PROBLEMS OF SAVING THE ARAL SEA

PRESERVATION AND RESTORATION OF THE WATER RESOURCES OF THE ARAL SEA – AN URGENT NATIONAL ECONOMIC PROBLEM

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In the Decree of the Central Committee of the CPSU and the USSR Council of Ministers "Concerning measures on a radical improvement of the ecological and sanitary conditions in the region of the Aral Sea, improvement of the efficiency of the use and intensification of the protection of water and land resources in its basin," it is noted that the putting into operation of large water-management and reclamation facilities and the creation of agroindustrial complexes mainly for the production of cotton, rice, and other crops under conditions of increasing volumes of consumptive use of water for irrigation are being carried out without due consideration of the ecological consequences for the Aral Sea and with a pronounced worsening of the sanitary and epidemiological conditions in this basin.

As a result of the cessation of the runoff of the Syr Darya River and considerable reduction of the runoff of the Amu Darya River, the level of the Aral Sea has dropped by 13 m and is continuing to drop intensely. The water area of the Aral Sea has decreased by one-third, a multitude of islands and shoals has appeared. Intense drying and salinization of the lands in the Amu Darya and Syr Darya deltas is accompanied by a change in the local climate, which in the future will lead to the destruction of the ecosystem of the Aral basin. The catastrophic drop of the Aral Sea level right now is forming a number of social, economic, climatic, and ecological problems. Intensification of deflation processes leading to the transport of salts and the formation of sand—salt storms is causing the greatest disquiet.

The problem is aggravated by the expected global changes in the hydrometeorological regime caused by the mutual superposition of secular trends of moisture and macroscale anthropogenic transformation of the climate. The expected considerable increase of evaporative power and decrease of precipitation on the drainage basins of the Caspian and Azov seas and Lake Balkhash, determined by macrocirculation processes in combination with the regional economic use of the river runoff, will lead by the end of this century and during the first quarter of the next to degradation of water objects and to intensification of the strained situation in the southern part of the Middle region. In particular, we can become witnesses of an unprecedented phenomenon — the disappearance as a result of human activities of the Aral Sea as a geographic object. "Anthropogenic desertification" of a considerable territory of Central Asia and Kazakhstan will lead to unexpected and difficultly predictable consequences. Mesoscale changes in the climatic conditions and, as a consequence, a change in the conditions of the formation of river runoff can be among the most probable consequences. At present a concept should be developed about the expected reaction of the river runoff to the varying climatic conditions in this region.

The genetic basis for such judgments is the ideas of the founders of hydrological science A. I. Voeikov and V. G. Glushkov, whose geographic-hydrological approach has not only not lost its timeliness but is even acquiring fundamental significance under the new conditions. The formation of the new aspect of the interaction of the atmosphere and land waters determines an investigation of the scheme: surface waters (large lakes)—climatic conditions—surface waters (river runoff).

The baric-circulation characteristics of atmospheric processes over the region and the parameters of the heat and water balances of the territory are consistent with the state of large lakes of the region. A change in the albedo of the surface (about 35% for desert territories and within 4-7% for lakes in the latitude interval 40-50°) and roughness parameters can lead to variation of the pressure fields. A high albedo of the surface leads to an increase of reflected short-wave solar radiation, and an increase of the surface temperature involves intensification of the outgoing long-wave radiation, which owing to the insignificant content of water vapor is detained little by the atmosphere. Such a characteristic of the radiation regime, as a rule, leads to the formation of the mechanism of "desiccation" due to the occurrence of descending vertical movements of air masses and, as a consequence, to an increase of the saturation deficit of the air and to a decrease of the precipitation amount.

Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, pp. 11-16, February, 1989.
TABLE I. Ways to Reduce the Consumption of Irrigation Water (data of the Central Asian Irrigation Research Institute)

<table>
<thead>
<tr>
<th>Years</th>
<th>Unit withdrawal (gross) and its component, thousand m³/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual withdrawal</td>
</tr>
<tr>
<td>1976</td>
<td>17.2</td>
</tr>
<tr>
<td>1985</td>
<td>14.5</td>
</tr>
<tr>
<td>2000</td>
<td>11.0</td>
</tr>
</tbody>
</table>

latter characteristics determine the conditions of formation of the river runoff. Depending on the scale of the change in the runoff-forming factors, a decrease of river runoff is possible, and such changes can affect not only small and medium rivers of the region but also the total surface and subsurface runoff of the entire drainage basin. To restore the disturbed ecological equilibrium in regions near the Aral Sea and to preserve the Aral Sea with a diminished water surface as a natural object, an annual delivery with consideration of collecting of 8.7 km³ starting in 1990 to 11 km³ in 1995, 15-17 km³ in 2000, and 20-21 km³ in 2005 is guaranteed. Starting in 1991 new tracts of irrigated lands will cease to be put into operation in the basin of the Aral Sea on the basis of using the water resources of the Amu Darya and Syr Darya basins, and in the 13th Five-Year Plan zonal soil and water conservation systems of conducting agriculture will be introduced. In the future ways to reduce water consumption for irrigation are planned, which are given in Table 1.

In the 1960s the area of the Aral Sea, being a natural thermoregulator, exceeded 66,000 km² and its volume was more than 1000 km³ with an average salinity of 9 g/liter. At present this area has shrunk to 40,000 km² and the volume to 400 km³, and the salinity exceeds 20 g/liter. The continentality of the climate at a distance of 300-400 km from the sea has increased. The temperatures have decreased in the winter and increased in the summer by 1-2°, frosts have become more frequent. The drained bottom on an area of about 30,000 km² is being transformed into a sand–salt desert. The dust storms occurring in this zone transport a considerable amount of salt (up to 50-75 million tons of salt and dust) and reach the fertile lands of the lower reaches of the Amu Darya and Syr Darya, mineralization of the waters in them exceed 2.5-3 g/liter (versus 0.3-0.5 g/liter earlier). The sand barchans that formed on the bottom of the southern part of the Aral Sea are advancing at a rate up to 1 km/h. The Aral Sea has lost its fisheries significance (earlier the annual catch was about 0.5 million centners of valuable fish species). Salt transport is reaching remote regions of our country.

A decline of the water table, decrease of the amount and depreciation of the quality of the groundwaters (not only mineralization but also the discharge of wastewaters from fields with a large content of phosphorus, nitrogen, etc., compounds), deposition of sediments, siltation in the delta, and an increase of the base level of erosion are leading to a decrease of the draining capacity of the Amu Darya and Syr Darya, and to an intense process of anthropogenic desertification of the lower reaches of the rivers on an area of 2 million ha.

In the future the Aral–Amu Darya–Syr Darya water basin will be subjected to general desertification and the fate of Lake Chad in the Sahara Desert awaits it. This strongly saline lake also earlier received two large rivers, which during civilization and withdrawal of water for irrigation were filled by their own sediments and the surface runoff changed into subsurface runoff. The concept of rivers getting lost in rivers (for example, the Tedzhen and Murgab rivers, which are recharged by the Kara-Kum canal) when the entire river runoff is withdrawn for irrigation is characteristic for sand deserts. A large fresh (with low mineralization) underground lake formed at a great depth under Lake Chad and the rivers emptying into it earlier. The same such process is occurring also with the basin of Aral Sea.

It is necessary to accelerate works on reconstruction of the ameliorative systems, requiring overhaul of the irrigation network, improvement of the ameliorative state, and major grading of the lands. In regions of Central Asia it is necessary to limit the increase of irrigated lands, accomplishing it as water is freed due to reconstruction of existing irrigation systems, to examine the problem of changing the structure of agriculture, taking into account the need to introduce crop rotation, and to provide accelerated construction of the main conducting drains and reconstruction of the collecting-drain network in the basins of the Amu Darya and Syr Darya for collecting drain waters and diverting them to the Aral Sea.