A WATERSHED MANAGEMENT STRATEGY BASED ON THE DIVERSITY OF AQUATIC SPECIES CHARACTERISTIC OF THE LOCATION

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Watershed management is a concept that recognises the wise management of the three major resources of soil water and vegetation on a watershed basis to achieve a specific goal of human well-being.

Watershed management is the study of the relevant characteristics of a watershed aimed at the sustainable allocation of its resources, and the process of creating and implementing plans, programmes and projects to maintain and improve watershed functions. A large watershed can be managed in flat valleys or when forest or pasture development is the primary goal. In hilly areas or where intensive agricultural development is planned, a small catchment size is relatively preferable.

Aquatic ecosystems are being transformed both in the course of the planet's natural cycles and as a result of the impact of industrial civilisation.

Natural processes such as climate cycling, volcanism, etc. are still more powerful than anthropogenic influences. They are usually the backdrop against which current biodiversity has evolved and can therefore only significantly reduce it at the regional level or over long periods of time in terms of biodiversity protection issues. However, there are tipping points in the course of natural cycles when natural dynamics act quite rapidly.

Natural factors affecting biodiversity can significantly reduce it regionally. For example, in arid regions, biodiversity of aquatic ecosystems significantly decreases during warm-dry phases of climate, and in humid regions - during cool-wet phases. But, in general, these changes, due to their cyclical nature, are usually reduced to the migration of boundaries of the main types of biodiversity.

Impacts, negative processes and trends on biodiversity

The construction of hydraulic structures introduces serious changes not only in the regime of a watercourse, but also has a diverse impact on the natural environment of the territory upstream and downstream of the structure. The extent of this impact depends on many factors: climate, geological conditions in the construction area, the purpose of the hydraulic structure, the presence of large industrial facilities and cities in the construction area, etc.

As a rule, the construction of hydroschemes causes a negative impact on natural biological resources of water bodies, including the state of fish stocks. In this regard, when designing hydroschemes, it is necessary to carry out work in the following areas:

- study of biological resources of water bodies affected by hydraulic structures under domestic conditions;

- Forecasting the impact of construction and operation of hydraulic structures on biological resources;
- assessment of this impact in natural and cost terms;
- Development of measures to reduce the negative consequences of construction and operation of hydraulic structures on biological resources and to compensate for damages.

During the construction of hydraulic structures, many animals from the flood zone are forced to migrate to areas with higher elevations. In this case, the species composition and number of animals significantly decreases. In some cases, reservoirs contribute to the enrichment of fauna with new species of waterfowl and, in particular, fish: crucian carp, carp, pike, etc. Early reservoir drawdown after spring floods drains shallow waters, which negatively affects fish spawning in the upper reach. Deep winter drawdown of the reservoir in the middle zone of the country can lead to fish freezing in shallow areas of the reservoir.

As a result of the study of bioresources of water bodies affected by the designed hydraulic structures, a fishery characteristic should be developed, including information on the fishery category of the water body, on the species composition of fish, including the main commercial and passage species, on total and fishery productivity, on the existing fishery use of the water body (based on catch data for the last five years), on the prospects of fishery use of the water body.

Forecasting the impact of HS (hydraulic structures**)** allows to determine the boundaries of water bodies, in the water area of which negative impact on bioresources can be expected. Within these water areas shall be defined:

- Location, boundaries, area and productivity of spawning grounds, including species composition of spawning commercial fish and spawning dates;
- locations where juvenile fish are concentrated, indicating their boundaries, area, as well as species composition, hatching periods of juveniles and their concentration per unit volume of water;
- migration routes of spawning and transient fish with indication of migration timing and species composition of migrants;
- wintering pits, their areas, boundaries, species composition of fish wintering in them, densities of winter fish aggregations.

These data constitute the fishery characteristics of a water body and (or) its site, they are developed by organisations on the basis of

materials of the state registration or fishery cadastre of the water body; in their absence, special studies are carried out.

To reduce the negative impact of the projected facility, the nature and degree of influence of each factor (from among those discussed in the previous chapters) on the conditions of formation of fish stocks of the water body is determined, taking into account their condition at the time of design.

Based on this, the composition and extent of the required conservation or restoration measures are prescribed.

In case it is impossible to prevent negative impact on fish stocks, a fish-biological substantiation is developed to determine the amount of damage and the direction of compensation measures.

Opportunities for biodiversity conservation in aquatic ecosystems

As already noted, aquatic ecosystems are the most vulnerable and particularly difficult to protect because they are affected by the overall situation of the catchment area and are not balanced systems and therefore open to invasion.

Ways to protect the biodiversity of aquatic ecosystems can be summarised into several groups.

Conservation of water areas

Creation of special water reserves (ichthyosanctuaries) with full protection regime. The measure is certainly effective. But, firstly, the number of such sites is limited by economic and social considerations. For example, it is impossible to close all fishing or hunting grounds - fishermen would have nowhere to harvest their products, and amateurs would poach in the reserves. Secondly, there is growing resistance to the creation of new reserves in the country as the value of the land is realised. Third, reserves of this type are expensive, and the organisation of their protection and study is now lagging far behind the formation of reserves. Fourth, reserves have difficulties in managing aquatic ecosystems under regulated hydrological regimes. Finally (and this is the most important), fifth, they are fully effective only when they include the basin as a whole.

Conservation of certain species

Prohibition of fishing, inclusion of the species in the Red Book, breeding in artificial conditions and closed water bodies, cryopreservation of the genome, reintroduction to abandoned areas of the range. From this list, of course, it is possible to choose a sufficiently effective method or group of methods of species conservation. But, firstly, preservation of a species in a nursery or its genome in the form of cryopreservation, prohibition of fishing, etc. does not guarantee its preservation as a component of the biosphere - in case of habitat degradation there will be nowhere to reintroduce it. Secondly, especially for invertebrate animals, we

We do not yet have sufficiently reliable biodiversity monitoring to take appropriate action before the species is lost.

Species and population management

Regulation of fishing, regulation of predators and parasites, suppression and removal of competing introduced species from ecosystems, biotechnical measures. In most cases, these methods are quite effective, but they are most often applicable only to commercial species. They are expensive, so they are rarely used to protect non-target species.

Ecosystem management

It is widely used in rich countries to create favourable conditions for valuable commercial animals, the basis of fish farming. The main management methods are manipulation of water level (up to draining the reservoir), regulation of chemical, primarily acid and oxygen, regime of the reservoir, regulation of helophyte development, regulation of predators and parasites, as well as of the forage base. Effective but costly measures, therefore most often applied only on commercial species in specialised farms. Nature management

The range of measures regulating economic activities, especially those not directly related to fishing, in the interests of biodiversity conservation is quite wide. Most of them are currently prohibitive in nature. First of all, they include preliminary environmental impact assessment of projects and licensing of nature use.

Rational use of natural resources of the Kapshagai reservoir - water, hydropower, biological, recreational - is based on the integrated use of reservoirs for various sectors of the economy, social sphere, and environmental protection. The main directions of improving the efficiency of the integrated use of reservoir resources include: optimisation of hydrological, hydrochemical and hydrobiological regimes, ensuring water quality in accordance with the regulatory requirements of water users and water consumers; rational use of the coastal zone and shallow waters; directed formation and protection of ecosystems; fishery development with the formation of fodder base, spawning grounds, stocking; increase of useful bioproductivity.

Optimisation of the system of integrated use of reservoir resources, based on the prospects of socio-economic development of the district, should be based on the development and comparison of alternative options of resource use, taking into account the interconnection, and in some cases even contradictory nature of various activities, the complexity of interaction between natural and economic systems. At the same time, the priorities remain

creating an environment favourable to humans and preserving ecological balance.

The solution of the set tasks requires a differentiated approach to the use of individual sites of large reservoirs, taking into account their peculiarities, application of the principles of functional zoning, planning and arrangement of reservoirs.

Rational use of natural resources of the Kapshagai reservoir also significantly depends on economic activities, environmental protection measures in the catchment area upstream of the reservoir, including conditions of water use, land use, discharge of untreated wastewater, etc., which may lead to deterioration of water quality, acceleration of siltation of the reservoir. For example, in order to ensure rational use and protection of water resources, flood control in the upper part of the Ile River basin and in the zone of influence of the future HPP reservoir, it is planned to increase the area of forests from 22 to 45 per cent; it is also envisaged to drastically reduce the discharge of untreated wastewater into the Ile River through the construction of treatment facilities, closure of a large number of small polluting enterprises, etc., as well as to reduce the volume of untreated wastewater into the Ile River.

The design of hydraulic structures should be based on pre-developed schemes for the integrated use of water resources in the river basin, including environmental protection measures and schemes for the energy use of the watercourse. All issues of placement of economic sectoral objects and volumes of their water consumption should be interconnected and coordinated. In the absence of such schemes for any watercourse, the design and construction of private facilities, the use of water resources and the development of the catchment area of its basin are inadmissible.

The issue of preservation of floodplains and floodplain lands, which are, on the one hand, the initial base of natural and cultural fodder production and, on the other hand, the natural biochemical barrier of the river, the so-called filter-purifier, is extremely acute.

Therefore, when designing hydrosystems and reservoirs (selection of the elevation of the water level, reservoir mirror and setting the flooding area), considerable importance is attached to the preservation of floodplain lands, plots and old plough lands.

These issues can be addressed through feasibility studies of HPP site selection, floodplain protection through bunding and special releases of HPPs and hydrosystems. Watercourses can be preserved through rational and environmentally sound development of their catchments, especially in view of the development of new infrastructure on the basis of the hydrosystems being created.

At the design stage of industrial, agricultural, municipal and household enterprises and facilities on reservoir catchments, adjacent areas and tributaries it is necessary to carry out model simulation-optimisation calculations to establish the permissible contribution of these facilities to watercourse pollution and justify their main environmentally acceptable parameters.

Thus, one of the most effective directions of alternative energy development, not focused on burning fossil organic fuels and global environmental pollution, is the construction and operation of hydroelectric power plants using the energy of watercourses.