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Black Sea Region's ecological problems.

By Prof. Ivan Aidarov, PhD & Prof. Aleksey Zavalin, PhD[1]

Abstract

The article provides an analysis of causes behind worsened environment in the Black Sea. The crisis was brought about by pollutants getting into the Sea with river flows, from surrounding territories, also by runoff losses, disturbance of marine water balance and drastic reduction of water exchange through the Bosporus.

First steps towards improvement of the ecological state should be improvement of water and hydro-chemical balances of the Sea and terminal elements of river systems through changed regime of large water reservoirs, enhanced water quality and increased river discharge to the Sea, i.e. through environmental flows. The authors developed and tested a methodology for substantiating ecological river flow volumes designed to improve the ecological state of the flood plain, delta and northern part of the Caspian Sea, the Volga River used as an example. Due to the international importance of inland water transport, ecological river flow shall be arranged at the expense of reduced power generation in hydropower plants. Power shortages could be compensated for by building gas-turbine plants featuring high flexibility, reliability and cost effectiveness. The methodology can be used for substantiation of ecological river flow of large rivers flowing into the Black Sea.

Keywords

Ecological state of Black Sea, ecological river flow, floodplain, economic effect, environmental sustainability.

Introduction

Recently, ecological problems of the Black Sea Region have been the focus of many books, articles, conferences and workshops. The main message of what has been written and said there is that the Sea is being polluted with waste

[1] Prof. Ivan Aidarov and Prof. Aleksey Zavalin are experts on agriculture, hydraulic engineering and land reclamation at the Russian Academy of Sciences.

water, toxic substances and oil products. A cause of concern for ecologists is the state of biological resources of the Sea, with its ecosystem being heavily impacted by human activities.

The ecological situation in the Black Sea which can be described as critical is associated with huge volumes of pollutants entering the marine environment with river flows, ballast water discharged from oil tankers, surface waters running to the Sea from human settlements and farmlands. However, there is one more cause of deteriorated ecological situation in the Black Sea and the Sea of Azov which is equally critical but attracts less attention. It has to do with runoff control of large rivers draining into the Black Sea and the Sea of Azov; the use of water resources in industry and agriculture; irreparable loss of river runoff as a result of evaporation from the surface of numerous water reservoirs; worsened ecological state of terminal elements of river systems (flood plains and river estuaries); and, most importantly, with changed water balance of the Black Sea. Available estimates of Black Sea water exchange through the Bosporus vary widely from minus 476 to minus 176 km3 a year. However, despite wide variations in estimates, one thing is obvious: as time goes by, the water exchange will diminish posing a real threat of waters rich in hydrogen-sulfide upwelling from the sea depths and of further deterioration of the ecological state of the Sea.

Hence, if we are to improve the marine environment, our top priority should be to study water and hydro-chemical balances of the Sea, terminal elements of river systems and the coastal part of the Black Sea. This applies equally to the Black Sea and the Sea of Azov.

Experts' opinion

It is worthy of note here that politicians and economists erroneously, in our view, tend to address economic and ecological problems in isolation from one another. However, the economy and ecology are two sides of one and the same interdisciplinary branch of knowledge. Ecology as a science studies complex interactions among living organisms and organic and non-organic components of the environment, while the economy deals with processes of control of such interactions.

We have quite a long record of studies of issues relating to comprehensive solutions of ecological and socio-economic problems, including in conditions of river runoff control. Therefore, we deem it our duty to share our ideas about ways to improve the ecological state of terminal elements of the Volga river system and Northern part of the Caspian Sea. The Caspian Sea basin is sort of an analogue of the Black Sea one. However, its state has been by far better explored. The Volga River is a backbone of a single deep-water system of the European part of Russia. Through the Sea of Azov, the Black and Caspian Seas it provides for the development of a water-borne transportation system, connecting Europe, Russia and Caspian Sea region's countries. The E 50 Vb

system in question has a total length of 9,339 km and connects the Baltic, White, Caspian Seas and the Sea of Azov. The system includes the Volga-Baltic system being a network of channels, lakes and rivers (1,100 km) that connect the basins of the Caspian and Baltic Seas; 11 multipurpose water reservoirs on the Volga River with the available storage of 77 km3 and the Volga-to-Don Channel, providing an outlet to the Sea of Azov and the Black Sea. In accordance with the international classification, E50 Vb system provides for a passage of vessels of up to 85 x 9,5 m size and vessel depth of over two and a half meters. System's ramified network of inland waterways suggests a wide use of the water-borne transport as the one that compares favorably with the rail and automotive transport insofar as its environmental impact and cost of shipment is concerned.

The program of further development of the system in question incorporates widening of the Lower Svirsk ship locks on the Volga-Baltic part of the waterway, construction of a low-head water power development on the Volga River and widening of the Volga-to-Don Channel System, including construction of one more line of ship locks and water power development in the lower course of the Don River. If done, the required navigation depths (up to four meters) will be ensured all the way down from the Baltic Sea to the Caspian Sea, the Sea of Azov and the Black Sea. The Volga-to-Don Channel should be widened because of its special importance for the system of latitudinal and longitudinal international transport corridors connecting the Baltic, Caspian, Black and Mediterranean Seas.

Functioning of the deep-water system is ensured by the Volga runoff control which involves water accumulation in water reservoirs during spring and summer and use of the stored water during the rest of the year. In view of the above, we deem it necessary to assess the impacts of changed river runoff regime. Construction of water reservoirs led to drastic changes in the regime and volume of liquid, solid and biogenic river runoffs in the site of the Volzhskoye water reservoir, being the last one in the cascade. The volume of spring-and-summer floods dropped from 145 to 99 km3, while the volume of solid and biogenic runoff showed more than two times decline. Furthermore, there were significant changes in temperatures and water quality which resulted in disruptions in terrestrial and water ecosystems of the Volga terminal elements (Volga-Akhtuba flood plain and Delta), increased salinity of the marine waters and rapid deterioration of conditions for fish reproduction and fattening in the northern part of the Caspian Sea. The productivity of natural vegetation in the flood plain has decreased almost 10 times, accompanied by the onset of severe deformation of the flood plain landscape and diminishing of the soil fertility; fish capacity of the flood plain and Delta featured more than 20 times drop. A similar situation is observed in terminal elements of river systems and coastal waters of the Black Sea.

It is worthy of note that all of the above-mentioned natural objects are unique, have international importance and shall be preserved in accordance with the Ramsar Convention. Preservation of terminal elements of river systems is very important not only for the sake of the territories themselves but also for enhancing biodiversity of the flora and fauna of the Black Sea coastal waters.

Thus, creation of water-borne transport routes in downstream sections of regulated rivers calls for a comprehensive solution of at least three difficult and interrelated problems: conservation of unique natural systems, reduction of pollutants inflow into the Sea and providing for navigable water depths. The solution of those problems is complicated by that with multipurpose water reservoirs operating on rivers, it is impossible to meet the needs of all water system's stakeholders to the full extent. Hydroelectric power generation and navigation require maximum control of the river runoff, while agriculture, fishery and natural, including marine, environment require preservation of the natural volume and regime of liquid, solid and biogenic river runoffs, in other words, what is good for one usage of water resources is unacceptable for another.

How can this challenging problem be resolved?

We believe that in the first place it is necessary to assign priorities and set the order of precedence in solution of the problems. The first thing to do should be to take care of the preservation of ecosystems of terminal elements of river systems and reduce the inflow of pollutants from human settlements and farmlands. This can be accomplished by changing the current water reservoir management pattern: lowering the volumes of water accumulated during spring-and-summer floods and increasing water discharge during summer-and-fall (navigation) period, i.e. providing rationale for the volume of required environmental ecological river flow. Such measure would require constraints to be imposed on the needs of some of the water system's stakeholders. The Russian legislation gives precedence to the preservation of public health, natural ecosystems and habitats.

Given the global importance of the water-borne transport, it would therefore be most appropriate to reduce power generation in hydropower plants. To this end, we have come up with a methodology for justifying volumes of environmental flows based on a system of models of changes taking place in the vegetation cover and fish capacity in response to changes in volumes of environmental flow. The methodology was presented at the meeting of the national committee for Sustainable Innovations and Development of Land and Water Resources. The environmental flow volume for the Volga conditions should be 120 km3 in the multiyear plan (varying from year to year in the range of 95 km3 to 163 km3). It can be achieved if power generation in hydropower plants located on the Volga River is reduced by 20%. Power shortages could be compensated for by commissioning additional power

generation capacities in gas-turbine plants that feature high flexibility, reliability and cost effectiveness. The calculations done have shown that environmental flows will guarantee sustainability of land ecosystems and reproduction of fish and ensure navigability.

Going forward, measures should be taken to modernize industrial and agricultural technologies, reduce water resources consumption per unit of product, lower emissions and pollutants discharge to rivers and replace gradually hydropower generation by other types of power generation.

We have prepared this statement for publication by ICBSS, which is capable of raising and resolving challenging international problems. The basins of the Sea of Azov, Caspian and Black Seas are the most important bodies of water and a core of the single deep-water system in the European part of Russia, connecting it with the countries of the Black Sea and Caspian regions. We are convinced that those basins and E 50 Vb system of waterways will play, as we go forward, a crucial role in a wide-ranging development of international outbound and inbound cargo shipments.

Any studies related to stepping up of solution of the problem of improving the state of the above-mentioned water objects should involve funds of the Russian project financing mechanism for BSEC countries and scientists from different countries.

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Building a Sustainable Future for the Black Sea Area

International Centre for Black Sea Studies (ICBSS)
4 Xenophontos Str., 10557 Athens, Greece
Tel: +30 210 324 2321| Fax: +30 210 324 2244
E: icbss@icbss.org | W: www.icbss.org