Ways to solve ecological problems of natural ecosystems amid constantly increasing anthropogenic load

M A Bandurin and I P Bandurina

Kuban State Agrarian University named after IT Trubilin, Kalinina st., 13, Krasnodar, 350044, Russia

E-mail: chepura@mail.ru

Abstract. The article describes the impact of human activities on the environment. In general, arable farming leads to more significant changes in natural biocenoses than cattle breeding. Steppes plowing, deforestation and forest burning aimed to obtain arable land as well as construction of irrigation systems have radically changed the natural landscapes. The article considers the state of natural ecosystems to date. The work emphasizes that the main receiver of pollution is water bodies, mostly small rivers. The need for measures aimed to reduce the degree of environmental pollution, specifically, at minimizing anthropogenic impacts on nature, is noted. The most significant changes in nature occurred with the development of industry. Industrial production has required more and more natural resources in the economic turnover. In connection with their intensive exploitation, the share of lands used for industrial development of minerals, the construction of roads, settlements, and the creation of reservoirs has increased. The exploitation of natural resources being spontaneous and ever-increasing in its pace and scale leads to their rapid depletion and increasing environment pollution. Substantially, man, engaged in agriculture, created new artificial (anthropogenic) systems being agrocenoses, deliberately controlled by the selection of cultivated plants, reclamation, agricultural technology, the use of fertilizers and pesticides, harvesting, etc.

1. Introduction

Contradictions in the relationship between society and nature in the second half of the 20th century. became menacing. A careful analysis of the reasons leading to the ozone screen destruction, acid rain, chemical and radioactive pollution of the environment was required. The life activity of a human being as a biological species affects the natural environment no more than other living organisms. However, this influence is incomparable with the enormous influence that human labor has on nature. According to V.I. Vernadsky, human activity has turned into a powerful force transforming the Earth and comparable to geological processes [1].

The transforming impact of a human on nature is inevitable. It increases with the population growth, scientific and technological progress, the increase in the variety and mass of substances involved in economic circulation [2].

It became clear that the preservation of the exponential growth of the Earth’s population, the rapid anthropogenic transformation of natural natural ecosystems, and further environmental pollution can lead to catastrophic consequences up to the death of human population. The general reasons for the biosphere degradation became understood only in the 20th century and not by everyone.

The life activity of the most ancient people influenced the balance existing in nature no more than
other species of animals as long as the population remained small [3], and the means of production were primitive. The emergence of a productive economy was the most important achievement of the primitive community, the foundation for the further development of mankind, and contributed to the generation of the main branches of agriculture, farming and animal breeding, which have survived to the present day.

With the development of animal breeding, the influence of human activities on nature increased many times. Grazing of large herds on pastures resulted in changes in vegetation and the displacement of wild herbivorous ungulates from their native habitats [4].

If before the beginning of the 20th century the impact of people’s economic activities on nature were of a local and regional nature, then by the middle of the 20th century they had become global. By this time, there were almost no regions on Earth that were not affected by the economic activity [5].

The spontaneous use of natural resources without appropriate measures for their protection and the possibility of restoration, intensive and ever-increasing pollution of the environment lead to irreparable changes in nature, catastrophic phenomena in the biosphere. According to D. Meadows [6], the impact of man on nature has already gone beyond the possibilities of its independent restoration.

In the process of constantly increasing anthropogenic load, water bodies, whose water quality deteriorates every year, are especially susceptible to negative impact. Therefore, the importance of fresh water as a natural raw material is constantly increasing.

2. Materials and methods

The accumulation of pollutants in water bodies exceeds the maximum permissible concentrations and worsens water bodies’ sanitary and epidemiological condition, reduces the water management potential, reduces the possibility of using them for economic and recreational purposes, changes the natural environment, leads to the degradation of aquatic ecosystems, changes in the habitat, and human health status.

Assessing the state of water bodies based on ecosystem analysis, results in the conclusion that at present most of them are ecologically defective, i.e. incapable of fulfilling the main function being maintaining the biological diversity and equilibrium formed as a result of long-term evolution.

Human demand for fresh water is met mainly from surface and underground sources, most of which are small rivers. They are an essential component of the hydrological network. Despite their size, small rivers form medium and large rivers predetermining their hydrological, biological and biochemical regime, performing the functions of landscape regulator, maintaining equilibrium and moisture redistribution. However, their ecological state (especially of the ones in the European part of the country) is assessed as catastrophic as a result of the sharply increased anthropogenic load. Uncontrolled water intake in some regions makes many small rivers dry up and become silted up. Hundreds, and maybe even thousands of small rivers disappear in the country every year [7].

For example, small rivers located in a natural and technogenic landscape (catchment areas of industrial cities and rural settlements, intensive agricultural production) [8] are more susceptible to pollution than rivers in an undisturbed landscape. Industrial and consumer waste generated as a result of nature management enter the terrain, and being in a different aggregate state and possessing varying degrees of danger can cause changes in the components of the natural environment.

All sources of pollutants formed during nature management can be conditionally divided into primary and secondary ones.

Sources of primary pollution make pollutants originating from waste or being the products of direct technological processes enter into surface waters [9].

Sources of secondary pollution are the ones formed as a result of physical, biochemical and other processes in natural environments after ingestion of ingredients from sources of primary pollution (for example, bottom sediments represented by technogenic silts, etc.).

Small rivers being natural and natural-man-made elements of landscape-geochemical systems, in most cases are the final link in the runoff accumulation of the majority of mobile man-made substances.
Most of pollutants get to small rivers from the sources of pollutants diffusion together with products of water erosion caused by surface runoff. Experience shows that pollutants enter water bodies mainly with surface runoff, which makes up more than 50% of their total water supply.

Some of the pollutants enter small rivers with groundwater flow. The total groundwater runoff entering water bodies is about 46% of their total water supply. In urban conditions, groundwater is often polluted by leaks from water supply and sewerage networks, as well as by filtrate water coming from the strata of technogenic rocks of unauthorized and unorganized landfills for industrial and consumer waste disposal.

Pollution of surface waters as a result of the discharge of all types of untreated wastewater often leads to an undesirable change in the physicochemical and biological properties of water in water bodies. Bacterial and radioactive contamination is relevant for water bodies [10].

Bacterial pollution of small rivers occurs mainly due to the discharge of untreated wastewater of various origins including non-disinfected treated wastewater. Pathogenic microbes including typhoid and cholera microbes remain viable in water for quite a long time.

Radioisotopes discharged with wastewater into rivers can accumulate in bottom sediments and various substrates of animal and plant origin posing a threat to aquatic ecosystems. Experience shows that the accumulation of chemical pollutants in small rivers including the accumulation of biogenic elements (nitrogen, phosphorus, silicon, iron, trace elements, etc.) [11] actively provokes eutrophication processes and forms hydrochemical anomalies in them.

A variety of physical, chemical and biochemical processes occur in the natural aquatic environment of rivers. These processes are conventionally divided into the processes that contribute to the water body purification (reducing the concentration of undesirable components), and the ones that pollute or prevent the development of purifying processes (increase the content of harmful components).

Polluting processes include the buildup of organic matter by aquatic plants due to eutrophication, secondary water pollution by contaminated bottom sediments, pollution of channels by dead trees, garbage and other objects.

In some cases, a rather dangerous source of pollution of a water body is a focus of its secondary pollution concentrated in bottom sediments.

Exchange processes between contaminated bottom soils and the aquatic environment are determined by a number of factors, the main of which are as follows: the concentration difference between the pore solution of bottom soils and water in a water body; filtration coefficient of bottom sediments; physical and mechanical properties of bottom sediments; type of solute [12].

Silting of watercourses and reservoirs is also important due to the presence of suspended particles in the aquatic environment and their fallout. As a rule, suspended particles in the water of rivers and reservoirs are represented by channel sediments and suspensions arriving with surface runoff from the catchment area, i.e. having off-channel origin and carrying a certain amount of pollution. The state of the stream and channel is characterized by the exchange of sediment between the surface of the channel and the adjacent layers of the stream, i.e. through the process of erosion and sedimentation. Channel formation is a self-regulating process based on regulating the ratio between the erosion and transporting capabilities of the stream. The transporting capacity of the flow is the limiting concentration of suspended sediments of a given size, which the flow can maintain under constant boundary conditions of the flow.

If the particles precipitation in a water body prevails (the actual flow turbidity is greater than its transporting capacity), the finely dispersed suspension and pollutants adsorbed on it accumulate in the bottom sediments causing deterioration in its sanitary state [13].

Self-purification of water is an indispensable link in the natural water cycle. Pollution of any type [14] during self-cleaning of water bodies [15] ultimately turns out to be concentrated in the form of waste products [16] and dead bodies of microorganisms [17], plants and animals feeding on them, which accumulate in the silt mass at the bottom. Water bodies [18], in which the natural environment can no longer cope with the incoming pollutants, degrade, which is mainly due to changes in the composition of the biota and disturbances in food chains, primarily the microbial population of the
water body. Self-purification processes in such water bodies are minimal or they completely stop. Such changes can be suspended only by purposeful influencing the factors contributing to the reduction of the waste volume and pollution emissions [19].

The task can be solved only by applying a system of organizational measures as well as engineering and reclamation work aimed to restore the natural environment of water bodies. When restoring water bodies, it is advisable to start implementing the system of organizational measures and engineering and reclamation work with the arrangement of the catchment area, and then purify the water body followed by coastal and floodplain areas arrangement [20].

The main objective of the environmental protection measures and engineering and reclamation works in the catchment is to reduce waste generation and prevent unauthorized discharge of pollutants onto the catchment relief. In this regard the following measures are carried out: introduction of the system regulating waste generation rate; organization of environmental control in the production and consumption waste management system; improvement of sanitary cleaning schemes for cities and settlements from production and consumption waste; taking an inventory of objects and places of industrial and consumer waste disposal; reclamation of disturbed lands and their arrangement; toughening fees for unauthorized discharge of pollutants outside the terrain; introduction of low-waste and non-waste technologies and recycling water supply systems.

Conservation activities and works carried out in coastal and floodplain areas include surface leveling, slopes flattening or terracing; erection of hydraulic engineering and recreational structures, banks strengthening and the restoration of a stable grass cover and tree and shrub vegetation, which subsequently prevent erosion processes. Landscaping works aim to restore the natural complex of the water body and transfer most of the surface runoff to the underground horizon for the purpose of cleaning it, using rocks of the coastal zone and floodplain lands as a geochemical barrier.

The banks of many water bodies are littered, and the waters are polluted with chemicals, heavy metals, oil products and floating debris, and some of them are eutrophied and silted. It is impossible to stabilize or activate the self-purification processes in such water bodies without special engineering and reclamation intervention.

The purpose of performing engineering, reclamation and environmental work is to create conditions in water bodies that ensure the effective functioning of various purifying processes in the aquatic environment. This can be achieved by constructing special water purification facilities, and taking measures to eliminate or reduce the negative impact posed by the sources of distribution of pollutants of both off-channel and channel origin. Only a systematic approach to the problem of restoring water bodies can improve the quality of water in them.

3. Conclusion
The anthropogenic impact on the natural environment increases exponentially with the development of mankind and the improvement of its economic activities. The impact of man on nature has already gone beyond the limits of the possibilities of its independent restoration. Small rivers, whose water quality is deteriorating every year, are especially susceptible to negative impact. Due to the uncontrolled water intake and discharge of pollutants, small rivers dry up, get silted up, and degrade. Every year the number of small rivers decreases critically.

It is necessary to immediately take decisive measures to prevent the negative impact of human activity on the nature. For this, it is necessary to carry out a system of organizational measures as well as engineering and reclamation work aimed to restore the natural environment as a whole. And most importantly, every inhabitant on Earth should be aware that neglecting the environment will subsequently lead to an irreversible natural disaster.

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