THE ARAL SEA DEGRADATION AND BIOLOGY DESCRIPTION OF ACTIONS ON THEIR ELIMINATION

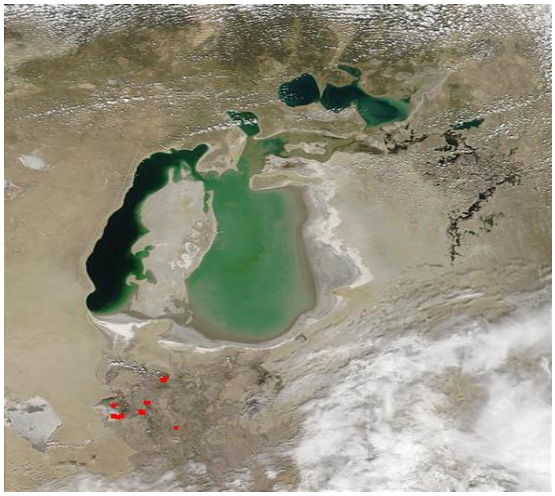
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Abstract*. This article represents the updated version of the texted version on the state of environment of the Republic of Uzbekistan, prepared in 2024. Its purpose is providing of the broad sections of the public and decision-makers with easy for understanding, modern and reliable environmental information about region.*

Keywords*: ecology, Environmental Protection, Pollution, water resources, the population, Aral Sea, desert "Aralkum", The regional flora.*

Introduction

The basic attention in the report is given to the description of the some priority national environmental problems, identified at the development of the National Environmental Action Plan for Sustainable Development of the Republic of Uzbekistan: Deficit of water resources; Degradation of pasture and arable lands; air pollution of urban territories; Environmental pollution in oil fields area; Environmental pollution with industrial and municipal solid waste; Shortage of forests and especially protected territories; Pollution of the water bodies with wastewater. Most of the sands and soils in the Pre-Aral area are light and easily transported by wind [1].



From picture is seen that Aral SEA divided on two parts, on Big Aral and Small Aral

The brief characteristic of the causes of occurrence of problems and description of actions on their elimination is given in this report. The article is based on the official statistical information, materials of the Ministry of Natural Resources and Environmental Protection of the Republic of Uzbekistan [2]. Central Asia (territory is 1.7 mln. sq.km) is situated in the mid-part of Eurasia at the crossroad of ancient caravan routes between Europe and Asia, Middle and Far East and mainly coincides with the geographical borders of the Aral Sea, completely including territories of Tajikistan, Uzbekistan, a large part of Turkmenistan, Kyrgyzstan and the south of Kazakhstan.

As one of the most ancient centers of world civilization, this region has vast territories of arid and semiarid zones with only 5% of densely populated oases. The basin is inner water body of the discharge less Aral Sea which was the fourth largest inland lake in the world before 1960. The dependence of the Central Asian civilization's development of water resources dates back to ancient times. Water and irrigation have always been the basis of life, the development of every living thing, and the main component of nature in the region.

By the beginning of the 20th century, 7-8 million people lived in the region. Irrigated lands made up about 3.5 million hectares and had irrigation networks of different levels. It was the foundation of society's economic base. At present the population of the region has increased 7 times, exceeding more 50 million people (57.4 million people in 2010). Irrigated lands had doubled (7.5-7.9 milllion hectares).



The Map of a Central Asia. Red line is specified zones Priaraliya

Based on geographical and archeological research it was established that the Aral Sea has had periodical changes of its water area, i.e. expansions are followed by with drawals. This was brought about by climate change and changes in the state of the environment in the region. With the development of land use, anthropogenic factors affected the natural periods of sea fluctuations changing flows of the Syrdarya and Amudarya. This is especially explicit in the present. The beginning of irrigated agriculture in the region dates back to the 6th-7th centuries B.C. and coincides with flourishing the most ancient civilization where irrigation was a major decisive factor of historical and socio-economic development. Today the Aral and surrounding territories are world-known for ecological disasters attributed mainly to anthropogenous factors. The growth in water consumption connected to cultivation of new irrigated territories, where mainly cotton and rice are grown, together with the increase in the population working in agriculture, the flow of water to the sea from the two major river systems -the Amudarya and Syrdarya - completely stopped.

🗐 Main reasons of the Aral crisis

☐ before 1960 amount entering on Aral Sea and vaporizing water from Aral Sea a were equal, t.e.57-60 kub.km water entered and as much as were vaporized

☐ In 1960 Soviet union planned to create monopoly a cotton growing in Central Asia and developed agricultural irrigation network

☐ The Result: Aral sea is sentenced to ruins Soviet union main by exporter of the cotton in the world.

☐ Area irrigations lands increased nearly in two with 5 mln.gektars in 1960 on 9,2 mln.gektars in 1980

☞ To this effect fence of water increased from Aral Sea with 40 cubes kilometers on 136 cubes kilometers

In spite of intensive glacier melting which should have led to increase of territory of the Aral Sea, during last 25 years disastrous reduction of the largest inland water body takes place. The Aral Sea is the largest inland body of salty reservoirs in the world. Situated in the centre of the Central Asian deserts at an altitude of 53 metres above the sea level, the Aral Sea functions as a gigantic evaporator. About 60 km^2 of water evaporates per year.

🗐 Concrete reasons of the crisis Aral Sea

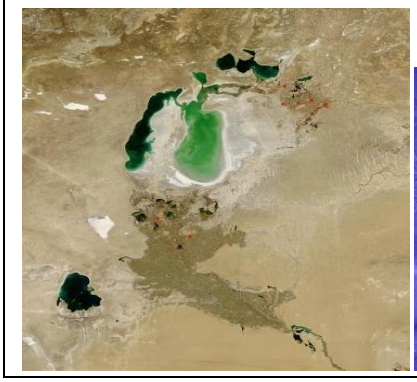
☐ Sowing technical type plants requiring much water (cotton-requires much water)

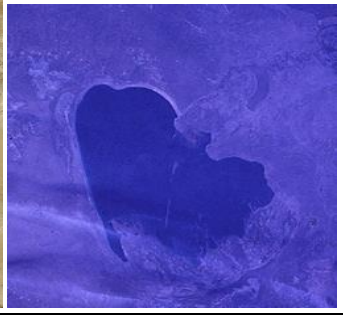
☐ Use the barrel lands, were in some cases used sands and desert zones for these integer

➢ inefficient irrigation systems Creation the most large in world canal of a Karakum

☐ Irrigacioning systems were not saved good-conditioned, more than 50% whole water going for irrigation were lost.

The sea contributed to hydrothermal regime improvement, influenced water regimes of arid plants, pastures productivity, and provided normal functioning of artesian wells etc. Ecological balance in the basin was formed in the first half of the 20th century and was stable up to the beginning of the 1960's, with a volume of 1,064 kmi, and a water territory of 66.4 thousand kmI. Because of irrevocable removal of river water on irrigated territories, ecological balance began to decline. Only half of the previous river runoff reached the Aral Sea. But even this quantity of water was not sufficient to support sea level at 53 m. However, as a result of a tendency of economy development in agrarian areas, leading to growth of irrigated territories and volumes of irrevocable water consumption during years of water shortages, water flow into deltas of the Amudarya and Syrdarya rivers was reduced sharply. In 1982 and 1983 this made up only 2.28 and 3.25 km^3, respectively. Since 1961 the sea level has declined with increasing speed from 20 to 80-90 cm per year.





☐

☐

The lake "Sarikamish" was formed to account of the ascent of underground water and collectoring water of Aral Sea

During the last 50 years, from 1960 to 2010, the sea received less than 2,000 km^3 of river water, which led to the lowering of the sea level by 22 m, accompanied by a reduction of the volume of the water area by 87%.

As a result of the complete stop of the Amudarya and Syrdarya runoff and expansion of irrigated territories without any control of the Aral Sea and environmental needs, a serious complex of ecological, social and economic problems was formed in the Pre-Aral area. These problems by origin and level of consequences have an international character. The sea has lost its fishery and transport importance. It was divided into two parts, the Bolshoi and the Maly (Northern) Aral, and moved 140-190 km away from the original shore. From exposed salty bed (35 thousand kmI) up

to 100 million tons of salty dust flew out annually. Suspended solids in the form of aerosols with agricultural pesticides, fertilizers and other harmful components of industrial and municipal wastes prevail in the composition of the winds.

- Overweening use pesticide
- The Barrel floor forced to enter the enormous amount a pesticide (the pesticides, herbicide). In 1987 in Uzbekistan at the average on 1 gectar land was incorporated more than 350 kg pesticide.
- Pesticides: the largest factor on whole world, in 35 times greater than on average factor in USSR

Due to the reduction in the sea dimensions, and the increase in evaporation and drainage-collecting water, water salinity considerably increased from 9.94 g/litre in 1965, to about 22 g/litre in 2010.

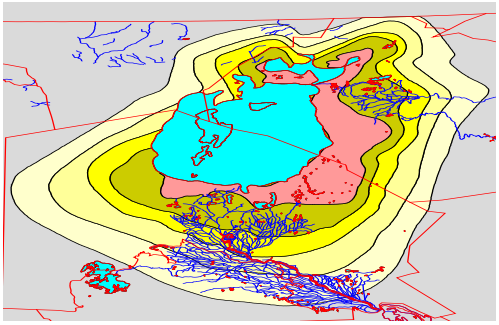
Sharp continental climate is a feature of the Pre-Aral area climate.

During the last 10-15 years the drying off of the Aral Sea, brought about noticeable changes in climate conditions. In the past the Aral was considered a regulator mitigating cold winds from Siberia and reducing the summer heat. Climate changes have led to a dryer and shorter summer in the region, and longer and colder winters. The vegetative season has been reduced to 170 days. The pasture productivity has decreased by a half, and meadow vegetation destruction has decreased meadow productivity 10 times. On the shores of the Aral Sea precipitation was reduced several times. Average precipitation magnitude is 150-200 mm with considerable seasonal ununiformity.

High evaporation (up to 1700 mm per year) is marked while air moisture is reduced by 10%. Air temperature during winters has fallen, and summer temperatures have increased by 4-6 degrees C, including observations of 54 degrees C. Frequent occurrence of long dust storms and ground winds is characteristic feature of the Pre-Aral area climate. Strong winds often blow in the region. They are the most intensive on the western coast - with perhaps more than 50 days of storms per year. Maximum wind velocity reaches 23-28 m/s. These climatic conditions defined that agriculture without irrigation is impossible. The result is intensive accumulation of salt in the soil leading to water use for watering plants and washing off lands.

Most of the sands and soils in the Pre-Aral area are light and easily transported by wind.

The drying off of the Aral Sea resulted in two different kinds of desertification. The newly dried sea bed, and the artificial water logging of irrigated lands. As a result, a new desert "Aralkum" appeared in the centre of the great deserts. It is solid salt-marsh consisting of finely-dispersed sea depositions and remnants of mineral deposits, washed away from irrigated fields.



Centre of broadcast sand and salts

Place of to settle sand and salts > 80 т/км^2

A new qualitative phase of desertification affecting the Pre-Aral ecosystem degradation, regional and global climate, mountainous flow-forming systems and water-salty regime of agricultural zone takes place.



Picture on the left: ground covering salt to broadcast with wind. Drawing on the right: bottom, coated by salts

The sea bed, formerly referred to as a so-called "fresh water maker" of vast water collecting basin at the expense of rich sea hydrobiocenose activity, is an artificial anthropogenous volcano, throwing tremendous masses of salt and finely-dispersed dust into the atmosphere. Pollution is increased because the Aral Sea is located along a powerful air stream running from west to east. It contributes to aerosol transference into upper layers and fast spread in the atmosphere of the Earth. That is why traces of pesticides from the Aral region were found in the blood of penguins in the Antarctic, and typical Aral dust has been found on Greenland's glaciers, in Norway's forests, and Byelorussia's fields, all situated thousands of kilometers away from Central Asia. One of the dangerous consequences of the drying off of the Aral Sea, is the increasing degradation of mountainous glaciers of the Himalaias, Pamir, Tiyan-Shan, and Altay, feeding the Syrdarya and Amudarya.



From picture made from artificial satellite is seen greater fields covered by salt (specified by red ellipse).Call attention red arrow is specified new forming field to salts beside seashore The increase of dust on glacier surfaces and mineralization of precipitation on them lead to intensive melting of glaciers. At present, 1081 glaciers have disappeared in the Pamir-Altay area , 71 glaciers in the Zaili Alatau area, and the volume of glaciers in Akshirak has been sharply reduced.



From picture made from artificial satellite possible to notice what speed away wind in distant distances mixture dust of sand and salts

On average, valley glaciers in the Tiyan-Shan area retreat 7.5-13.1 m per year and grow thicker at the same time. This is a dangerous process for a dry region, because in Central Asia, mountainous glaciers are the only ancient remaining storage of fresh water supply and are the main atmospheric moisture condensators of the region. If the cover of moraine depositions increases, they no longer will be moisture condensators and sharp reduction of the river flow will start. The Aral disaster has deteriorated the sphere of inhabitation of the region sharply, due to polluting of the atmosphere, the drinking water and the soil.

An evaluation of the field with drawl from the dry parts of the Aral Sea bed shows that this magnitude varies from several hundred thousand tons to 20-30 million tons per year. In the composition of dust cloud suspended solids in the form of aerosols with agricultural pesticides, fertilizers and other harmful components of industrial and municipal sewage prevail. Salt content makes up 0.5-1.5%. Sand-and-salt aerosol effects on oasis soils and pastures are predominantly negative. Replacing multilayer herbage by single-layer, reduces the quantity of useful feeding plants, and often plants that have no feeding value are cultivated. Two million hectares of fertile lands disappeared as a result of overwatering and as a result of fast rise of ground water they got polluted for the second time.



Influence upon health of the population

Today these lands are either water logged or salinized. Former arid soils of the Pre-Aral area with automorphic feed and moisture regime became meadow-swamp soils with hydromorphic regime. To support this regime artificially it is necessary to raise standards by 2-3 times, in order not to activate the secondary salinization process. A vicious circle of agriculture was formed in this region, where heavy swamped lands are left. The land-improvement condition of irrigated

soils in Central Asia is worsened by collective-drainage water saturated with pesticides and discharged as return runoff into numerous local landscape depressions. As a result, artificial reservoirs-accumulators appear. These reservoirs are a real disaster for surrounding lands. Some of them cause secondary pollution when poisonous bed depositions become dry and are brought on irrigated lands, ruin them and pollute the atmosphere in the surrounding regions.

The most spread pollutants in the Aral Sea are: oil hydrocarbons, phenols, synthetic surface-active substances (SSAS), chlororganic pesticides (COP), heavy metals and minerals. The abundant use of pesticides with high physiological reaction (B-58, metaphos, corotan, butiphos, hexachloran, lindan, DDT etc.) poses a tremendous threat to living organisms. Reservoirs carrying water with undecided compounds of heavy metals and chlororganic pesticides, led to the destruction of fishery, the appearance of cancerogenic diseases, and changes in citogenetic indices. The maximum pollution level by oil hydrocarbons in 1970 was 54 MPC (maximum permissible concentration) in the Maly Aral (MPC=0.05 mg/dmi), and 80 MPC in the Bolshoi Aral. Since 1978 the tendency to oil hydrocarbons pollution stabilization at the level of MPC is marked. Phenols made up 28 MPC (MPC=0.001 mg/dmi)in the Maly Aral, and 63 MPC in the Bolshoi Aral. At present there is no information about phenol pollution because observations have been stopped. Concentrations of SSAS and heavy metals do not exceed MPC.

Salinization increased from 10 g/l to 40-50 g/l because of lack of fresh water inflow.

In the past the uniqueness of the Aral Sea contributed to richness and diversity of the biota which could be compared with Africa. The Pre-Aral area possessed half of the biological species of the former USSR, many of these, however, have disappeared or are threatened. There were 500 kinds of birds, 200 species of mammals and 100 species of fishes, thousands of insects and invertebrates.

Before 1960 the river deltas were home to over 70 kinds of mammals and 319 types of birds. At present only 32 kinds of mammals and 160 types of birds remain. In low streams of the Syrdarya River, more than 100 thousand hectares of alluvial soils became salt-marsh, and more than 500 thousand hectares of swamp and medow-swamp soil became dry. This resulted in the transformation and destruction 5-7 kinds of herbs needed for fodder for sheep, horses, camels and goats. Diseases and death of cattle began, musk-rats cultivation stopped, and sheep live-stock decreased sharply.

The regional flora is impressive and includes 1,200 flowers, 560 types of tugai forests of which 29 are endemic to Central Asia. The flora of the Aral-Sea coast includes 423 kinds of plants of 44 families and 180 genera. The highest diversity of sand vegetation is concentrated on the former islands of the western coast. The dry strip of the Aral is characterized by lower diversity in comparison with the coast. Among them are 30 species which are valuable fodder plants, 31 kinds of weeds, and more than 60 kinds of local flora are potential phytomeliorants for dried coasts. The change in water balance caused mineralization of the water in the Aral Sea basin, which led to the loss of unique biocenosis and a number of endemic species of animals. Inflow reduction into the Aral caused irreversible changes of hydrological and hydrochemical sea regimes and hydro systems. Salt balance changes increased the sea salinity 3 times, transforming it into a desert.

The formerly flourishing sea ecosystem supported 24 species of fishes that are disappearing. These include carp, perch, sturgeon, salmon, sheat-fish and spike. There were 20 kinds of fish in it, but fishery was based mainly on bream, sazan, aral roach (vobla). Barbel and white-eye fish were caught in the Aral Sea. The first signs of the negative impacts of salinization on ichtyofauna of the Aral Sea, appeared in the mid 1960's when salinity reached 12-14%. On

shallow water the salinity of water increased faster than in the open parts of the sea, negatively affecting spawning places. By 1971 the average salinity exceeded 15% and resulted in the destruction of fish spawn. Since 1971 the average salinity has reached 12% in the open part of sea, and the first signs of negative impact on fish have appeared. Some kinds of fish have slowed their growth, and the number of fish has been sharply reduced. By the mid 1970's average salinity of the sea exceeded 14%, and the natural reproduction of the Aral fish was completely destructed. In the late 1970s several species of fish did not reproduce at all. By 1980 salinity exceeded 18%.

The ecosystems of delta valleys have been transformed greatly by agricultural land use for many centuries. Irrigated or cultivated fields, rice fields and non-cultivated agricultural lands which are characterized by different stages of soil and vegetation cover rehabilitation, are singled out. The following anthropogenic factors that brought about changes in the ecosystems should be considered according to their significance: pastures, land-use, agriculture, transport, city, rural, military objects, hydrotechnical (artificial reservoirs, dams, canals, sewage accumulators), and cattle-breeding.

The process of degradation in the Aral region caused progressive crises in the social and economic spheres. The primary victims of the crises were the most vulnerable layers of population, namely children, women, ill-paid inhabitants of cities and rural areas. The region has the highest child mortality rate in the former USSR (10-12 children per 100 newly born), high level of maternity death: about 110 women per 1000 births. Diseases such as TB, infections and parasites, typhus, hepatite, paratyphoid always accompany poverty.

The disease rate has a tendency to increase. In the epicenter of ecological disaster, anemia, dysfunction of thyroid the gland, kidney and liver diseases are wide spread. Blood, oncological diseases, asthma and heart diseases are progressing. Medical research proves that the incidence and growth of these diseases are directly dependent on ecological disaster.

In agriculture, there is a steady tendency to transition to ecological management of production. One of the main principles of the above-mentioned tendency is maintenance of positive humus balance in soil at the expense of introduction of alternation of crops and application of organic fertilisers. For the decision of the set forth above problems of economy of our republic on department «Ecology and ground science» Tashkent university building and sivil engineering, the center of science on maintenance of ecological and industrial safety of the Central Asian global environmental problems and industrial enterprises of all branches of our republic is created. The center of science renders the necessary competent and practical help at the decision of various problems both natural, and ethnogeny character, and also develops necessary recommendations under their decision.

Conclusion

We believe that researchers not only be connected with researchers of Uzbekistan, but our academic collaboration will form the foundation of one of the most important scientific projects to solve the environmental problems that threaten a lot of population in whole Central Asia and even the whole globe.

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