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ORGANIZATIONAL SUPPORT OF STATE MANAGEMENT OF WATER RESOURCES ACCORDING TO THE BASIN PRINCIPLE

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ОРГАНІЗАЦІЙНЕ ЗАБЕЗПЕЧЕННЯ ДЕРЖАВНОГО УПРАВЛІННЯ ВОДНИМИ РЕСУРСАМИ ЗА БАСЕЙНОВИМ ПРИНЦИПОМ

Water resources are an integral part of nature management, which in terms of market relations is considered a commodity. Uneven territorial distribution of water resources and significant anthropogenic pressure lead to acute water shortages. At present, Ukraine's water management has a significant number of problems, including: deepening the trend of irrational water use; unsatisfactory water quality in natural water bodies; significant increase in material damage from the negative impact due to floods, flooding of groundwater, waterlogging, secondary salinization of land, water erosion, reduced investment in water management. The realities of water use, especially in the field of water resources management, have led to the need to improve existing scientific approaches that will allow more efficient allocation of resources and will be based on the principles of sustainable development. For a long time there was a notion of unlimited water resources and, accordingly, of free access to them. However, with the development of the country's productive forces and especially water-intensive enterprises, pollution of water sources, disputes between water users over the use of water resources, and, finally, water scarcity in some large river basins, society's costs of increasing water resources and bringing them to quality standards have risen sharply. It has become clear that water is a limited and rather expensive resource for society. The main essence, features and main advantages of the basin principle of water resources management are considered in the work; the functions, types and features of the water resources management system based on the basin principle were studied and researched, the structure was analyzed, the main problems of implementation were identified and measures for the effective operation of the water resources management system were proposed. It is noted that the development of the basin system of water resources management in Ukraine should be carried out with maximum use and significant expansion of the functions provided by the water sector of the State Water Management. This approach makes it possible to predict the consequences of human activities, for early prevention of environmental and man-made disasters.

Водні ресурси є невід'ємною частиною природокористування, яка в умовах ринкових відносин вважається товаром. Нерівномірний територіальний розподіл водних ресурсів та значний антропогенний тиск призводять до гострого дефіциту води. Нині водне господарство України має значну кількість проблем, серед яких: поглиблення тенденції нераціонального водокористування; незадовільна якість води в природних водоймах; значне збільшення матеріальних збитків від негативного впливу внаслідок паводків, підтоплення підземних вод, заболочення, вторинного засолення земель, водної ерозії, зменшення інвестицій у водне господарство. Реалії водокористування, особливо в сфері управління водними ресурсами призвели до необхідності вдосконалення існуючих наукових підходів, які дозволять більш ефективно розподіляти ресурси та будуть базуватись на принчипах сталого розвитку. Тривалий час існувало уявлення про необмеженість водних ресурсів та відповідно про безоплатність їх отримання. Однак, з розвитком виробничих сил країни та особливо водомістких підприємств, забрудненням водних джерел, виникненням протиріч між водокористувачами з приводу використання водних ресурсі, та, нарешті, з дефіцитом води в ряді басейнів великих річок, затрати суспільства на збільшення розташовуваних водних ресурсів та їх доведення до стандартів якості різко зросли. Стало очевидним, що вода являється обмеженим та доволі дорогим для суспільства ресурсом. В роботі розглянуто основну сутність, особливості та основні переваги басейнового принципу управління водними ресурсами; було вивчено та досліджено функції, типи та риси системи управління водними ресурсами за басейновим прин-

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ципом, здійснено аналіз структури, виявлено основні проблеми впровадження та запропоновано заходи для ефективної роботи системи управління водними ресурсами. Зазначено, що розвиток басейнової системи управління водними ресурсами в Україні повинен здійснюватись з максимальним використанням та значним розширенням функцій, які забезпечуються водогосподарською галуззю Держводгоспу. Даний підхід дає можливість передбачити наслідки людської діяльності, для завчасного попередження екологіної та техногенної катастроф.

Key words: water system; biotic communication; hydroecosystem, water resources, sustainable development, basin principle, water management.

Ключові слова: водна система; біотична комунікація; гідроекосистема, водні ресурси, сталий розвиток, басейновий принвип, водний менеджмент.

INTRODUCTION

The end of the XX — beginning of the XXI century is characterized by the deterioration of the ecological situation on the planet. The most important component of ecologically safe development of natural and socio-economic systems is the use of nature, which involves the organization of water resources, which ensures sustainable development and for a long time retains sufficient water potential. The nineteenth century is characterized by significant negative changes in the environment caused by the uncontrolled use of natural resources, the development of industry and transport, which leads to increased water consumption and at the same time an increase in its pollution. This has been particularly noticeable over the last 50 years, when human impact on the planet's water cycle has reached a global scale [1—3].

The distribution of water resources, as well as the needs of society in them, on Earth is uneven. The total water reserves of the Earth are 1359 million m3, of which only 2—3% is fresh water. Water supply per capita ranges from 0.69 in North Africa to 96.2 in Siberia and the Far East and 219 thousand m3 / year in Canada and Alaska [4].

Stocks of easily accessible fresh water are distributed on the planet very unevenly. For example, in Africa only about 10% of the population has a regular water supply, and in Europe this figure exceeds 95%. South America has the best water resources, while North America and Europe have the worst. In many regions, large rivers and lakes are located in relatively underdeveloped areas: the Amazon, the rivers of Russia and Canada [5].

Irrational use of water resources on the planet has led to a decrease in water supply per capita in Europe by 22% (from 5.9 to 4.6 thousand m3 / year), Asia by 47% (from 9.6 to 5.1 thousand m3) / year), in Africa by 54% (from 37.2 to 21.3 thousand m3 / year), in North America by 43% (from 37.2 to 21.3 thousand m3 / year), in South America by 54% (from 105 to 48.8 thousand m3 / year).

Water resources are an integral part of nature management, which in terms of market relations is considered a commodity. Uneven territorial distribution of water resources and significant anthropogenic pressure lead to acute water shortages.

The problem of rational use of water resources is extremely important for Ukraine. This is due to the fact that Ukraine is one of the countries with the lowest water supply and significant anthropogenic pressure.

At present, Ukraine's water management has a significant number of problems, including: deepening the trend of irrational water use; unsatisfactory water quality in natural water bodies; significant increase in material damage from the negative impact due to floods, flooding of groundwater, waterlogging, secondary salinization of land, water erosion, reduced investment in water management.

The problems mentioned above have led to the aging of fixed water resources and the lack of fixed capital in water management. We also want to note that the current problems of this industry are deepening in the field of water management. The water fund remains almost 100% state-owned, and various forms of ownership have emerged in the water sector as a result of privatization.

In order to determine the most rational direction of nature management, priority areas have been identified that will ensure the sustainable development of the country's water management complex. At the same time, as a natural unit of water use management, it is necessary to consider the annual basin, within which the analysis of the current situation should be performed, and decisions should be made on the distribution of water resources.

The current national environmental policy in the field of sustainable use of water and water

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resources provides for the use of the principles of the European Water Framework Directive 2000/60 / EC, which aims to protect and improve the quality of natural resources, promote sustainable use of water resources. The main principle of the management system specified in the Directive is the use of an integrated basin management model.

RESEARCH RESULTS

Today, the water management of Ukraine has a large number of problems, including: the deepening trend of wasteful water use; unsatisfactory water quality in natural objects; significant increase in recent years of material damage from the harmful effects of water due to floods, flooding of groundwater, waterlogging, salinization and water erosion; significant reduction of water management investment. A number of these problems have led to the aging of fixed assets, and the lack of even basic recovery of water capital.

We would also like to note that the current problems of this industry are deepening due to disparities in the relationship between property rights and elements of the water sector. In order to improve the water management situation, the Concept of water management development of Ukraine was developed [1]. The main purpose of which is to determine the strategic goals and main directions for creating conditions for improving environmental sustainability and balanced development of the water complex, improving water supply and water management needs in compliance with optimal conditions for water use; improving water quality, reducing losses and social tensions; conservation of water systems [2].

In the period from 1990 to 2020 there is a significant decrease in the production of goods and services, and, accordingly, the amount of water consumption and wastewater discharge. However, no improvement in the qualitative and quantitative state of water resources is observed. On the contrary, there is a deterioration of water quality in microbiological, organoleptic, physicochemical, sanitary and toxicological indicators, depletion of water resources, degradation of aquatic ecosystems and the negative impact of climate change [4; 5].

There is an exacerbation of the problem of ensuring public access to water bodies and drinking water, which is associated with the inefficiency of management systems in the field of protection and restoration of water resources, water management, land reclamation. The current system of water use management and protection of water resources is administrative-territorial or sectoral, which has led to low efficiency of measures to regulate water use and resource potential of water bodies.

The issues of efficiency of natural resources management, aspects of their organizational support are covered in the works of A.V. Jacyk, V.I. Danilova-Danilyana, V.M. Udod, M.Yu. Tarasova, I.O. Dragana, N.M. Osadcha, N.S. Klebanov, B.I. Osadchiy, Yu.B. Stuffing, etc. Most scientific papers do not fully take into account the features of aquatic ecosystems of Ukraine and the diversity of attitudes towards them.

The main document in the field of EU water policy is Directive № 2000/60 / EC of 23 October 2000, better known as the Water Framework Directive (WFD). The urgency of adapting the national strategy for the protection of water resources to the provisions of the WFD is enhanced by the presence in Ukraine of a number of transboundary river basins common with EU Member States. The Directive requires Member States to carry out a preliminary flood risk assessment to identify river basins and associated coastal areas where such a risk exists. This preliminary assessment must include a description of past floods that are likely to recur, as well as historical maps of floods.

Currently, the water resources management system has an administrative-territorial and sectoral nature, as a result of which measures to regulate the use and restoration of water resources do not give the desired effect. Therefore, in order to improve the basin management principle and bring water management closer to the principles of sustainable development.

The water management process around the world has undergone a number of significant improvements and reforms, and shows that the basin management principle is effective and ensures compliance with the requirements for improving quality and safe water use.

There are several main models of basin water management:

— English model, which provides for full privatization;

— the French model, which provides for privatization through a delegation of authority;

— German model, which provides for partial privatization and the creation of a supervisory board.

The Water Code of Ukraine provides for the introduction of the principle of basin management in the management of water resources of the country. However, there is still no official decision in Ukraine to define the boundaries of river basins or basin districts, so water management in Ukraine is still based on the administrative-territorial division of the country.

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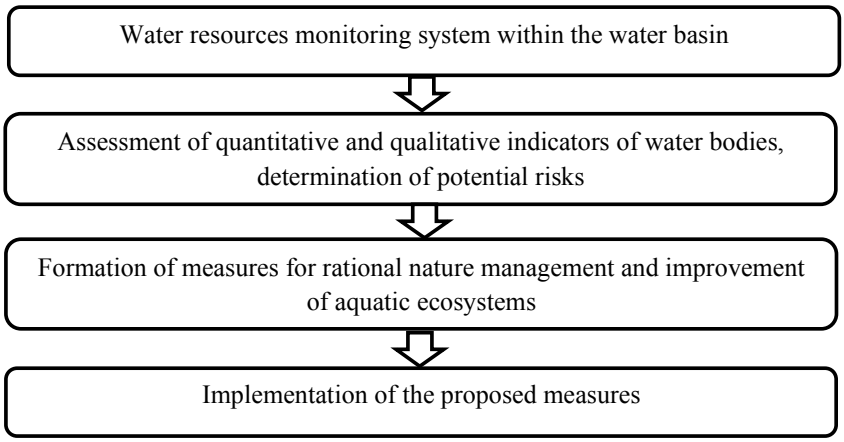

Fig. 1. Block diagram of integrated water resources management according to the basin principle

The basin principle is a modern approach to the management of the basic unit — river basins with clearly defined environmental, social and economic ties. Ukraine is divided into the following seven main river basins, all of which flow into the Black Sea, except for the Western Bug, which flows into the Baltic Sea: the Dnieper basin (covers 65% of the country), the Dniester basin (12%), the Danube basin (7%), the coastal a basin covering all small rivers that flow directly into the Sea of Azov and the Black Sea (7%), the Seversky Donets river basin (4%), the Southern Bug basin (3%) and the Western Bug basin (2%).

The ecological state of water resources is closely linked to the economy and the location of productive forces, social and living conditions.

Thus, the coefficient of discharge of harmful substances into reservoirs is 24.4 m^3/Ha (in the region of industrial Dnieper — 104.6 m^3/Ha, Western Polissya -2.0 m^3/Ha, the Ukrainian Carpathians — 9.0 m^3/Ha, Podillya — 2.9 m^3/Ha, Kyiv Dnieper — 5.4 m^3/Ha, Left-Bank Dnieper — 8.2 m^3/Ha, Black Sea — 17.6 m^3/Ha, Crimea — 8.8 m^3/Ha) [6; 7].

Today it has become obvious that the changed values and regimes of river runoff, high-quality depletion of water lead to disruption of the life cycle of aquatic organisms [8; 9] and in general initiate degradation processes in the aquatic ecosystem. These changes in water systems contribute to the violation of the mechanism of homeostasis.

The water basin is the main indicator of the state of the environment, namely the ecological state, which is due to both anthropogenic impact and the action of specific environmental modifiers. The use of the basin principle of water resources management allows to prevent quantitative and qualitative depletion of aquatic ecosystems, to reduce the negative man-made impact.

The basin principle of water resources management provides the following:

— comprehensive protection of all water bodies of the water basin;

— wide involvement of society and public organizations;

— consistent improvement of legislation;

— openness of procedures for discussion and decision-making.

Integrated water resources management is a management system based on the accounting and monitoring of all types of water use located within the regional ecosystems of the respective river basins, which takes into account the interests of different industries and hierarchical levels of water use, involves all stakeholders in decision-making and promotes efficient and sustainable their use.

Based on the conducted research and experience of the EU countries, the basic principles of integrated river basin management were identified and the corresponding structural scheme was formed (Fig. 1).

The main principles of integrated water resources management include:

— surface water resources are managed within the river basin territory;

— the object of management are all elements of water management infrastructure and types of water use;

— integrated management of water resources on a basin basis takes into account the interests of all participants in the process and regulates their impact on aquatic ecosystems, efficiency;

— openness and transparency of information is provided.

High concentration of industrial and agricultural production, transport infrastructure, combined with high population density, have created an extremely high man-made and anthropogenic load on the biosphere — the highest in Ukraine and Europe. The total man-caused load per unit of the territory of the regions of Eastern Ukraine is 4 times higher than the average in Ukraine. For the Donetsk region, water consumption and water supply is one of the main environmental problems that need to be addressed urgently, as the volume of discharges of untreated and insufficiently treated waters reaches almost 30% of the total discharges in Ukraine [6,50]. The region is one of the least supplied with water resources in Ukraine. There is about 0.23 thousand m^3 of local river runoff per person per year (in Ukraine, on

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average, there is 1.14 thousand m^3 of local river runoff per person per year).

On the territory of Zhytomyr region flows 2822 rivers with a total length of 13.7 thousand km. There are no large rivers in the structure of the hydrographic grid of the region, there are eight medium rivers: Sluch, Ubort, Stviga, Slovechna, Uzh, Teteriv, Irsha, Irpin, the total length within the region is 996.6 km. In total, rivers with a length of more than 10 km — 321, their total length is 6692 km. There are 2491 streams less than 10 km long, their total length is 7062 km.

The main impact of water use on the water resources of the region is due to the irreversible water intake and discharge of polluted effluents into water bodies. Although water use tends to decrease annually, the degree of anthropogenic pressure on the resource water potential remains quite high.

Analysis of the ecological condition of the basin makes it possible to identify the main causes of the existing situation and identify a range of the most important problems that require a phased solution. The level of pollution of river basins is due to inefficient operation of most facilities for wastewater treatment and drainage systems; high anthropogenic load on river basins as a consequence of an extensive way of economic development; imperfection and non-compliance with the current economic mechanism of water use and implementation of environmental protection measures, allocation of funds for water protection purposes; inefficient management and non-compliance with environmental legislation.

Under the influence of substances of anthropogenic origin is the process of transformation of the water basin, which can be represented by the following sequence:

— when the water man-caused load is exceeded according to the maximum concentration limits on individual and total indicators (1.5—2.5 times) the chemical composition of water changes, which further leads to changes in indicators characterizing the state of hydrobiocenoses, but the main structural parameters of ecosystem self-organization

— structural restructuring of ecosystems begins when the man-made load exceeds the MPC by 3—5 times;

— at the stage of emergence of degradation processes of water systems (at excess of MPC in 6—7 times) the biological structural organization changes ecosystems, reduced self-regulatory capacity;

— at the stage of qualitative depletion of water systems (exceeding the multiplicity of the MPC in relation to the "background" state by 10 times) decreases not only self-regulatory but also assimilative capacity and so on.

In the development of aquatic ecosystems, the main role is retained by biota (assimilative and self-regulating abilities) due to the importance of the functions performed by living organisms. At the level of hydrobiocenoses there are specific reactions and total effects (synergism, changes in metabolic and biosynthetic processes, etc.), which affects the different levels of biotic self-organization of aquatic ecosystems in the process of their development.

Assessing the potential of water bodies is the basis for developing an integrated management plan. This indicator is estimated due to the ratio of water volumes (the volume of water consumption and wastewater dilution) to the volume of total water inflow into the territory, taking into account the volume of normatively treated return water.

The management plan includes assessment of hazards, risks, methods of encouraging sustainable methods of rational use of water resources. The priority is to ensure safe living conditions, as well as measures to improve the natural mechanisms of self-regulation.

The objects of the study were the ecosystems of the rivers Gnilopyat, Teteriv and Sluch within the Zhytomyr region.

The Teteriv River is one of the main rivers of the Kyiv and Zhytomyr regions, the waters of which are used for the needs of various spheres of the national economy. The Teterev River originates on the Volyn-Podilska Upland and flows into the Kyiv Reservoir. Its length is 385 km, width — within 12—40 m, total area of the basin — 15,300 km^2.

The ecological situation in the area of the Sluch River basin is associated with the presence of agricultural land, a wide range of production activities of enterprises on the territory of which there are treatment facilities that are not able to achieve a high level of water treatment.

The river Sluch belongs to the middle rivers (total water intake area 13900 km^2) of the Dnieper river basin. Sluch Basin is located in Rivne, Khmelnytsky and Zhytomyr regions in the zone of intensive economic activity. The basin stretches from south to north and has a length of 300 km, an average width of 46 km (the largest — 110 km).

The Gnilopyat River originates in the Vinnytsia region. In the Zhytomyr region it flows through the territory of Berdychiv and Zhytomyr districts, where it flows into the river Teteriv. The length of the river in the Zhytomyr region is 70 km.

Ecological monitoring data for the period 2015—2021 were used to study river ecosystems. Accordingly, a number of indicators were cal-

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culated that characterize the current state of subsurface objects and their changes as a result of anthropogenic impact.

The use of complex analysis allows to establish the most informative hydrochemical indicators, indices of changes in qualitative and quantitative characteristics of water bodies with domestic and domestic effluents and to track the dynamics of dilution and self-purification of the studied rivers.

The obtained results indicate that water bodies are subject to significant anthropogenic pressure and are confirmed by the index of trial and self-purification. High concentrations of pollutants are reflected in each index.

Precipitation can also be a source of pollution of the studied reservoirs. Fertilizers used in the fields by farmers cause great damage to water bodies, as chemical and organic fertilizers from the top layer of soil are washed away by rain into water bodies, as well as into groundwater.

Table 1. Averaged indicators of man-made impact on aquatic ecosystems

Water pollution index	Water quality class	Averaged water quality indices				Saprobity zone	The value of the saprobity index	Self-cleaning coefficient, %			Resistance to anthropogenic load
		Pollution index of salt components (I_1)	Tropho-saprobiological (ecological-sanitary) index (I_2)	Index of specific indicators of toxic action (I_3)	I_e			base	average	long	
Gnilopyat river											
3,4	IV (contaminated)	2,1	3,29	4,01	3,13	β-mesosaprobic	2,3	61	30,1	8,9	$0 < I \leq 1,0$
Teteriv river											
3,31	IV (contaminated)	2,0	3,19	4,26	3,2	β-mesosaprobic	2,2	73	23	4	$0,51 \leq I \leq 1,0$
river Sluch											
3,39	IV (contaminated)	1,9	3,25	4,41	3,19	β-mesosaprobic	2,3	54	38	8	$0,51 \leq I \leq 1,0$

Chemical pollution of water occurs due to the ingress of inorganic (acids, alkalis, mineral salts) and organic (organic compounds, surfactants, detergents and disinfectants, pesticides, herbicides) into rivers together with wastewater, which are toxic to aquatic life and manifest strong depressant effect.

CONCLUSIONS

Water pollution is a serious problem for mankind, but there are many ways to solve it: learn to care for natural resources, create better water treatment mechanisms, introduce wastewater-free technologies in industry, reuse treated wastewater (eg in agriculture). In most EU countries, the water management process is based on the basin principle, which is the most efficient known to date. The basin principle of water bodies management allows to determine the main directions and prerequisites for the management of qualitative and quantitative status of surface and groundwater bodies, allows to implement the strategy of state policy aimed at preventing the depletion of water bodies.

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