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MATERİALLARI

MÜNDƏRİCAT-СОДЕРЖАНИЕ-CONTENTS

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Water resources and methods for their efficient use

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Key words: life, water resources, ocean, glacier, lake, mineral, water storehouse

Though there is a lot of information about water, it continues to surprise people with its newly discovered features. Therefore, the conception of"water is life" has not great meaning for majority of people. Water does not keep such disregard unpunished and in recent years, an increasing number of water-related disasters is visual evidence for it.

What we know about water? Surprisingly, water is the least studied substance of the nature. This was caused by an excess of water. Water is everywhere, under our feet, above our head, in the air covered us and in ourselves.

Water is 65-96% of the weight of human organism depending on age. 86% of lungs, 83% of kidney weight, 83-90% of blood, 22-40% of bones, 0,3% of dental treatment, 20% of fat tissue, 95-99% of biological fluids of organism consists of water. Professor V.I.Vernadskiy called human organism"realm of natural waters". The quantity of water passed from human organism is more than quantity of water in the world oceans during a few hundred years.

Old Greek philosopher Fales Miletski said that,"We went out of water Band shall return to water". It is not in vain that, biochemical composition of ocean water is very close to the biochemical composition of animal and human blood. It is possible to see it from numbers specified in the following table.

Table 1.

Elements	In human blood	In ocean water
Chlore	49,3	55,0
Sodium	30,0	30,6
Oxygen	9,9	5,6
Calium	1,8	1,1
Calcium	0,8	1,2

Water is the existence of the life base of its development. Though water resources of the space remained without change in the last 5 thousand years, when civilization was developed, the number of people lived here increased with hundred times and technogeneous demand to water increased incisively. Fortunately, these reserves are constantly renewed. But, renewal rate of resources get ahead of resources of humanity.

Water balance of our planet

Water surface of the earth (oceans, seas, rivers, lakes) is called hydrosphere and is 70,8% of its surface. According to the materials [1] of the 3rd International Water Forum held in Kioto on March, 2003, total volume of hydrosphere is 1400 million km^3. 97,5% of this volume is sea and oceans, their water is very salty, for this reason they are unfit for drinkable water supply. For example, mineral condition of ocean waters changes 33,0-37,4 gr/l averagely, 7,2 gr/l in Baltic Sea, 26,0-30,0 gr/l in White Sea, 12,7in the north of the Caspian Sea, 13,0 gr/l in its south, 18-22 gr/l in Black Sea, etc.[2].

About 2,5% of hydrosphere may be used as source for drinkable water supply.

- about 69% of this number collected in Antarctic and Greenland ad snow and ice;
- about 30% under the space;
- only 0,12%-0,45% collected in surface river and lakes[3].

Total annual flow of freshwater rivers in the world is equal to 37,3 thousand km^3. Besides, subsoil freshwater, which volume is equal to 13 thousand km^3, may be used.

Water of rivers is the most rapidly renewable surface water sources. Process ends during 10-14 days. We can come to this conclusion that, the most practical thing for humanity in terms of water supply is fresh water of rivers.

Water supply of various regions of our planet is not in the same condition. It is clearly seen in the numbers specified in table 2.

Totally 10 countries of the space hold to the majority of 60% of freshwater resources of the world. China includes in their ranks. One of each 5 residents of the planet lives in this country. 90% of rivers of this country became dirty, for this reason fresh water shortage manifests itself. Brazil is the country with the world's most abundant water. Freshwater supply of this country is 9950 km^3/year. Annual fershwater supply of Russia is 4500 km^3. USA (3051 km^3), Canada (2902 km^3), Indonesia (2838 km^3), China (2830 km^3), Columbia (2132 km^3), Peru (1913km^3), India (1880 km^3), Conqo (1283 km^3), Venezuela (1233 km^3), Bangladesh (1211 km^3), Birma (1046 km^3) takes the next places.

Table 2. Water volume in different parts of space hydrosphere and its renewal actiivty

Part of hydrosphere	Water volume, thousand km^3	Share with% from all water volume	Share with% from all freshwater volume	Period of renewal
World ocean	1338000	96,5	-	2500 il
Subsoil waters	23700	1,72	30,9	1400-10000 il
Glaciers	26064	1,74	68,7	9700 il
Lakes	176	0,013	0,26	17 il
Land humidity	16,5	0,001	0,05	1 il
Atmospheric waters	12,9	0,001	0,037	8 gün
Bogs	11,5	0,0008	0,033	5 il
Wster storehouses	6,0	0,0004	0,016	6 ay
Rivers	2,0	0,0002	0,006	16 gün

French Guiana is at the first place **for quantity of water per capita per year in a population**-609091m^3. Iceland (539638m^3), Gayane (315858m^3), Suriname (236893m^3), Congo (230125m^3), Papua New Guinea (121788m^3), Gabon (113260m^3), Bhutan (113157m^3), Canada (87255m^3), Norway (80134m^3), New Zealand (77305m^3), Peru (66338m^3), Bolivia (64215m^3), Liberia (61165m^3), Chile (54868m^3), Paraguay (53863 m^3), Laos (53747m^3), Columbia (47365m^3),Venesuela (43846m^3), Panama (43502m^3), Brazil (42866m^3), Uruguay (41505m^3), Nicaragua (34710m^3), Fiji (33827m^3), Russia (31833m^3) takes other places.

Kuwait-6,85m^3 is at the first place **for the least water quantity per capita per year in a population**, United Arab Emirates (33,44m^3), Qatar (45,28m^3), The Bahamas (59,17m^3), Oman (91,63m^3), Saudi Arabia (95,23m^3), Libya (95,32m^3) takes the next places. Totally 24646m^3 water falls per capita per year in a population of the space.

A share of transboundary flow takes great part in river flows of the world countries. There are few countries having abundant water resources that, they have river basins undivided with territorial boundaries. For example, Kuwait 100%, Egypt 96,9% Mauritania 96,5%, Hungary 94,2%, Bangladesh 94,2%, Nigeria 89,6% depends on neighbour states about it.

This situation is as follows in the former Soviet Union: Turkmenistan-97,1%, Moldova-91,4%, Uzbekistan-77,4%, Azerbaijan-76,6%, Ukraine-62%, Latvia-2,8%, Belarus-35,9%, Lithuania-37,5%, Kazakhstan-31,2%, Tajikistan-16,7%, Armenia-11,7%, Georgia-8,2%, Russia-4.3%, Estonia-0,8%, Kyrgyzstan-0% [4].

Geographical distribution of water supply in our planet is as follows:

Asia: 55% of all water;

North America: 19%;

Europe: 9,2%;

Africa: 4,7%;

South America: 3,3%;

The rest of the world: 8,8%.

Water supple **on separate areas:**

Agriculture: 70% (however, 800 million people suffer from hunger);

Industry: 22%;

Housekeeping: 8%.

A person's daily water demand:

In North America and Japan: 600 l;

In Europe: 250-350 l;

In around counties of Sahara: 10-20 l

Water and sanitary condition

At the presen time, 1,4 billion people deprive of safe drinkable water; 2,4 billion people deprive of safe sanitray condition, their:

2% live in Europe;

13% in Africa;

80% in Asia;

5% in Latin America and in Caribbean.

250 million people in 26 counties suffer from water shortage.

Every year 2.2 million people die of lack of water in the world. Every day 6000 children die of diseases related to water shortage and lack of normal sanitary condition. Every year 250 million people suffer from these diseases.

40% of the population of our planet live in the regions having water stress in high level and their number will be 5,5 billion people till 2025.

Water supply was 6 times more during last 100 years and increase of population was 2 times.

Water reserves of the Republic of Azerbaijan

Azerbaijan Republic locates in arid zone, its water reserves are very limited. Surface water resources are 32,2 billion m^3 and they decrease till 22,6 billion m^3 in dry years. Subsoil water resources are 5,2 billion m^3. 70% of surface water resources is formed in abroad of country boundaries.

There are 8350 rivers included in the basin of Caspian Sea in Azerbaijan, the length of the majority of them (7860) is lesser than 10 km [5]. The main water artery od the South Caucasus, also od Azerbaijan is Kur river. Araz is the second river of the republic for its bigness and mellowness. Internal rivers of the republic are distributed unequally on separate regions and the main part of their flow falls on spring. The flow of the most of rivers is regulated, for this reason, it is impossible to use efficiently of violent and stream waters and these waters flow to the sea. Water of the most of little rivers dries in warmer months of a year.

Every year streams and floods cause serious damage to the national economy. Hundreds of residential houses, thousand hectares of sowing areas, railways and automobile roads, electric lines, gas pipelines, channels and collectors, hydrotechnical plants, other engineering communications undergo to their harmful influence.

At the present time, average annual water shortage in the republic is 3,7 km^3, it is 4,75 km^3 in low watery years. If we consider compulsory water leaks from rivers for ecological, power engineering and other purposes, the number of water shortage will possess to unimagined price.

In general, 10-13 km^3 water is used in the republic during a year, its 60-70% is used for agriculture, 20-25% is used for industry, other parts for economy and drinkable water.

Water storehouses having 640 mln.m^3 water capacity remain in 20% territories of Azerbaijan occupied by aggressor Armenia, for this reason, impossibility of their water for a long time creates tension in the republic in the field of water deficiency.

Water shirtage, pollution of the waters of transboundary rivers in the territory of the Republic of Georgia and Armenia and their quality worsening is the main factor increased social and ecological tension in the country.

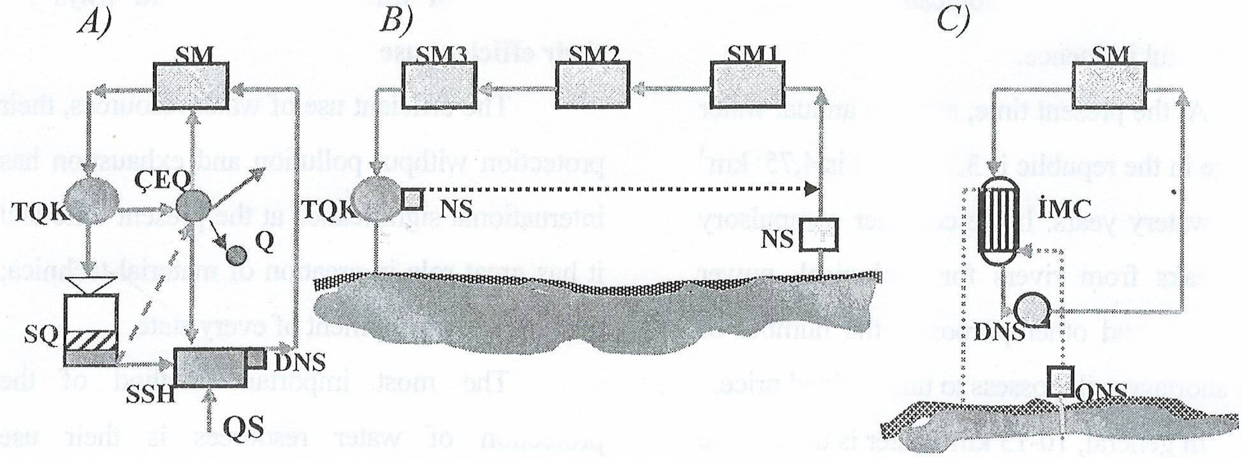
It is many years that, Kur, Araz, Okhchuchay and other transboundary river, which flow from territory of these states, flow to the territory of Azerbaijan in high polluted condition. Even Okhchuchay, which flow from Armenia, is polluted critically, for this reason it is called dead river.

Protection of water resources and ways for their efficient use

The efficient use of water resources, their protection withput pollution and exhaustion has international significance at the present time and it has great role in creation of material-technica; base of the development of every state.

The most important method of the protection of water resources is their use economically. It was noted above that, 70% of total water consumption falls to the share of irrigation. 25% of water losses with filtration and exhalation during irrigation. Hydroisolation of the bottom and walls of channels may be great help about it. 5-6 times less water is used for irrigation during use of water sprinklers. Other method for use of water economically in irrigation is drip irrigation. It gives an opportunity to prevent from water lose with exhalation and exact regulation of the quantity of water to be provided for plants.

The most reliable way to use water resources economically and to protect natural water resources without pollution with production wastes is creation of the closed water supply in industrial enterprises (picture.*A*), as well as two-sided re-usable water supply systems (picture.*B*) (picture.*C*), water use regime without waste and waterless technologies.



In picture: IE-industrial enterprise; CPC-cleaning plants complex; PS-pump station; CD-cooling device CWR-chilled water reservoir; RPS-rotary pump station; NPS- nutrient pump station; NW-nutrient water; SPF- sediment processing facility; W-well to bury unnecessary rests.

Creation of simple and reliable technical solving to use cleaned waste waters in production, creation of systematic washing houses regulated and collected water used in mechanization and motor transport bases and prohibition of washing of cars in open water reservoirs and near them has great role in this field.

Here, water supply of residential houses and industrial enterprises and preparing of high specialized engineer personnels in projecting, construction and exploitation of systems extracted waste waters takes significant place. This issue has actual importance in the period, when wide range construction works are conducted in this field in our republic. In general, there is great necessity in our country to engineer-technologists on cleaning of nature and waste waters.

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Водные ресурсы и пути их рационального использования

Ключевые слова: жизнь, водные ресурсы, океан, мерзлота, озеро, минеральность, водоемы.

РЕЗЮМЕ

В статье приводится анализ распределения водных ресурсов земли и в том числе Азербайджанской Республики, а также возможные пути их рационального использования.

Su ehtiyatları və onlardan səmərəli istifadə yolları

Açar sözlər: həyat, su resursları, okean, buzlaq, göl, minerallıq, su anbarları

XÜLASƏ

Məqalədə su ehtiyatlarının yer kürəsində, o cümlədən Azərbaycan Respublikasında paylanması, həmçinin onlardan səmərəli istifadə yolları təhlil edilir.

UDK: 574.5; 572.1/4

Environmental problems of the Kura-Araz plain

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Water resources of Azerbaijan amount to about $39km^3$. About $29.3km^3$ of these are surface waters and $8.8km^3$ are groundwater. Only 25-30% of the country's surface water resources originate from within its borders. The per capita share of water resources is about $1000m^3$ per year, which places Azerbaijan among countries with the lowest available water resources [1].

Azerbaijan is disproportionately dependent on polluted transboundary rivers (Aras, Kura, and Samur) for its domestic needs. The eastern part of the Kura-Aras plain is an extensively irrigated water deficit area. The disruption of irrigation system maintenance has worsened the build-up of salinity that now affects more than one third of all irrigated lands. Agriculture continues to be the main user of water but continues to use it inefficiently.

A number of rivers contain chemical compounds, which concentrations exceed the maximum permissible concentration (MPC). The basins of the two main rivers of Azerbaijan, the Kura and the Araz, also occupy large parts of Georgia, Armenia, and Turkey.

The Kura River is one of the largest transboundary rivers in the South Caucasus region. The river originates in the Kizil-Giadik mountain range of north-eastern Turkey, crosses the territory of Georgia and enters Azerbaijan. Finally, the Kura River discharges into the Caspian Sea.

Contamination from the large Georgian cities of Tbilisi and Rustavi means that when the Kura crosses Azerbaijan's borders it is already contaminated (including a 5 day biological oxygen demand (BOD) of–3.7mg/l, 0.15mg/l of oil products and 0.03mg/l of phenol). Passing through Azerbaijan the Kura becomes enriched with agricultural contaminants. In some places, the BOD increases to 4.1 mg/l, oil products to 0.24-0.30mg/l and phenols to 0.04-0.08mg/l [2-4].

The Kura River's poor quality is due to the wastewater discharges from industrial and municipal sources as well as agricultural and urban runoffs. Approximately $3.0x109m^3$ of wastewater is discharged by Georgia into the Kura River annually. According to published works[5-6], average annual concentration of phenols exceeded 13 to 17 times the MPC in the Kura River near the village of Shikhili in Azerbaijan, at the vicinity of the Georgian border between 1992 and 1994 years. In addition, according to their report the discharge of untreated wastewater into the river on the territory of Georgia, increases demand on Biological Oxygen consumption and therefore, BOD in inflow waters exceeds the standards by 2-3 times. Millions of tons of untreated sewage and industrial waste regularly push the level of water pollution from 10 to 100 times the international standards in the Kura River and its main tributary Araz.

The second main river of Azerbaijan, the Araz, contains hazardous contamination due to input from two of its tributaries, the Razdan and Okhchu in Armenia. Copper content in Araz river is 25-50 times over the MPC and phenol 6-15 times greater because the Okhchu and Bergushad (Voratan) rivers bring industrial runoff from the copper-molybdenum plants of Dashtakert and Kafan cities of Armenia. According to the information of the Ministry of Ecology and Natural Resources of Azerbaijan [7], as a result of the accident happened in Armenian"Akhtala" mining plant in 2007, a huge amount of hazardous waste were carried through Khrami river into Kura and Araz rivers. As result of a monitoring performed by the Ministry of Ecology and Natural Resources it was established that the concentration of phenols in Khrami and Kura rivers were 8 and 6 times higher than the MPC, respectively. The concentration of oil and oil products in both rivers exceeded the MPC by 1,2 times. Waters collected from monitoring site were highly mineralized. In several samples, the concentration of copper exceeded the MPC from 3 to 6 times.

As for the Araz River, the monitoring results have revealed that copper contamination was observed at all monitoring stations within one year.

DDT and its derivatives were found in sediment particulates of Kura River water samples; however the authors further explain that"these were expected results because DDT was one of the intensive used pesticides in region during more than 50 years". Concern arises in the literature over pollution of the Kura River with chlorine- organic pesticides and other organic chemicals, which are classified as Persistent Organic Pollutants. Persistent Organic Pollutants or „POPs are synthetic organic chemicals and were widely used after World War II in industries and crop production, as well as for pest and disease control. POPs include organochlorine pesticides such as DDT, aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene and other types of chemicals like polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzo-p-furans (PCDF), which are often referred as dioxins and furans, and polychlorinated biphenyls (PCBs) [8-10].

POPs are distinguished by their bioaccumulation and bioconcentration ability. Because of these abilities, they may persist in the environment for decades and increase in concentrations up to 70 thousand times. POPs are regulated by the Stockholm Convention because of their adverse effect on human health and the environment. It is believed that POPs are still used in South Caucasus region. Therefore, it is suspected that concentrations of these chemicals might be elevated in the Kura River basin [11].

There are a number of sites along the Kura River basin in Georgia, which cause potential danger for POPs pollution (see Table below) [12].

Table. Cities/districts within the Kura River Basin with known POPs

POPs	Location
Pesticide Storage Sites (DDT, DDE, Heptachlor)	Khashuri, Kareli, Gori
Pesticide Burial Sites	Near Rustavi, Marneuli district
PCBs and Dioxins	Tbilisi, Rustavi

The UNECE assessment report provides information regarding other pollutants of the Kura River, which include copper, zinc and cadmium from mining sites and the leather industry. In addition, the Kura River is also contaminated by ammonia and nitrate that come from fertilizer use. The same assessment report identifies industry as a primary source of pollution, discharging pollutants like sulphate, chloride, different forms of nitrogen and suspended solids into the river and its tributaries. According to the report [13], industrial discharges in 2004 on the territory of Georgia based on production estimations accounted for: "9.945x106kg surface active synthetic substances, 2x103kg sulphate, 72x103kg chloride, 46.839x106kg ammonium-nitrogen, 23x103kg nitrate-nitrogen, 159x103kg iron, 37.005x103kg total inorganic nitrogen, 600x103kg BOD and 4,958x103kg suspended solids".

Some authors [14] distinguish two types of radioactive pollutants that may affect the quality of the Kura River. These radioactive pollutants include naturally and technically produced radionuclides. Since some of the radionuclides are found in the earth's crust they might be washed naturally into the ground and surface waters. In contrast, some radionuclides may enter into the water bodies from anthropogenic sources such as nuclear weapons tests, nuclear reactors and nuclear waste disposal sites. The authors identify K-40 (naturally occurring radioactive isotope of potassium), U-238 and U-235 (uranium isotopes), Th-132 (thorium isotope) as well as Ra-226 (radium isotope) and Rn -222 (radon isotope) as naturally occurring radionuclides. Other radionuclides have anthropogenic sources and include St-90 (strontium isotope) and Cs-134 and Cs-137 (cesium isotopes).

The chemical water quality parameters monitored by the NATO Science Program, Science for Peace, South Caucasus River Monitoring Program through 2003-2007 included twenty one chemicals. These are heavy metals such as copper (Cu), molybdenum (Mo), lead (Pb), zinc (Zn), mercury (Hg), cobalt (Co), chromium (Cr), nickel (Ni), manganese (Mn), cadmium (Cd), and arsenic (As), as well as inorganic ions such as sodium (Na+), potassium (K+), magnesium (Mg^{2}+), calcium (Ca^{2+}), sulphate $(SO_4)^{2-}$, chloride (Cl^-), hydrocarbonate $(HCO_3)^{2-}$, carbonate $(CO_3)^{2-}$ and other inorganics such as Total Nitrogen (Total N) and Total Phosphorous (Total P) [15].

Very elevated concentrations of cadmium were observed in r. Kura at Rustavi station (see Figure below) [12].

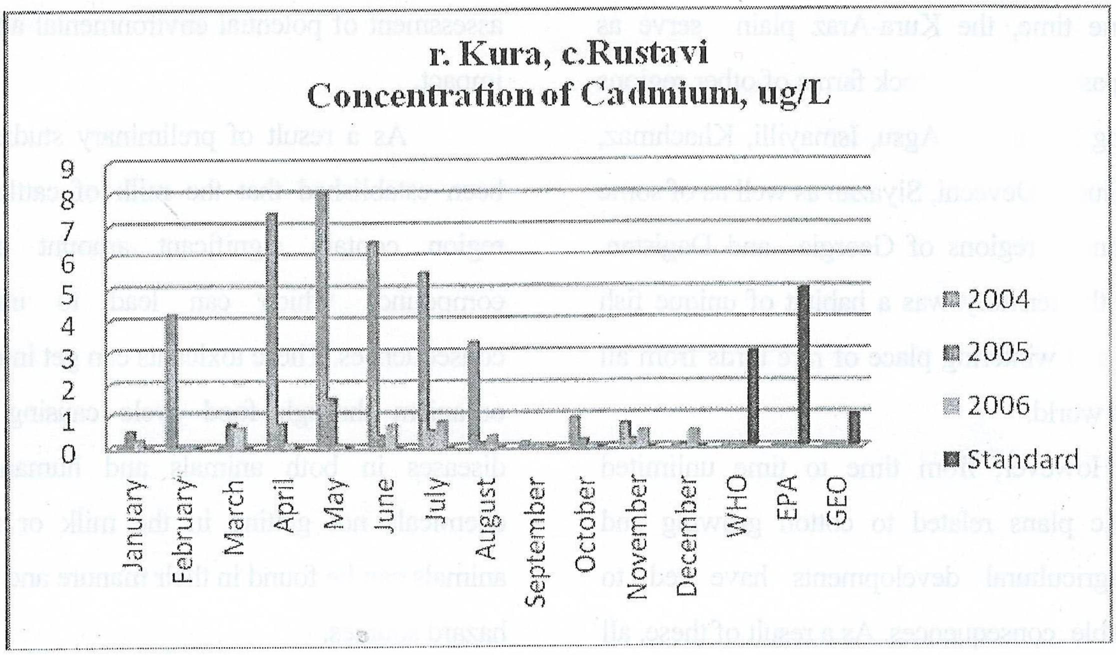

Figure. Cadmium concentration at r. Kura, Rustavi station

The cadmium data analysis results show that the concentrations of cadmium were significantly elevated in all study stations in 2004 and in many cases even exceeded the Surface Water Quality Standards for Drinking/Household and Recreation (0.001mg/L) and fisheries (0.005mg/L) and WHO Guidelines for Drinking-water Quality [16].

Analysis of the literature data shows that the current list of chemical parameters monitored in the Kura River is not sufficient to assess the real environmental situation in the Kura-Araz plain. The data derived from past researches is not sufficient to describe potential risk to the region's ecosystem including its most valuable component–human. Therefore, in order to have comprehensive information about possible hazard of these pollutants it is important to carry out researches on their environmental impact.

Formerly, in 1950s a great number of plant species were grown in the Kura-Araz plain including bulbous plants (ephemerones), tamarisk, lucerne, black clover, rush, reed, wormwood, coltsfoot and garlic, etc. Also, there was a sufficient number of fish and bird species due to the availability of the abovementioned and other wild plants which they fed. Some of these plants were used as construction material for building houses. People who live here use waters, plants and other resources to meet everyday needs. At the same time, the Kura-Araz plain serve as winter pasture for livestock farms of other regions including Shamakhi, Agsu, Ismayilli, Khachmaz, Guba, Gusar, Devechi, Siyazan as well as of some mountainous regions of Georgia and Dagistan. Earlier, the territory was a habitat of unique fish species and wintering place of rare birds from all over the world.

However, from time to time unlimited economic plans related to cotton growing and other agricultural developments have led to undesirable consequences. As a result of these, all natural resources along the Kura and Araz rivers were subject to severe anthropogenic impact.

There are a number of factors causing negative impact on people health in this territory including plants, fish, cattle and underground waters. Pollution of soils, water basins and air results in the getting of heavy metals, organic chemicals and other toxic compounds into food cycle through biont, fish and animal organizms. Reprodutivity of many fish species has been significantly reduced. Majority of plants has been destroyed that caused serious deforestation problems in the region. Some birds left these places for ever. A large territory became salted and useless. Most of the people who lived here before moved to other places.

Despite the fact that significant funds have been invested in Kura-Araz plain in the last years, the territory is permanently subject to seasonal floodings and other disasters due to long term pollution. One of the principal aspects of anthropogenous impact's scientific analysis is the assessment of potential environmental and health impact.

As a result of preliminary studies it has been established that the milk of cattle in this region contain significant amount of toxic compounds which can lead to unpleasant consequences. These toxicants can get into human organism through food cycle causing various diseases in both animals and human. Toxic chemicals not getting in the milk or meet of animals can be found in their manure and another hazard sources.

Considering all the abovestated, it is important to develop an informative database to asses the current environmental situation, analyse the existing problems and take appropriate measures. For this purpose proposals for the implementation of complex environmental studies on the Kura-Araz plain has been developed by our team.

The main goals of the proposed work are:

carrying out of environmental studies to create a comprehensive database on the pollution of soil, water and bottom sediments and atmosphere air in the territory;

assessment of the current environmental situation and potential impact of environmental pollution on the flora and fauna and people health; identification of the problems related to environmental pollution and development of recommendations and measures aimed at thier solution.

In order to achieve these goals the following works will be implemented:

- selection of sampling stations on the study site;
- study of chemical pollution degree of soil, water, sediment and air samples;
- analysis of heavy metals and other hazardous compounds in plant samples;
- analysis of milk samples from the cattles feeding the plants and forage crops grown along the riverside for toxic compounds;
- analysis of fruit and vegetable samples cultured in the Kura-Araz plain to identify the concnetrations of toxic compounds causing health hazard;
- analysis of fish samples for toxic compounds causing serious health hazards;
- analysis of liver and other tissues of the birds, which use the Kura-Araz plain resources for toxic compounds;
- carrying out of researches on forage crops and other agricultural plants irrigated with Kura and Araz rivers water in terms of plant fiziology.

Study stations will be selected at 15-20 km distances throughout the Kura-Araz plain from Georgian borders to the Caspian Sea.

On the basis of the research results an informative electronic database including the pollution maps of individual areas will be developed. The database will be continuously updated that will play an important role in the protection of both wildlife and human health in the region as well as in people awareness rising and finding of proper solutions of the problems.

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Kür-Araz çayları ovalığının ekoloji problemləri

Xülasə

Məqalədə Kür-Araz çayları ovalığında ətraf mühitin çirklənməsi problemləri müzakirə olunur. Yerli və xarici mütəxəssislərin tədqiqatları, həmçinin əlaqəli dövlət qurumları və beynəlxalq təşkilatların məlumatları əsasında Kür və Araz çaylarının əsas çirklənmə mənbələri müəyyən olunur, çirkləndiricilərin ekosistemin komponentlərinə potensial təsiri göstərilir. Kür-Araz ovalığında ətraf mühitin qiymətləndirilməsi və yaxşılaşdırılması üçün tədbirlər planı təklif olunur.

Экологические проблемы Кура-Араксской равнины

Резюме

В статье рассмотрены проблемы загрязнения окружающей среды в области Кура-Араксской равнины. На основе результатов исследований местных и зарубежных специалистов, а также данных соответствующих правительственных и международных организаций определены основные источники загрязнения в реках Кура и Аракс. Указаны возможные потенциальные воздействия загрязнителей на компоненты экосистемы. Предложен план мероприятий по оценке и улучшению окружающей среды на Кура-Араксской равнине.