %. This testifies, first of all, to the improvement of irrigation and reclamation technologies, the transition of a significant part of agricultural producers to drip irrigation and other water-saving technologies. The reduction in the total volume of fresh water consumption in industry, unfortunately, is primarily due to the reduction in the volume of industrial activity in physical terms.

According to the authors, the general structure of the industry strategy in the context of individual consumers should contain the terms shown in **Fig. 4.3**.

For each type of user, it is advisable to develop a differentiated combination of strategy components that together ensure balanced water consumption, fair distribution of resources, minimize

environmental impact, stimulate the modernization of technical systems on an innovative basis and, in general, will contribute to the achievement of sustainable development goals socially.

Resource strategies determine the choice of alternatives for providing the process of implementing the strategy with the necessary types of resources, namely: material, financial, personnel, energy and information.

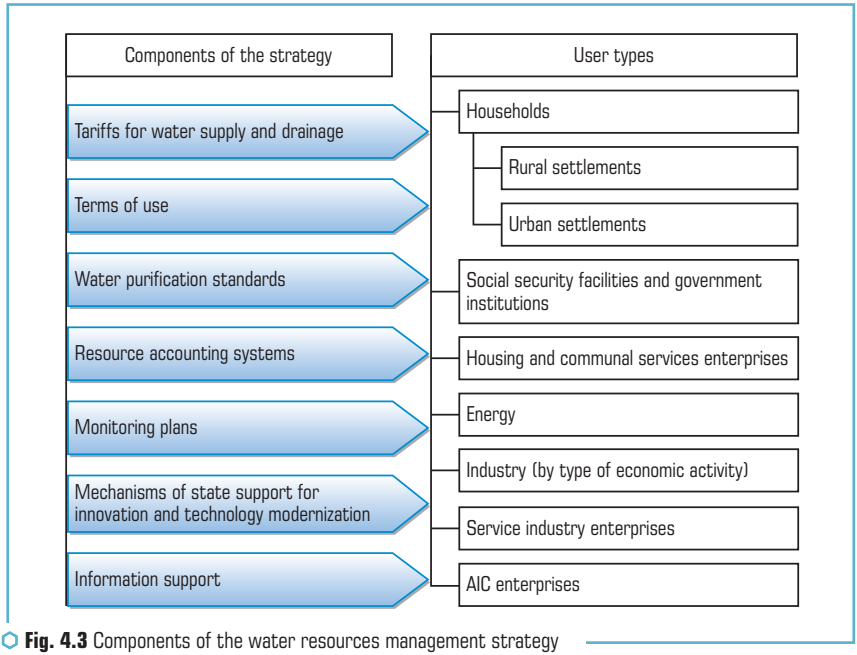

Fig. 4.3 Components of the water resources management strategy in accordance with the types of consumers [6]

Accordingly, in the context of each type of resource, a strategy is formed that determines the volume of necessary resources, the choice of the most optimal sources of their attraction and ways to optimize their use.

The logistics strategy determines the list of material resources necessary for the effective functioning and development of water resources, the provision of services to the population, the state and business, as well as the implementation of water protection and monitoring measures of material resources. The strategy involves the analysis of strategic resource zones in terms of materials, machinery, equipment, selection of suppliers and conclusion of relevant agreements. Since water resources are predominantly in the sphere of public administration, and the purchase of resources is carried out at the expense of the state budget and budgets of other levels, the selection of suppliers should be carried out through public tender purchases using the Prozorro system.

The financial strategy for the sustainable development and use of water resources is aimed at identifying the main and additional sources of financing for the implementation of the water strategy, creating effective and transparent mechanisms for selecting budget-funded projects, organizing control over the distribution and use of funds. In the structure of financing costs for the implementation of work in the field of water management, more than 96 % are budgetary funds. As additional sources of raising funds, one can consider international assistance in the framework of the implementation of sustainable development projects, investments from business in the framework of the implementation of public-private partnership projects and foreign investments in the development of joint projects.

The authors of the Water Strategy of Ukraine [7] note that improvement in the financial support of the water sector and attraction of investments in the industry would be facilitated by a more active introduction of market relations, in particular:

"– establishing partnership relations between the state and business structures on the basis of public-private partnership agreements;

– corporatization of the management of water facilities, natural and artificial water bodies and integral property water management complexes (water supply and sewerage and water management and reclamation);

– formation of an institutional environment for increasing the level of capitalization of water management activities and diversifying the sources of investment support for the implementation of water management and water protection projects".

In the context of global trends and state policy on the formation of an information society, an important condition for building an effective information system is the development of a plan for the digitalization of water resources, the introduction of modern technologies for searching, systematizing and managing data, creating an information map of water resources, and increasing the level of information literacy of employees. An important task of water policy is to promote the rational use of water resources among the population. It is citizens who are a conscious force capable of contributing to the implementation of a strategy for the sustainable use of water and other natural resources at all levels and in all areas of the economic complex.

4.2 INVESTMENT DOMINANTS FOR THE IMPLEMENTATION OF AN INNOVATIVE MODEL FOR THE SUSTAINABLE USE OF FRESHWATER RESOURCES IN THE REGION

Of course, in addition to an effective system of control and administration of water resources, an important factor in the implementation of an innovative model for the sustainable use of freshwater resources in the regions is the introduction of new technologies aimed at cleaning freshwater bodies and promoting the rational use of water resources. The activation of such work requires sufficient funding and attraction of additional investments in the industry.

In order to work out all the possibilities in the field of attracting investments and other sources of financing projects to provide the population and the economy of the regions with sufficient

quality water, the Government created the Interdepartmental Coordination Council for Water Resources of Ukraine. The Council will make it possible to coordinate the activities of all parties in the formation and implementation of state policy in the areas of drinking water, water supply and sanitation [8].

Statistical data show that the main source of financing the costs of work in the field of water management are the funds of the state and regional budgets. In 2015–2019, the gross volume of financing of the industry almost doubled (**Table 4.3**), which indicates the priority of this area for the development of the economy and territories. In the context of the main areas of financing during the period under review, the greatest growth is observed in the field of financing the costs of management and management of the water sector, which is associated with the reform of the industry, the introduction of information technologies in management.

Table 4.3 Financing of works in the field of water management from the state budget [9]

Directions of financing	2015	2016	2017	2018	2019	growth, %
Total	1143121,2	1158162,9	1559437,4	1985584,3	2133375,2	86
Advanced training of personnel in the field of water management	2545,3	2714,1	3971,5	4462,3	4885,0	92
%	0.2	0.2	0.3	0.2	0.2	0.0
Leadership and management in the field of water management	10049,3	10598,7	18754,9	27379,4	32912,6	227
%	0.9	0.9	1.2	1.4	1.5	0.7
Applied scientific and scientific and technical developments, performance of works under the state order in the field of water management	147,8	168,2	196,1	196,1	196,1	33
%	0.013	0.015	0.013	0.010	0.009	0.0
Operation of the state water management complex and water resources management	975274	1089172	1468920	1743108	1960182	101
%	85.3	94.0	94.2	87.8	91.9	6.6
Development and improvement of the ecological state of irrigated and drained systems	0,0	30000,0	0,0	0,0	50000,0	100
%	0.0	2.6	0.0	0.0	2.3	2.3

Analyzing the structure of budget expenditures for the development of water management, it should be noted that 91 % are the costs of operating the state water management complex and managing water resources. During the study period, the share of this sex increased by 6.6 %. A negligible share of the costs of innovative developments in the field of water management is negative. Thus, the costs for the development of applied scientific and scientific and technical developments, the execution of work under the state order in the field of water management during 2015–2020 is only 0.013–0.09 %.

In dynamics (**Fig. 4.4**), there is a significant increase in capital investments in the protection and reproduction of water resources. Over the past 10 years, the volume of investments has grown by 115 %, which has a positive impact on the state of water bodies. However, given the high level of depreciation of the water infrastructure, which, according to the State Statistics Service, is on average 63 % of the available investments, it is not enough for the transition of the water sector to an innovative model of sustainable development, in addition, studies have shown that more than 98 % of investments are directed primarily to elimination of current problems in the water sector and almost no funds are invested in the development of innovative activities in this area.

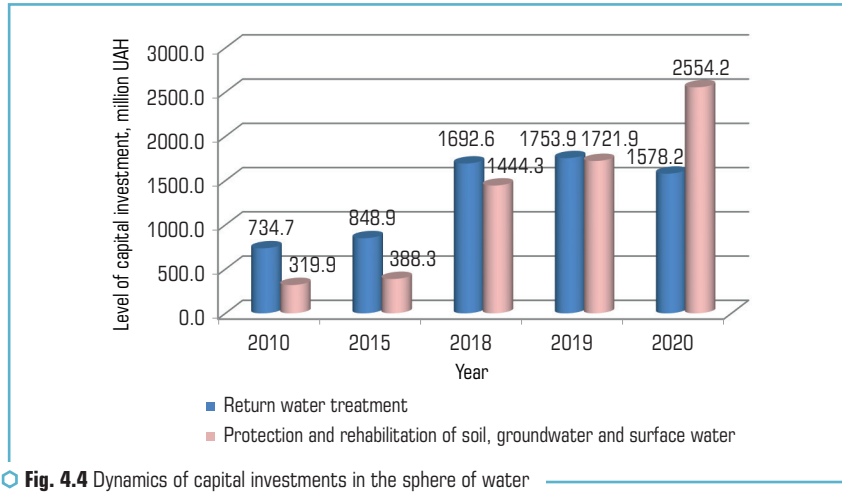

Fig. 4.4 Dynamics of capital investments in the sphere of water management of Ukraine, million UAH [9]

The Black Sea region of Ukraine is characterized by different trends in capital investment in the development of water resources by region (**Table 4.4**).

In the last 10 years there have been significant changes in the volume and structure of investments in the development of water management in the regions of the Black Sea region. In absolute terms, the largest volumes of capital investments in water consumption and protection

of water resources were attracted in the Mykolaiv region (54 million UAH in 2020). At the same time, their size increased by more than 5 times, although the specific share in the structure of capital investments in environmental protection decreased by 11 % and amounted to 16.5 % at the end of 2020. This indicates the production of an active regional policy in the field of protection and reproduction of natural resources in the region.

Table 4.4 Dynamics of capital investments in the field of water management in the Black Sea region of Ukraine [11]

Period	Mykolaiv region		Odesa region		Kherson region	
	Thousand UAH	% in total investment	Thousand UAH	% in total investment	Thousand UAH	% in total investment
2010	8718.9	27.9	31902.9	57.6	1219.2	43.3
2011	22956	40.4	34216.2	41.6	2028.2	58.3
2012	9702.4	15.4	16013.1	50.3	1572.0	75.2
2013	8880.2	26.6	20320.6	57.1	5100.7	64.0
2014	6315.9	12.2	2112.1	21.6	3471.9	51.5
2015	5403	5.5	12958.4	48.9	4065.2	51.7
2016	19890.2	16.2	3654.0	20.8	1935.0	84.9
2017	36228.7	30.7	10405.2	10.9	2135.6	66.5
2018	63169	45.8	22221.9	30.2	12590.1	82.3
2019	56581.6	45.6	33684.8	49.9	5539.1	75.3
2020	54814.9	16.5	34424.4	27.6	6847.9	62.1
Growth, %	528.6	–11.4	7.9	–30.0	461.6	18.8

Analyzing the dynamics and structure of capital investments in the development of the industry in the Odesa region, it should be noted a slight increase in the volume of attracting investments in the water sector and a significant reduction (30 %) of their share in gross investments directed to environmental protection. Opposite tendencies are observed in the Kherson region. Thus, during the studied period, the total volume of capital investments in the field of return water treatment and the protection and rehabilitation of soil, surface and groundwater increased by more than 4 times and amounted to 6.8 million UAH at the end of 2020, and their share of total investments increased by 18.8 % and amounted to 62 %.

Obviously, the growth of investment in the industry needs to diversify the relevant sources. According to the authors of [10], the diversification of investment support for the sphere of water use should include the use of the following sources of financing: State and local budgets, including special and reserve funds, as well as off-budget funds; own funds of enterprises, organizations

and institutions, including water management organizations, received on the basis of the provision of paid water management and ecosystem services; funds of foreign business structures, governments of foreign states, international financial and credit structures, including as part of the financing of global environmental projects provided for by environmental conventions; credit unions, financial and banking institutions, insurance organizations, pension funds, public organizations; revenues accumulated as a result of joint activities of water management entities and business structures on the basis of public-private partnership agreements; financial resources obtained as a result of the sale of local loan bonds and mortgage lending secured by land inseparably from water facilities and hydraulic structures.

Effective tools for attracting private investment in the development and reproduction of water resources used in countries with developed economies include public-private partnerships. In Ukraine, there are certain prerequisites for the introduction of the mechanism of public-private partnership in the field of water supply and sewerage, in particular:

– guaranteed sales markets for enterprises as a result of a monopoly position in the water and sewer services market, which is an important advantage for private business;

– a significant potential for reducing costs associated with the provision of centralized water supply and sanitation services through the introduction of resource-saving and energy-saving technologies;

– state guarantees and investments from the budget for the modernization of infrastructure;

– distribution of financial risks by the state.

At the same time, the analysis of data on the implementation of public-private partnership projects in Ukraine showed that this tool in the field of development and use of infrastructure, in particular public utilities, is at an early stage. The total number of public-private partnership projects in Ukraine is growing, but at a very slow pace. In particular, "According to the data of central and local executive authorities in Ukraine, as of January 01, 2021, 192 agreements were concluded on the terms of PPP, of which 39 agreements are being implemented (29 concession agreements, 6 agreements on joint activities, 4 other contracts), 153 contracts are not implemented (118 are not implemented, 35 are terminated/expired) [12].

Among the main problems in the implementation of public-private partnerships in the field of water supply and sanitation in Ukraine (which is typical for all infrastructure projects), scientists note:

– lack of a logical and understandable system of legal regulation of the relevant relations (inconsistency between the laws "On Public-Private Partnership", "On Concessions" and several laws regulating concession agreements in the areas of construction of roads, heat supply and water supply facilities of a communal form of ownership, projects of the fuel and energy complex state form of ownership, its infrastructure);

– uncertainty of investors;

– caution and uncertainty of public authorities;

– low institutional capacity of central and local authorities;

– lack of public awareness in this area;
– high risks [13];
– unsettled mechanisms for setting tariffs for the provision of services;
– dependence of economic relations on changes in the political situation;
– high level of corruption, in particular in the sphere of licensing activities;
– instability of legislation and the uncertainty of the economic prospects of Ukraine.

According to [14], the development of PPPs in the form of ESCO contracts is promising in the field of the use of natural resources and natural monopolies. The scientist gives the following advantages of this form of development of public-private partnership:

a) firstly, they ensure the involvement of small and medium-sized businesses in the DPP mechanism due to the low barrier to entry into the PPP;

b) secondly, the productive part of these projects has a social orientation, since it is implemented on the basis of communal and municipal property and is aimed at guaranteed provision of energy consumption standards by these facilities;

c) thirdly, the ESCO formula itself determines the level of innovative result that the GSP private partner must achieve;

d) fourthly, PPP projects from ESCO contracts contain an environmental component, since the conditions of this form of PPP include requirements to reduce greenhouse gas emissions, etc.

The uniqueness of PPP projects with ESCO contracts lies not only in combining the interests of the state and a private partner in solving a common technical and economic problem. The main principle of ESCO is a completely new legal structure of relations between PPP partners, which determines the direct dependence of the private partner's profit on the degree of achievement of control results in terms of quantity and quality, as well as its direct motivation to achieve these results. It is possible to add that the development of such forms of public-private partnerships in regions and small towns can become one of the tools for the gradual transition of the water use and sanitation sector to an innovative model, since innovations diffuse faster within small projects.

A promising area for the sustainable use of freshwater resources and attraction of investments in the industry is the production of aquaculture. The development of this type of activity is one of the global trends that allows the rational use of natural and artificial reservoirs for the production of fish and other aquacultures, contributes to the economic development of the territories and the receipt of additional funds in the regional water development fund through appropriate rent payments and plays an important role in strengthening food security in the region.

The population of Ukraine consumes fish and fish products almost two times less than the average worldwide. At the same time, the volume of production of fish and fish products is declining every year. Despite the reduction in the total consumption fund, the import of this product is growing every year. In particular, as of the end of 2019, the total volume of imports of fish products amounted to more than 400 thousand tons, with a reduction in domestic production to 128 thousand tons. The dynamics of production, export and import of aquaculture to Ukraine is shown in **Fig. 4.5**.

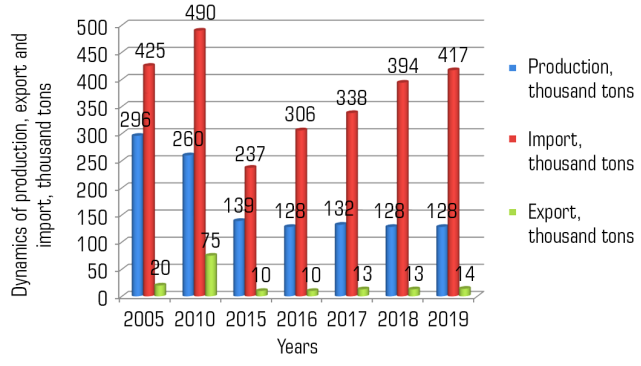

Fig. 4.5 Dynamics of production, export and import of aquaculture to Ukraine [15]

The low level of internal supply of the fish products market in Ukraine and high import dependence leads to a decrease in the economic accessibility of this product for the population. According to experts, "Currently, in the structure of obtaining all aquatic biological resources, the share of aquaculture fish products is only 21.8 % of the total. At the same time, as world experience shows, it can be more than doubled by introducing innovative achievements of domestic and foreign science" [15, 16].

Taking into account the significant capacity of the domestic market of fish products and other aquacultures, as well as the growing trends in the development of the world market, this type of economic activity is classified as one of the four most investment-attractive in Ukraine. Additional factors of investment attractiveness are:

– duty-free and quota-free access to the EU market;

– the presence of numerous water bodies that can be used for this purpose;

– fisheries and aquaculture is considered the most efficient form of converting vegetable proteins into animal proteins, since fish do not need to expend energy to heat them;

– no waste and minimization of feed, since aquaculture farms can be designed to have multiple layers, thus minimizing feed loss.

One of the promising areas for diversifying funding and organizing individual work aimed at improving the environmental situation of water resources, information activities on sustainable environmental management and certain clearly defined problems of the industry in the territory of a particular region is the involvement and support of public organizations. The projects that were carried out in the field of water management, together with public organizations, were successfully implemented in the Lviv, Volyn and Cherkasy regions (**Table 4.5**).

The given data show that the practice of financing regional programs in the field of sustainable water use together with public organizations in Ukraine has not yet become widespread. In our

opinion, it is the regional authorities and local communities that should initiate programs aimed at the efficient use of water resources and attract a variety of sources for their financing, among which may also be funds from regional funds for environmental protection.

Table 4.5 Financing of targeted regional projects and programs in the field of protection and rational use of water resources with the participation of public organizations in 2018–2019 [17]

Region	Program	Amount, UAH
Cherkasy region	Public organization "Kolooborot"; the project "Forgive life to springs" (the importance of preserving water resources was popularized by clearing and ordering the sources "Cossack", "Devichye"; restoration of a dried-up pond, which was created by two sources; printing and popularization of the legend about the sources, establishing an index sign to the source	24 900
Volyn region	Public utility information-analytical center "Volynenergosoft"; project – production of an interactive map of water bodies of the Volyn region	100 000
Lviv region	Public organization "Association of producers of the fishing industry" (measures to combat the harmful effects of water through biological reclamation of water bodies within the framework of the project "Protection and rational use of wildlife resources")	100 000
	Public organization "Grebeniv Society" (overhaul of the existing storm sewer on Shevchenko St. to drain rain and melt water on the territory of the Grebeniv Village Council of the Skole District within the framework of the "Grebeni for a Clean Environment" project)	90 000

Unfortunately, the current mechanism for allocating the environmental tax to the environmental fund and its interbudgetary distribution leads to an inefficient redistribution of financial resources for the implementation of environmental protection measures. In most cases, funds are spent either on solving urgent problems that arise in a particular region, or on long-term financing of projects that in some cases are not brought to completion. This violates the principle of subsidiarity, that is, the solution of problems at the level at which they arise.

The ideal solution to the problem, according to EHR analysts, is to create, following the example of the EU countries, the "Environmental Protection Fund" as a separate legal entity, similar to the Pension Fund or the Social Insurance Fund. The entire environmental tax should be credited to this fund. And the allocation of funds for solving local environmental problems will be organized through its regional territorial divisions. The independence of this fund from the management of the Ministry of Natural Resources will allow minimizing subjective factors when making a decision on the allocation of funds. And the main advantage of the existence of this fund will be the ability to provide long-term guaranteed financing (for several years) of strategic environmental activities and the allocation of funds for activities at the beginning of the year, and not at the end of it, which is impossible with the current system of distribution of budget funds for environmental activities [18]. Such distribution, with the organization of transparent public control, will help ensure the principle of subsidiarity, as well as the targeted spending of funds for the implementation

of environmental activities in accordance with the environmental problems of the territories. In addition to the environmental tax, the fund may receive grant funds, funds within the framework of international programs.

Regional targeted programs aimed at eliminating the most acute problems in the field of water management have been developed in almost all areas. An example of such a program is the Program for the Conservation and Restoration of Water Resources in the Basin of the Kuyalnyk Estuary of the Odesa Region for 2019–2023. For the implementation of the program from the regional budget, 30280.0 thousand UAH are provided, as of the end of 2020, 700.0 thousand UAH were financed, the balance is 29580.0 thousand UAH.

An important source of financing and investment in the industry is the creation of a water fund in each region, which should be filled with rent payments, local taxes on the use of water resources and discharges of polluted water from users that affect water quality or change the water regime. The accumulated funds should be directed, first of all, to the restoration of the region's water management infrastructure, the introduction of innovative technologies and equipment. At the same time, it is important to organize transparent reporting on the functioning of the fund and the possibility of public control.

In [19], it is noted that "one of the ways to regulate rational nature management is the use of taxes, which allow the withdrawal of part of the rent in order to use it to finance the needs of the reproduction of natural resources and create prerequisites for stimulating the efficient and economical use of resources. The system of penalties also plays an important role. However, it is not only the size of the fine that matters, but also the possibility of its application.

Table 4.6 defines the main goals of rational water use and the instruments for their financing. As can be seen from the above data, the use of taxes is one of the ways to regulate the rational use of natural resources, which allows, for the purpose of use, to exclude part of the rent to finance the needs of the reproduction of environmental resources and create prerequisites for stimulating their efficient and economical use. The system of penalties also plays an important role. However, it is not only the size of the fine that matters, but also the likelihood of its application.

The analysis shows that, despite a certain increase in investments from both public and private sources in the field of water management, the level of innovative activity in the industry remains extremely low. Ensuring the transition to sustainable water use on an innovative basis requires not only the development of mechanisms for attracting additional financial resources and investments, but also the creation of conditions for their priority innovative direction.

In [20], it is noted that the investment and innovation mechanism of rational nature management should be considered as:

"– the process of changing the investment and innovative attractiveness of certain objects of nature management and involves a dynamic analysis of the phenomenon in space and time;

– an economic phenomenon that reflects the current state of the attractiveness of nature management objects for investment and development of the latest technologies for investment and innovation from different sources of investment and their origin at different levels of management".

Table 4.6 Objectives of optimal water use and instruments for their financing [4]

Objective	Financing instruments	Financing sources
Comprehensive research and analysis of the state of water resources, formation of a water cadastre and interactive databases	Financing instruments	Taxes
Carrying out environmental protection measures on water bodies, ensuring flood control measures	Budget financing	Special funds
Modernization of centralized water supply systems	Budget financing (priority programs)	Local taxes, penalties, tariffs
Treatment of already polluted waters, consisting in the elimination of undesirable substances from surface waters	Regional budget (municipal, UTC)	Taxation, penalties
Installation of innovative wastewater treatment and filtration equipment, water reuse technologies, and drip irrigation technologies	Funds from the Water Fund, incentives for investors	Taxation, penalties
Application of closed-loop water consumption schemes with the aim of saving water resources and preventing pollution of the hydrosphere, in particular, and the natural environment in general		
Formation of a monitoring network with modern equipment and laboratories	Funds from the Water Fund	Taxation, penalties
Creation of new and preservation of existing water reserve zones, preventing their transfer to private ownership	Direct government regulation	Penalties

The activation of investment processes and their direction in the innovation sphere requires an improvement in the investment climate both in the economy as a whole and in the industry. Improving the investment climate in Ukraine will primarily help end the military conflict and establish sustainable peace in Ukraine, which will create prerequisites for establishing stability and predictability for further economic development, reducing the level of potential dangers, military, economic and man-made dangers. The key factors for improving the investment climate are also:

– further unification of legislation in the field of investment and innovation activities, as well as in the regulation of property rights in accordance with the norms in force in the EU;

– providing state guarantees for the succession in the execution of the law and protecting investors from political influence on changes in legislation or the tax code during the payback period of projects, in particular in innovative areas;

– effective implementation of reforms in the judiciary and building an effective anti-corruption system;

– formation of effective institutional, financial and legal mechanisms for the development of investment and innovation activities, reducing the level of uncertainty and avoiding duplication

in the distribution of regulatory, supervisory and other administrative functions between government bodies of different levels and areas;

– implementation of digital technologies in the provision of administrative services; optimization and simplification of tax, customs and other administrative procedures;

– activation of public-private partnership programs;

– expanding the rights of territorial communities in terms of a set of tools to stimulate investment and innovation activity of business entities in the regions;

– development of a rational system of innovation infrastructure;

– state regulation of tariff and price policy in life-supporting sectors of the economy.

The environmental tax is an important instrument of financial support for sustainable environmentally balanced management of freshwater resources. The legislative base of the country provides for amendments to the Budget Code by reducing the percentage of local budgets increasing the percentage of environmental tax crediting from 25 to 30 percent of such tax crediting to the state fund. At the same time, for the regional budgets, it is planned to increase the percentage of tax credits from 30 to 50 percent, and for the cities of Kyiv and Sevastopol – from 55 to 80 percent (also due to a decrease in the percentage of this tax credited to the state fund) [17].

It is important to support the initiative to increase the share of environmental tax that falls into the budgets of communities to the level of 50 %. After all, this will ensure the establishment of a correspondence between the financial capabilities and the environmental load of different territorial units. An objective need is to increase the share of environmental tax deductions to local government budgets up to 50 %, which will ensure the possibility of preventing and eliminating the consequences of pollution of natural resources at the basic level of territorial communities, which is closer to ordinary citizens in terms of addressing environmental safety issues.

"As of November 1, 2019, 2,938 payers were registered in the Odesa region, who sent 26.3 million UAH to the budget over the ten months of this year environmental tax. Compared to the corresponding period in 2018, revenues increased by 3.6 million UAH. In turn, out of the total amount, 13.7 million UAH of environmental tax was sent to the state treasury, and 12.6 million UAH to local budgets" [4].

An increase in the share of environmental tax deductions to the budgets of the local self-government level will strengthen the upward trend in revenues to the local budgets of the Odesa region due to environmental payments.

It should be noted that in comparison with other regions of Ukraine, the share of environmental tax in tax revenues of local budgets in the context of the Odesa region for 2014–2016 was quite insignificant (**Fig. 4.6**).

One can agree with the opinion that "preserving the environmental friendliness of the environment for present and future generations is without a doubt what a modern developed society should take care of. The environmental tax is a manifestation of this attitude and helps to reduce the harmful emissions of enterprises and increase the financing of costs for improving the ecological state of the country" [17].

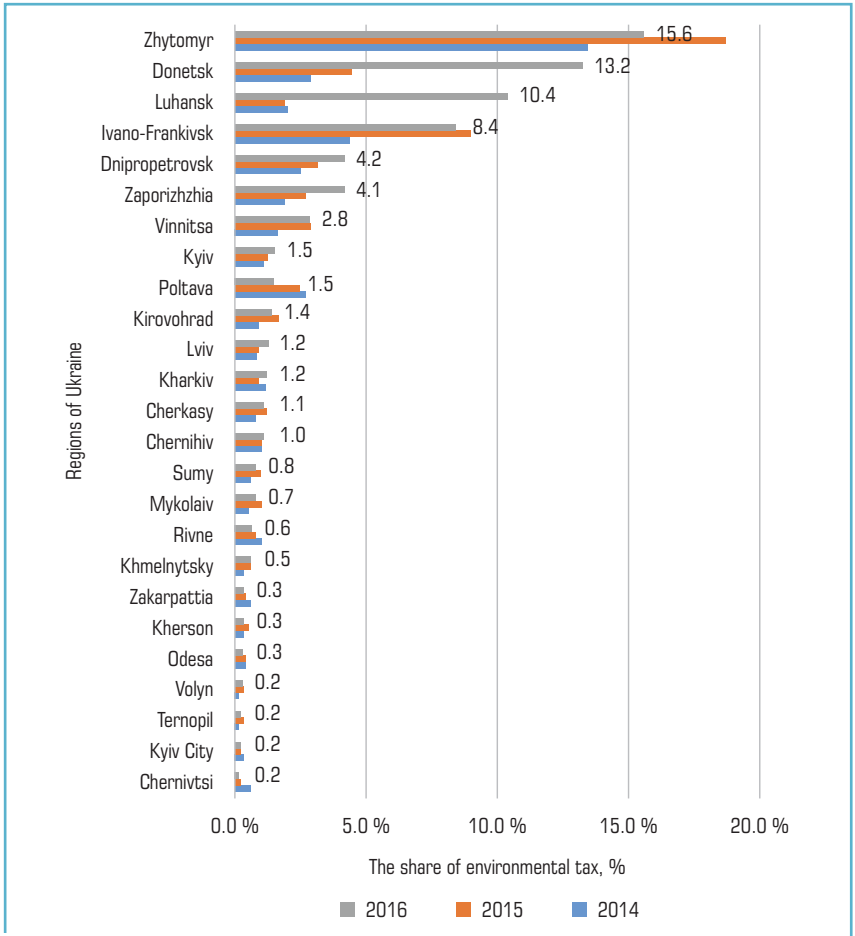

Fig. 4.6 The share of environmental tax in tax revenues of local budgets in the context of individual regions of Ukraine [21]

Improving the investment climate in the field of use, protection and distribution of freshwater resources requires, before the completion of the industry reform processes, a clear distribution of functions, powers and sources of funding between governments at all levels, improvement of the system of economic relations between participants in the water market by establishing clear, unambiguous and transparent rules games", clarification of priorities for the development of water resources in the field of their protection, distribution and use. It is important to create conditions for cooperation between scientific institutions, educational institutions and business entities on

request, development and transfer of technologies, as well as their implementation in the water industry, training specialists in the field of water management, taking into account the needs of the present, establishing an effective dialogue with the public.

4.3 IMPROVING MODELS OF FRESHWATER RESOURCES MANAGEMENT ON AN INNOVATIVE BASIS IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

The efficient use of freshwater resources is an extremely urgent problem in the regions of the Black Sea region due to their uneven distribution across the territory, the high level of strategic needs and the difficult environmental situation.

It should be noted that in terms of the level of water supply, the Mykolaiv and Odesa regions belong to the regions with an average specific level of water supply, and the Kherson region belongs to the regions with a high level. **Table 4.7** shows the main indicators of the region's water supply by regions.

Table 4.7 Indicators of provision of the Black Sea region of Ukraine with water resources at the beginning of 2019 [4]

Indicators	Ukraine	Mykolaiv region	Odesa region	Kherson region
Specific provision with river runoff, thousand m^3/year per 1 person	4.980	3.550	4.200	52.560
Specific supply of groundwater (operational reserves)				
Per 1 person, thousand m^3/year	0.136	0.025	0.052	0.325
Based on 1 km^2 area, thousand m^3/year	9.470	1.170	3.740	11.820
Specific supply of groundwater (forecast reserves)				
Per 1 person, thousand m^3/year	0.535	0.143	0.114	1.735
Based on 1 km^2 area, thousand m^3/year	37.300	6.550	8.080	63.660
Groundwater abstraction				
Per 1 person, thousand m^3/year	0.060	0.016	0.015	0.078
Based on 1 km^2 area, thousand m^3/year	4.240	0.730	1.080	2.840
Operating reserve utilization level, %				
Per 1 person, thousand m^3/year	44.118	64.000	28.846	24.000
Based on 1 km^2, thousand m^3/year	44.773	62.393	28.877	24.027
The level of use of the predicted reserve, %				
Per 1 person, thousand m^3/year	11.215	11.189	13.158	4.496
Based on 1 km^2 area, thousand m^3/year	11.367	11.145	13.366	4.461

As the data in the table show, within the Black Sea region (excluding the Autonomous Republic of Crimea, whose territory is temporarily occupied), there is a different level of water supply, which is due to natural and geographical factors. Thus, the level of specific provision of the population with river runoff compared to the average value for the regions of Ukraine is 72 % (Mykolaiv region), 85 % (Odesa region) and 95 % (Kherson region).

An important role in the water supply of the population and the economy is the presence of a sufficient supply of groundwater, the use of which allows diversifying the supply of water resources in areas characterized by a lack of sufficient surface water. These tables indicate that the Mykolaiv and Odesa regions do not have a sufficient supply of underground water resources. In particular, per inhabitant, the specific operational availability of groundwater in the Mykolaiv region is 0.025 thousand m^3, which is 18 % of the average for Ukraine, and in the Odesa region – 0.052 thousand m^3 (38 %). The level of groundwater availability in the Kherson region is higher than the average Ukrainian indicator by 39 %. At the same time, in the regions, the current situation regarding groundwater abstraction for operational needs is better than the average indicators for the regions, and the level of use of predicted reserves is on average 10 %. That is, it is possible to say that there is a certain potential in providing the region with freshwater resources, but its volume and return depend on the effectiveness of their protection and rational use.

Despite the different levels of provision of territories and the population with freshwater resources in the context of regions, the region is characterized by a number of common problems regarding the state of water supply and the efficiency of using water potential, including:

– uneven distribution of surface freshwater reservoirs and river flows across the territory of the region;

– high level of wear and tear of equipment of pumping stations and other water infrastructure facilities;

– imperfect control system and significant volumes of pollutant discharges;

– poor quality of drinking water for the population;

– irrational use of freshwater resources, pollution by household waste, runoff from industrial enterprises, agricultural waste, etc.

The problems of restoration and modernization of the water supply and sanitation infrastructure are most acute at the present time in the Black Sea region. In particular, according to the regional state administration of the Odesa region, "There are 47 sewage treatment plants in the region, of which 30 are located in small towns, towns and villages, they work inefficiently and do not provide proper sewage treatment. Of the 129 water pumping stations, 30 % are in need of major repairs and reconstruction, and of the 126 sewage pumping stations, almost 60 % are in need of reconstruction. Most of the sewage treatment facilities, mainly located in the settlements and villages of the region, do not provide regulatory requirements for the quality of sewage treatment. 98 % of the settlements of the region are provided with round-the-clock water supply, including 96 % of the population. In 53 settlements of the region, water supply is carried out according to the schedule" [22]. A similar situation is also observed in Mykolaiv and Kherson regions.

Analyzing the dynamics of indicators of the use of freshwater resources in the context of the regions of the Black Sea region, both positive and negative trends can be identified.

Positive trends include a reduction over the past 10 years in the volume of fresh water use in Mykolaiv (–15.8 %) and Odesa (–14.2 %) regions. In contrast, in the Kherson region, this figure increased by 29 %. In 2019, water withdrawal from surface water bodies in the Odesa region decreased by 60 % compared to 2010. Among the main reasons are the increase in the number of groundwater abstraction facilities and the increase in their capacity, as well as the introduction of new technologies in enterprises that allow more rational use of water. In the Kherson region, the volume of water intake has increased over the past 9 years by 137 %, which is primarily due to the growing needs of the region's agriculture due to climate change. For irrigation in the Kherson region, more than 92 % of the volume of withdrawn water is used. The comparative structure of water use in the context of the main sectors of the economy in the regions of the Black Sea region is shown in **Fig. 4.7**.

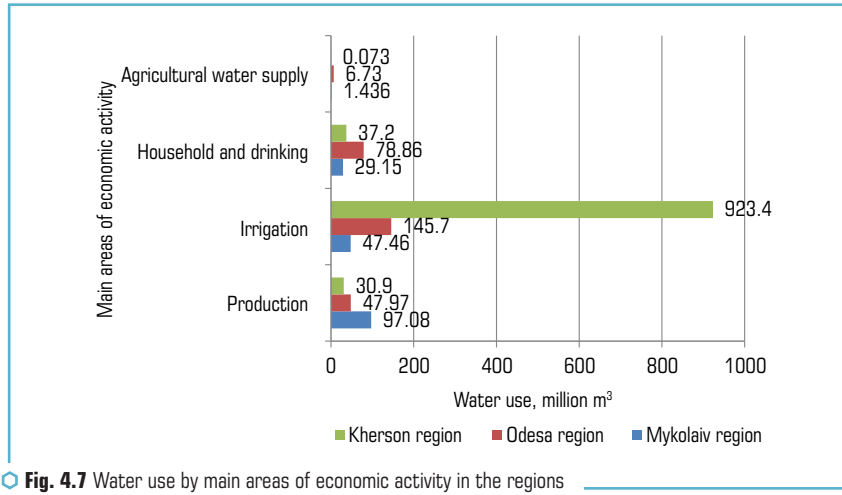

Fig. 4.7 Water use by main areas of economic activity in the regions of the Black Sea region for 2019, million m^3 [23–25]

As positive trends, one should also note the reduction in the volume of discharges of polluted return waters into surface water bodies in all regions of the region, in particular: in the Odesa region by 75 %, Mykolaiv region – 31 % and Kherson region – by 50 %.

Negative trends are the decrease in the volume of recycled and consistently (re)used water in the region by an average of 42 % in the Black Sea region. Among other things, this indicates a gradual reorientation of the region's economy from industrial to agricultural production. There is also a decrease in the capacity of treatment facilities, especially in the Mykolaiv region.

The analysis of the state of provision and trends in the use of freshwater resources in the Black Sea region showed the impact of structural changes in the economy, namely, the reorientation from industrial to agricultural specialization to varying degrees on the use of water resources and the nature of their environmental pollution. The region is unevenly provided with water resources, and the existing potential requires the introduction of innovative models focused on resource saving, improvement of technologies in all processes related to the provision, use and purification of used water.

It should be noted that the formation of innovative models in the field of water management in one aspect or another is reflected in the regional strategies of the regions of the Black Sea region. Thus, in the development strategy of the Odesa region until 2027, the formation of a system of rational water use and the provision of clean drinking water is one of the strategic goals in the context of Strategic Priority 2 "Ecotransformation". In the strategy of the Mykolaiv region, ensuring the rational management of water resources is noted in the operational goal 3.2.2 (implementation of measures to restore the water content of water bodies and protect and protect forests in the forest fund), which is a strategic goal 3 "Conservation and development of territories" as well as an operational goal (promoting the construction, reconstruction and modernization of irrigation systems in Mykolaiv region) within the framework of Strategic Priority 1 "Sustainable Economic Growth of a Diversified Economy", Operational Goal 2.3.1 (development of the drinking water supply and sanitation system). Unfortunately, clear indicative indicators of the implementation of these goals in the context of the planning period have not been established. So, despite the achievements and increased activity of government bodies in the field of water resources development, the problem remains the lack of a clear and integrated approach to the management of freshwater resources in the regions, priority areas for their effective use, control, protection, monitoring, infrastructure development, etc.

Table 4.8 shows the Sustainable Development Goals in the context of the main indicators in the regions of the Black Sea region at the starting positions (2015), as well as the level of their compliance with the average value for Ukraine. These tables highlight the main problems of the region at the initial stage of implementation, which should be addressed by both the efforts of regional governments and the state, as well as the benefits, the development of which should be supported.

While the indicators differ significantly in each region, the vast majority of indicators are higher than the average Ukrainian value. This indicates a relatively good start in the region.

The most problematic in varying degrees for all areas are:

1) a high level of water intensity of GDP, especially in the Kherson region, where this indicator exceeds the average value by 90 times;

2) compliance with sanitary standards of communal water supply sources, which indicates certain problems in the water supply systems, more than 60 % worn out;

3) the level of provision of the population in rural areas with centralized drainage.

Table 4.8 Objectives and indicators of sustainable development in the Black Sea region [4]

Indicators	Mykolaiv region		Odesa region		Kherson region	
	2015	relative to the average for Ukraine (+;–)	2015	relative to the average for Ukraine (+;–)	2015	relative to the average for Ukraine (+;–)
6.1 Ensure the availability of quality safe drinking water services						
Compliance with sanitary standards of rural drinking water sources, %	7.8	0.2	8.7	1.3	2.8	–4.8
Water use for drinking and sanitary needs, m^3 per person	26.7	0.9	35	1.18	36.4	1.23
Compliance with sanitary standards of communal water supply sources, %	3.8	–0.8	7	2.4	2.8	–1.8
Share of rural population with access to centralized water supply, %	57	32.8	35.4	11.2	85	60.8
Share of urban population with access to centralized water supply, %	100	10.6	95.3	5.9	100	10.6
6.2 Ensure the availability of modern drainage systems, construction and reconstruction of water intake and sewage treatment facilities using the latest technologies and equipment						
Share of rural population covered by centralized sewerage, %	3	–1.1	19	14.9	1	–3.1
Share of urban population with access to centralized sewerage systems, %	100	27	85	12	100	27
6.3 Reduce the volume of untreated wastewater discharges, primarily through the use of innovative water treatment technologies at the state and individual levels						
Discharged polluted (without treatment and insufficiently treated) wastewater into water bodies, million m^3	0	0	44	0.05	0	0
Share of discharges of polluted (polluted without treatment and insufficiently treated) wastewater into water bodies in the total volume of discharges, %	0	–87.81	25	3.36	0	–6.67
6.4. Improve water use efficiency						
Water consumption GRP, m^3 of used water per 1000 UAH of GDP (in actual prices)	4.83	1	7.62	1.56	45.51	935

To simplify the implementation of sustainable development indicators in the regional planning system, as well as to improve the information support system for the formation of a model of sustainable innovative development of the water management of the regions, an improvement in

methodological approaches to measuring and evaluating sustainable water use is proposed. The proposed methodological approaches include the following steps:

1) systematization of indicators of water use and their addition in accordance with the three vectors of sustainable development: environmental, social and economic. At the same time, the basic indicators are taken as a basis, since this will allow benchmarking and determining the degree of critical inconsistencies with respect to the accepted benchmarks. The system of characteristics of sustainable water use and relevant indicators is shown in **Fig. 4.8**;

2) analytical assessment tools include a number of calculation steps. The first stage of the calculation is the standardization of the indicators of the region relative to the average value of the corresponding indicators achieved in all regions in the comparative period or the target indicator for this period according to the formulas:

– for indicators that are stimulators of sustainable development:

$$N_{ir} = \frac{I_{ir}^{t}}{\overline{I}_{i}^{t}}; \tag{4.1}$$

– for indicators that are stimulators of sustainable development:

$$N_{ir} = \frac{\overline{I}_{i}^{t}}{I_{ir}^{t}}, \tag{4.2}$$

I_{ir}^{t} – the value of the indicator of sustainable development of water resources in the analyzed year; $\overline{I}_{i}^{t}$ – average (or planned) value of the indicator of sustainable development of water resources in the year under review.

At the next stage, let's determine the growth of indicators in the sustainable development of water resources in the region and on average in Ukraine relative to the base level using the formulas:

– for indicators that are stimulators of sustainable development:

$$\Delta I_{ir} = \left(\frac{I_{ir}^{t}}{I_{ir}^{t_0}} - \frac{\overline{I}_{i}^{t}}{\overline{I}_{i}^{t_0}} \right); \tag{4.3}$$

– for indicators that are stimulators of sustainable development:

$$\Delta I_{ir} = \left(\frac{\overline{I}_{i}^{t}}{\overline{I}_{i}^{t_0}} - \frac{I_{ir}^{t}}{I_{ir}^{t_0}} \right), \tag{4.4}$$

where ΔI_{ir} – the increase in the value of the indicator of sustainable development of water resources in the comparative year relative to the base year and in comparison with the average increase in all regions; $I_{ir}^{t_0}$ – the value of the indicator of sustainable development of water resources in the region in the comparative year; $\overline{I}_{i}^{t_0}$ – average value of the indicator of sustainable development of water resources in the region in the comparative year.

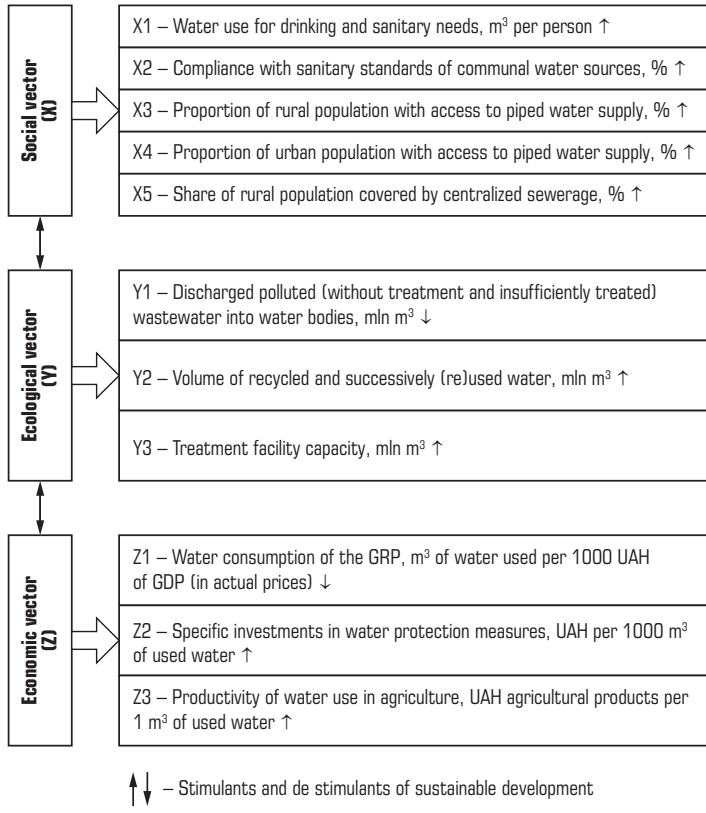

Fig. 4.8 Indicators for assessing the use of water resources in the region in the context of sustainable development [4]

This stage allows to determine the degree of advance or lag of the region in terms of the indicator in comparison with other regions or the degree of lag or advance in achieving planned values.

At the third stage, let's determine the vector of movement of the region, showing its achievements on the path of sustainable development according to a certain indicator relative to the comparative year and other regions according to the formula:

$$V_{ir} = \Delta I_{ir} \times N_{ir}, \quad (4.5)$$

where V_{ir} – the vector of movement of the region according to the i^{th} indicator.

At the last stage, let's determine the degree of achievement of the goals of sustainable development of the region in the context of the social, environmental and economic components. To ensure comparability of the results for each component, the assessment of which may involve a different number of indicators, it is proposed to use a weighting factor. The weighting factor (k) can be determined in accordance with the priority of indicators in the assessment system or by the formula:

$$k_i = \frac{1}{n};\ k \in (0;1), \tag{4.6}$$

where n – the number of indicators.

To determine the total length and direction of the sustainable development vector, the following formula is proposed:

$$X = \sum_{i=1}^{n} V_{ir} \times k_i; \tag{4.7}$$

3) evaluation of results. The results of calculations at each stage make it possible to determine the strengths and weaknesses of the region according to certain indicators. Generalizing indicators highlight the main direction of movement (progress or regression) and the speed of the region's movement in the process of achieving sustainable development goals in comparison with general trends in Ukraine.

Using the proposed approaches, monitoring of the implementation of the goals of sustainable development of water resources in the regions of the Black Sea region for the period 2015–2019 was carried out. The initial data for the calculations are presented in **Table 4.9**.

Indicators and indicators of sustainable development of water resources in Ukraine and regions of the Black Sea region are divided into:

– social vector (X);

– environmental (U);

– economic (Z).

For monitoring, let's calculate indicators and indicators of sustainable development of water resources in Ukraine and the regions of the Black Sea region according to **Fig. 4.8** according to the State Statistics Service of Ukraine.

According to **Table 4.9** and, accordingly, formulas (4.1)–(4.7), the main indicators and indicators of sustainable development of freshwater resources in the Black Sea region were calculated (**Table 4.10**).

In general, the results of the calculations showed that in all areas there is some progress in the context of the transition of the management system of freshwater resources to an innovative model of Sustainable Development. This is evidenced by the obtained values of the vectors, which together characterize the movement as progressive. In the context of individual indicators, one can analyze the position of the region relative to others, as well as the comparative speed of ongoing reforms in the industry. In the context of the implementation of the social vector, it can be

concluded that certain positive developments are observed in all areas. The scores obtained do not differ. The largest number of achievements in this area is in the Odesa region (2.84). Comparatively strong positions of Mykolaiv (5.95) and Odesa regions (2.76) in terms of the vector of economic development are typical, provided by the relatively low water intensity of the GRP, investments in water treatment and a fairly high equal productivity of water use in agriculture. In the Kherson region, the given indicators are below the normative value, and progress in their improvement is insufficient over the past 5 years, which has led to a negative value of the economic vector.

Table 4.9 Indicators and indicators of sustainable development of water resources in Ukraine and Black Sea region [7]

Indicators		Ukraine		Mykolaiv region		Odesa region		Kherson region	
		2015	2019	2015	2019	2015	2019	2015	2019
SOCIAL VECTOR X									
X1	Water use for drinking and sanitary needs, m^3 per person	29.6	27.2	26.7	26	35	33	36.4	36
X2	Compliance with sanitary standards of communal water sources	2.4	2.5	3.8	3.9	7	6.8	2.8	2.5
X3	Proportion of rural population with access to piped water supply	24.2	24.1	57	58	35.4	36	85	84
X4	Proportion of urban population with access to piped water supply	89.9	26	100	100	95.3	97	100	100
X5	Share of rural population covered by centralized sewerage	4.1	4.8	3	3.8	19	21	1	1.8
ECOLOGICAL VECTOR Y									
Y1	Discharged polluted (without treatment and insufficiently treated) wastewater into water bodies, mln·m^3	35,58	18,75	21	20	44	36	0.2	1
Y2	Volume of recycled and successively (re)used water, mln·m^3	1670	1393	3141	3353	120	72	21	18
Y3	Treatment facility capacity, mln·m^3	214,3	203,7	67	56	281	276	102	137
ECONOMIC VECTOR Z									
Z1	Water consumption of the GRP, m^3 of water used per 1000 UAH of GDP (in actual prices)	23.85	10.3	4.83	2.5	7.62	4.39	45.51	42
Z2	Specific investments in water protection measures, 1000 UAH/m^3 of used water	87.5	157.9	23.4	242.7	6.2	38.2	2.4	1.8
Z3	Productivity of water use in agriculture, UAH agricultural products /1 m^3 of used water	37.4	51.5	74.6	86.4	27.9	27.4	7.8	6.2

Table 4.10 Calculation of vectors for sustainable use and development of freshwater resources in the Black Sea region [4]

I	*ki*	Mykolaiv region			Odesa region			Kherson region		
		N_{ir}	ΔI_{ir}	V_{ir}	N_{ir}	ΔI_{ir}	V_{ir}	N_{ir}	ΔI_{ir}	V_{ir}
X1	0.2	1.0	0.06	**1.01**	1.2	0.03	**1.26**	1.3	0.08	**1.41**
X2	0.2	1.6	–0.02	**1.54**	2.7	–0.07	**2.65**	1.0	–0.15	**0.85**
X3	0.2	2.4	0.02	**2.43**	1.5	0.02	**1.51**	3.5	–0.01	**3.48**
X4	0.2	3.8	0.71	**4.56**	3.7	0.73	**4.46**	3.8	0.71	**4.56**
X5	0.2	0.8	0.10	**0.89**	4.4	–0.07	**4.31**	0.4	0.63	**1.00**
X				2.09			2.84			**2.26**
Y1	0.2	0.94	–0.43	**0.51**	0.52	–0.29	**0.23**	18.75	–4.47	**14.28**
Y2	0.4	2.41	0.23	**2.64**	0.05	–0.23	**–0.18**	0.01	0.02	**0.04**
Y3	0.4	0.27	–0.11	**0.16**	1.35	0.03	**1.39**	0.67	0.39	**1.07**
Y				1.22			0.53			**3.30**
Z1	0.4	4.12	–0.09	**4.03**	2.35	–0.14	**2.20**	0.25	–0.49	**–0.25**
Z2	0.4	1.54	8.57	**10.11**	0.24	4.38	**4.62**	0.01	–1.05	**–1.04**
Z3	0.2	1.68	–0.22	**1.45**	0.53	–0.40	**0.13**	0.12	–0.59	**–0.47**
Z				5.95			2.76			–0.61

The results of achieving the Goals of sustainable development of water resources in the regions of the Black Sea region by the main vectors are illustrated in **Fig. 4.9**.

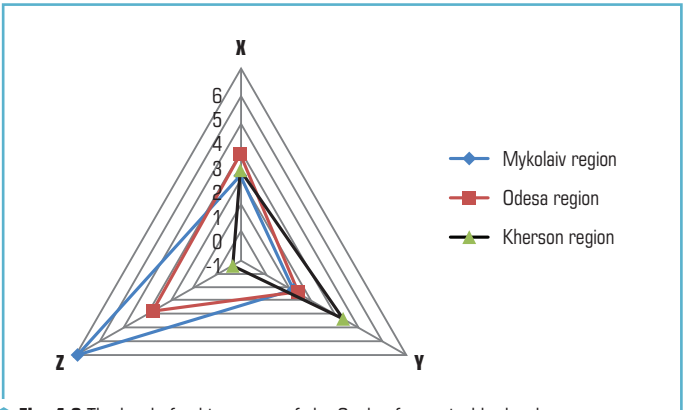

Fig. 4.9 The level of achievement of the Goals of sustainable development of water management in the Black Sea region [4]

Fig. 4.9 clearly shows that management activities aimed at the development and sustainable use of freshwater resources in the region are not sufficiently balanced. The most organic growth within the main vectors is provided in the Odessa region. As it is possible to see, the main priorities in providing water resources to the population and the economy of the region are observed. The high economic return on water use makes it possible to increase investments and current expenditures for the development of water management infrastructure. Somewhat less attention is paid to the environmental component compared to other regions, which should be taken into account when formulating a strategy and regional programs for the development of water resources.

The main priorities of the Mykolaiv region in water management are focused on providing the region's economy with water resources. The social vector also has a positive value, which indicates progress in the water supply system for the population, especially in rural areas. Problematic issues remain the ecological state of surface waters and water bodies associated with large volumes of insufficiently treated wastewater discharged from enterprises and agriculture. An additional problem is also climate change, which makes it necessary to revise the existing irrigation technologies.

Despite the high level of water resources in the Kherson region, their use in the economy and to meet the needs of the population is not effective enough. In the region, the worst among other regions are the implementation of the Sustainable Development Goals in the field of providing the rural population with central water supply and sanitation systems, as well as the quality of water supplied to the population for domestic and sanitary needs.

Thus, the analysis showed that, despite certain positive shifts towards the sustainable use of freshwater resources on the example of the regions of the Black Sea region, it is possible to see that significant progress on this path can only be achieved by enhancing innovation and attracting investment to the industry.

To implement the model of regional management of freshwater resources in the innovative plane, in addition to updating the system of investment and financial support, it is important to use innovative forms of interaction in the field of water use, in particular public-private partnerships. Public-private partnership in the field of water use should comply with the concept of decentralized management of the natural resource potential of territorial development, which is based on the balanced use of financial resources aimed at preserving and restoring natural benefits (**Fig. 4.10**).

Satisfaction of the personal needs of the population in water and the water supply of the economic sphere depend on the management system of water management facilities, which explains the impossibility of completely transferring the latter to the sphere of private property. Therefore, it is necessary to develop the possibility of spreading state ownership with the involvement of entrepreneurial capital in the field of freshwater resources management, which will allow commercializing water management activities and maintaining state control in the water supply system, because the main management tools (taxation, state orders, tariff policy, control over the state of natural resources and the quality of the provided services in the field of water management) remain permanently within the competence of state bodies.

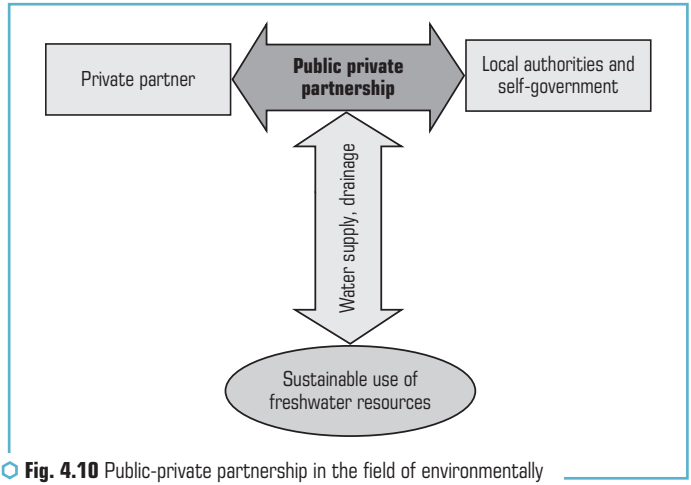

Fig. 4.10 Public-private partnership in the field of environmentally sustainable management of freshwater resources [20]

In the context of decentralization of power in the field of freshwater management, the initiative of local self-government to develop public-private partnerships is activated, because it is the territorial communities that become interested in increasing financial self-sufficiency and efficient use of resources on their territory in order to meet the needs not only for the present, but also for the future generations.

The formation of an innovative model of regional management of freshwater resources in the context of sustainable development requires the transformation of the targets for the functioning of the water management complex in the direction of meeting the needs of present and future generations in freshwater resources, ensuring a safe environment and protection from the natural possibilities of water, which should contribute to the necessary institutional and structural transformations. regions, districts and communities. Consequently, guidelines for the strategic development of the system of regional management of freshwater resources are being formed, in accordance with which social activity acquires significant weight, ensuring a balanced use of natural and economic resources, including human capital, based on the diversification of innovative forms of relationships in the management system itself in the context of institutional transformations.

An innovative model of regional management of freshwater resources in the context of sustainable development should be fully consistent with the goals of sustainable development, i.e. the conceptual unity of the goals of sustainable development and the goals of the development of freshwater territorial systems should be monitored (**Fig. 4.11**).

Sustainable management of freshwater resources lies not only within the framework of the concept of sustainable development of Ukraine and the states of the world, but also in the system of sustainable management of water resources, for which the Ministry of Environmental

Protection and Natural Resources of Ukraine is responsible in our state. "State management of water resources is an activity aimed at overcoming existing water and environmental threats in the country, creating favorable conditions for sustainable, environmentally safe water use, reproduction and protection of all water resources in the country, taking into account their transboundary significance, as well as water ecosystems" [26].

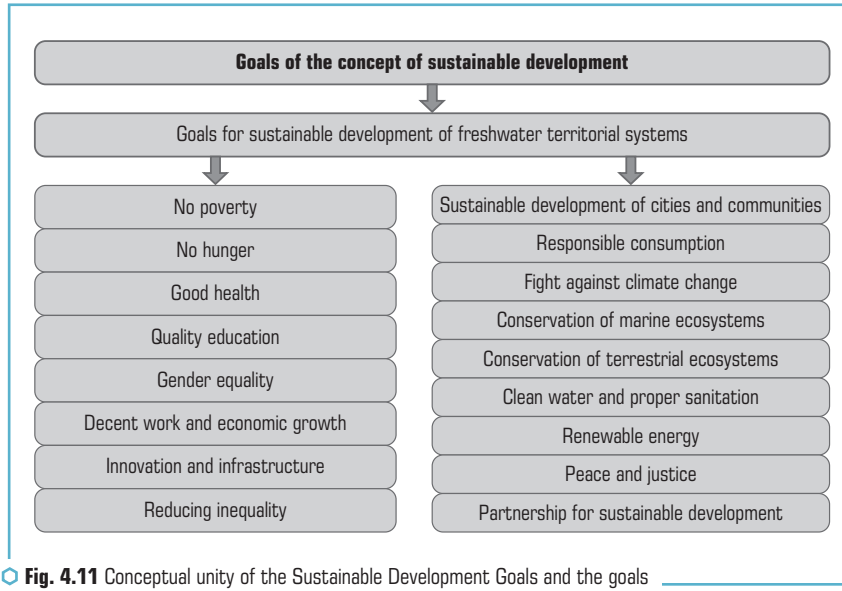

Fig. 4.11 Conceptual unity of the Sustainable Development Goals and the goals of the development of freshwater territorial systems [27]

The socio-humanitarian component in the formation of an innovative model of regional management of freshwater resources, which meets the principles of sustainable development, acquires great importance. In the model of regional management of freshwater resources in the context of sustainable development, there should be a structural subordination of subject-object relationships to objective natural-ecological and economic laws, taking into account the specific manifestations of water management activities (**Fig. 4.12**).

For the effective development of regional environmentally balanced management of freshwater resources, it is important to preserve the laws of proportionality of economic and social development, the use and reproduction of natural resources, the evolution of production relations and the laws of the functioning of the water resource potential of the regions, as the basis for sustainable life support and sustainable economic development.

An equally important direction in the formation of an innovative model of water management is the further implementation of reforms in the management of the industry, as well as the

development and implementation of digital technologies. Such technologies, which are actively used in the system of accounting, monitoring and regulation of water resources, include BIG DATA technologies in countries with developed economies. They make it possible to form a single and interactive platform for accounting for water resources and their use in the context of regions, territories and individual economic entities, which combines data on the ecological state and water balance under the influence of natural phenomena. Integrated GIS-technologies into the system of the cadastre of water resources simplify the accounting systems for water resources in the regions, their quantitative and qualitative characteristics, and also determine their territorial distribution, which will create prerequisites for more effective spatial planning of the development of territories, optimization of housing and communal services, development of agriculture and industry.

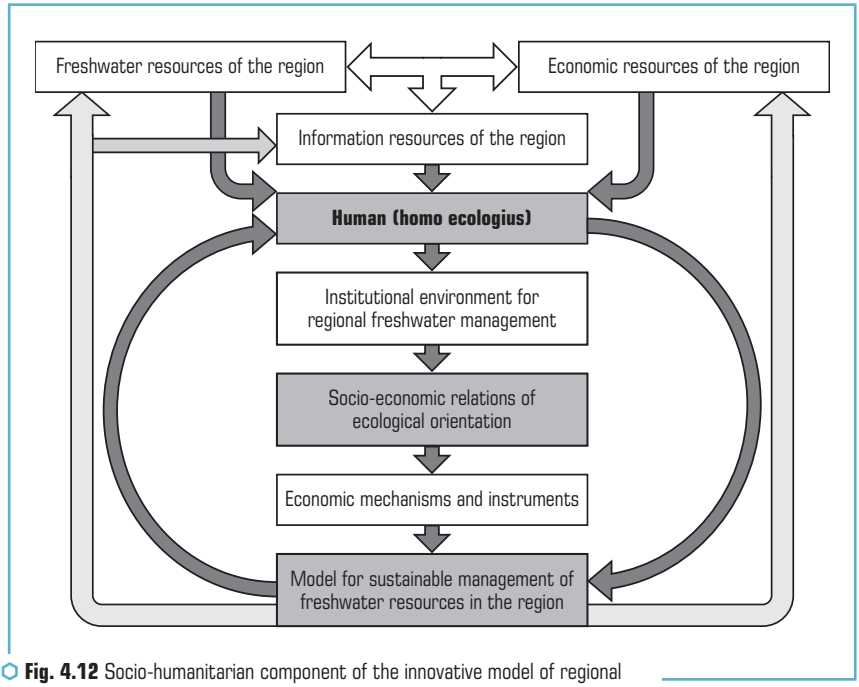

Fig. 4.12 Socio-humanitarian component of the innovative model of regional environmentally balanced management of freshwater resources [4]

Economic innovations create the prerequisites for the growth of funding for the water sector and increase investment, contribute to the growth of public and business confidence in ongoing activities and projects, and stimulate the rational, environmental and conservation use of fresh water in everyday life and production.

CONCLUSIONS

Based on the results of the study, the following conclusions were drawn:

1. It is noted that the effective management of freshwater resources is implemented through the appropriate management functions, which together contribute to the implementation of certain goals for the development of the water complex, ensuring a balance of interests of all subjects of water use, as well as sustainable use of the existing potential in the context of meeting the current needs of the population and the economy, and in the long term.

2. It is substantiated that at the present stage of development of the national economy in the context of global trends, environmental forecasts and social challenges, the obvious and uncontested goal of managing freshwater resources is to ensure a balance between the three vectors of sustainable development (economic, environmental and social), which are the triune imperative of the state and regional policies in the field of development and protection, distribution and use of national resources. The implementation of this goal requires the development of a unified strategy that defines the main imperatives of water policy, which are guidelines for decision-making at all levels, create framework conditions and criteria for using the available water potential, and uniform rules for all participants in the water market.

3. The main components of the national water strategy (regional, sectoral and resource) are identified and characterized, which together will contribute to its implementation in various areas of water management and at different levels of management.

4. The ecological situation and features of the use of freshwater resources in the Black Sea region are analyzed. It has been established that, despite the different levels of provision of territories and the population with freshwater resources in the context of regions, the region is characterized by a number of common problems regarding the state of water supply and the efficiency of using water potential, including: uneven distribution of surface freshwater reservoirs and river flows across the territory of the region; high level of wear of equipment of water infrastructure facilities; poor quality of drinking water for the population; unsustainable use of freshwater resources, household waste pollution, etc.

5. To simplify the implementation of sustainable development indicators in the regional planning system, as well as to improve the information support system for the processes of forming a model of sustainable innovative development of the water management of the regions, methodological approaches to measuring and evaluating sustainable water use have been improved. The proposed approaches include: a detailed system of indicators for assessing the process of sustainable water use in the context of the main vectors of sustainable development, mathematical tools for assessing the progress of the region on the path of sustainable water use and identifying the main problems in the context of individual indicators and indicators, which can become an analytical basis in the process of developing regional strategies for balanced use of resources.

6. The use of the proposed methodological approaches made it possible to assess the sustainable development of freshwater resources in the context of the regions of the Black Sea region,

determine the level of balance in water policy and determine the main strategic tasks for the future. In general, the results of the calculations showed that in all areas there is some progress in the context of the transition of the management system of freshwater resources to an innovative model of sustainable development.

7. The main directions for improving the system of investment support for the innovative development of water management systems in the region are outlined, including: improvement of regulatory and legal support and development of public-private partnerships, including in the form of ESCO contracts; the use of freshwater resources for aquaculture production, which will increase the economic efficiency of the use of surface water bodies, will help attract investment in the industry and strengthen food security; creating conditions for attracting foreign investment, in particular, in the construction and modernization of infrastructure; intensification of work to attract international finance: grants, participation in international programs for the protection and restoration of water resources, etc.

8. A model of sustainable socio-humanitarian and environmentally balanced management of freshwater resources at the regional level has been developed, taking into account innovative forms of interaction in the field of water use (corporatization, clustering, concession, capitalization, creation of holdings and associations) and the important role of public-private partnerships. The proposed model requires the transformation of the target guidelines for the functioning of the water management complex in the direction of meeting the needs of present and future generations in freshwater resources, ensuring a safe environment and protection from the natural possibilities of water, which should contribute to the necessary institutional structural transformations at the level of regions, districts and communities.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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