ELABORATE THE SYSTEM OF MEASURES TO SOLVE THE PROBLEMS OF TRANS- BOUNDARY COUNTRIES IN ORDER TO PREVENT HEAVY POLLUTION OF KURA RIVER

COORDINATING CENTRE: ECMHT, Azerbaijan

PARTNER CENTRES: GHHD, Georgia

REPORT ON THE RESULTS OBTAINED WITHIN THE COORDINATED PROJECTS FOR 2015

ECMHT

Project goal: in accordance with the International Declaration of Helsinki on the Protection of Transboundary Watercourses with the participation of countries around the Araz and Kura in order to prevent this tragedy the regulation of organizational and practical measures and its implementation are control over the organization. For this purpose, to check the level of radioactive and chemical contamination in the source and mouth of the river in each country, explore hazardous polluting facilities, the availability of water purification systems and their status and to develop recommendations to eliminate these problems. 97.5 percent of the Earth's water is salty and only 2.5 percent is drinking water. 96 percent of the fresh water is in the solid state. The liquid state of water is about 0,8 - 1 percent of the total volume of fresh water. In the last 50 years domestic accounts for 31 times increase of water consumption, 39 times for industry and 28 times for agriculture use. By approximately 2030, water covers in the north of China and south-east of India will dry out.

According to the World Food Organization, over the last 100 years the demand for drinking water has doubled compared to the growth rate of the population. Currently, 1.1 billion people lack access to clean drinking water and 2 billion people face the problem of water scarcity every day. According to UNESCO, in 2030, 47 percent of the planet's population will face water scarcity. According to estimates by World Health Organization (WHO) 20 percent of the world population use dirty water. From contaminated water in Sudan every 8 seconds dies a child, every hour - 430 children, every day - 10 800 and 3 billion 888 thousand of children annually lose their lives. Azerbaijan is one of the regions characterized by water scarcity. The amount of water per capita in Azerbaijan is less than in Georgia by 7 times and 2.2 times less than that of Armenia. As a whole, there are 310 billion cubic meters of fresh water including ground and surface waters in Caucasus. It accounts for up to 30 billion cubic meters of water resources for Azerbaijan. Water resources of local rivers are calculated 28,1 cubic kilometers. 80 percent of the surface water resources of Azerbaijan consist of the Kura and Araz Rivers and a series of their transboundary tributaries. Up to 70 percent of the total volume of these rivers is formed in the territory of neighboring countries. As a result of environmental strain in the Kura River and its main transboundary tributaries in the territories of Georgia and Armenia a large amount of dissolved chemical compounds and pollutants are brought with the flow into our country throughout the year. Pollution level remains stable. Significant steps are taken to prevent pollution of Azerbaijani Transboundary Rivers in Georgia. However, the fundamental solution is possible if prevent the level of pollution of transboundary rivers in neighboring countries. In 2000, Azerbaijan has ratified the Helsinki Convention on "The Protection and Use of Transboundary Watercourses and International Lakes". As Azerbaijan is situated in the bottom relief, in the mouth of the water flows so to join the Convention is especially important for us unlike the neighboring states. Because each country that have ratified the Convention must accept the obligations, emanating from the provisions of the Convention, and financial support to fulfill that obligations.

Azerbaijan and Georgia signed many legal documents to improve water quality in the Kura River. The most important among them is an agreement on economic cooperation between the two countries. Environmental management is one of sections of the agreement. The main point of this section is about the improvement water quality in the Kura River; "Georgia knows well which effects it has on Kura".

Being in the country's border with Georgia in the monitoring station of Shikhly-2 the level of phenols of the Kura River is 4-8 times above the sanitary norms, metals - 6-9 times, oil products 2-3 times and the amount of sulphate twice higher. The absence of permanent water polluting sources from the Mingachevir Reservoir across the Georgian border and the ongoing natural self-cleaning processes in the flow of the Kura River as well as the water treatment process in Yenikend Reservoir result in the reduction of pollutants in water by 30-55 percent but, despite this fact, it still remains 2 times high. Mineralization of the water of the Kura river raises till 800-1200 mg in the Surra settlement that is the connecting part of Araz and Kura Rivers. This is twice as much compared to the upper current of the Kura and 35-50 per cent more compared to its medium current. Density of the polluting substances raises in the part of the river . For example, the density of the copper is 9 times higher than the sanitary norms, phenols – 6 times, oil products and sulphates – 2-3 times. The over pollution of the Araz River, during the visit of Armenian nature, causes the heavily polluting of the Kura water as well as Araz fall in Kura. The observations show that the density of the copper composition in the Araz River is 10 MPC, phenols -8 MPC while oil products - 0.9 MPC times higher than the norm. Ganykh (Alazani) being one of the trans-border inflows of the Kura River is mainly exposed to the high pollution in the territory of Georgia. Density of the polluting substances constantly raises the sanitary norms in that part of the river where the Eyrichay and Ganykh Rivers meet.

To regularly control the quality of water in the Araz and Kura Rivers and their tributaries, in 2004, in Gazakh and Beylagan regions new analytical research laboratories have been established, the monitoring of water bodies continues.

This is generally a ten-days observations but in emergency situations it changes to every 3 hours, after that the ballots are prepared and submitted to the relevant authorities. As there is no high anthropogenic impact on water bodies in the country the work on improving them is conducted only once a month and once a season in the highest mountains rivers. This aims to reduce the damage to minimum level. For example, if detected contaminants in the upper course of the Kura exceeds the norm then we are able to warn people about the danger in a limited period of time considering the fact that the normal long term average rate of water flow in the Kura River is 20-30 hours. On the other hand, people's vigilance is very important to protect them from environmental terrorism.

Information about the pollution of the Kura River in the territory of Azerbaijan.

The source of Kura River is a group of springs found in North-East slope of Gizil-Gadik Mountain at a height of 2700m. The total length of the river is 1515 km, the total basin area is 188,000 km2. 174 km of the river length is in the territory of Turkey, 522 km in Georgia, and 819 km is in Azerbaijan. It's the biggest river of the Southern Caucasus. Being the major water artery of our Republic, this river plays an important role in the country's water supply. The distance from the river mouth to the Georgian border is equipped with a network of observations.

In the water of Kura along the flow, hydrocarbonate ion is prevailing (from Mingachevir to the river mouth), while the sulphate ion increases along the flow. Calcium cation prevails from Mingachevir to Zardab, and then from Zardab to the river mouth, the increase in the amount of natrium+calcium cation is a common case.

Through the river the amount of ions in water is increasing from 374.5 mg/L to 1098,1 mg/L. The water of Kura River is widely used in irrigation, energetics and water supply.

Upper course is Shikhli-2 station located on the border with Georgia. This observation station is moderately contaminated as a result of impact of untreated sewage and industry wastewaters discharged into the river from residential settlements in Georgian territory. Thus, 0.004 mg/L is the amount of phenols, 0.03 mg/L - surface active agent (= surfactant). The total amount of ions is 766.8 mg/L. This center belongs to the class of moderately polluted water. The density of the polluting substances in Yenikend settlement is characterized by weak development of anthropogenic factors there. The amount of phenols and surfactants are 2 times higher than the norm. The total amount of Ions is 557.7 mg/L and belongs to the class of moderately polluted water.

According to the results of hydro chemical observations at ***Mingechevir*** station, due to less anthropogenic impacts as well as the result of self-cleaning processes in the **middle course** of the river resulted in the fact that a total amount of phenols is 0,002 mg/L and nitrates in biogenic substances 2.1 mg/L respectively. The density of compositions in deposits has been reduced by 3.8 FTU depending on the concentration of substances in Yenikand and Mingechevir water reservoirs. Water of this station belongs to moderately polluted water class.

Amount of phenols at **Yevlakh** station is 0,002 mg/L. a total amount of ions is 419.8 mg/L, especially Ca ion exceeds a little more than 65.8 mg/L and water hardness equivalent to 8.2 mg/L. It belongs to clean water class.

At ***Zardab*** station the amount of ions is 0,001 mg/L. The amount of ions is 559,3 mg/L, Ca ion - 73,9 mg/L, hard water exceeded the norm by 9.2 mg eq/L. This part of the river undergoes the impact of wastewater discharged from agricultural activities.

From ***Surra*** station of the **lower course** along Araz River is also polluted with wastewater discharged from residencies, especially Shirvan and Salyan cities. The amount of polluting substances as phenols and surfactant is equal to 0 at Surra station. 6,2 mg/L is the total amount of biogenic nitrates and 1098.1 mg/L. – ions.

The concentration of hydrocarbons most exceeds by 561.4. The amount of phenols at ***Shirvan*** observation station is 0.002 mg/L, while surfactant - 0,04 mg/L. From biogenic substances the amount of nitrates is 6.0. Ions of Ca is a little greater than the normal value, 64.2 mg/L respectively. Water of this station belongs to moderately polluted water class.

Amount of phenols at ***Salyan*** station is 0,001 mg/L, surfactant -0.05 mg/L, total amount of ions -826,1 mg/L and ammonium (NH4) content in biogenic substances - 1,3 mg/L. Among ions Ca exceeded the normal quantity at 101.1 mg/L. Water of this station belongs to moderately polluted water class.

At ***North-Eastern Banka*** observation station the concentration of phenols is 0,001 mg/L, surfactant -0,03 mg/L, from biogenic substances the amount of ammonium (NH4) - 1,2 mg/L. The total amount of ions is 810,7 mg/L. Ca ions 84.2 mg/L above the sanitary norms. Water of this station belongs to moderately polluted water class.

To control the level of pollution in transborder rivers of Kura and Araz and their tributaries in Gazakh and Beylagan regions laboratories have been equipped with modern apparatus. A special consider is given to establish new analytical research laboratories.

In general, villages along the Kura-Araz Rivers used different water sources: water from Kura and Araz, drainage ditches, irrigation canals and etc. The cause and nature of contamination of water pollution are different: irrigation canals deposit little oozy but very dirty due to microbiological and chemical composition; another reason is the highest amount of pesticide pollution in irrigation canals is and etc. So that, different devices have been installed at various stages of contamination. First category stations (observation points) are organized in relatively small villages and small-sized settlements surrounded by drainage ditches. The devices are installed in accordance with this characteristics.

Representatives of rural community, village elders, municipalities, administrative officers and officials of the Ministry of Ecology and Natural Resources attended to design water distribution networks and water treatment facilities.

Based on Decrees of President of the Republic of Azerbaijan “On Certain Measures for Improving Provision of the Population with Ecologically Clean Potable Water”, villages along the Kura-Araz and other residential settlements were aimed at providing with ecologically pure water. Within the framework of the Program, the modular water treatment plants were put into operation by the Ministry of Ecology and Natural Resources in 156 settlements of 18 regions which contributed to provision of more than 300 thousand persons with high quality safe and potable water.

Pollution - prevention opportunities were developed after analyzing the level of contamination of the Kura River and seminars for municipal representatives and members have been held along coastal regions.

The multifaceted nature of these problems makes them possible to solve by systemic solution. To reduce the impact of climate change for each river basin a specific adaptation and mitigation strategies to be worked out. our suggestion is that in order to study the problems in-depth more comprehensive measures to be implemented.

- Efficient use of household water connections. We believe that to use water without wasting helps to prevent droughts. That is why it is important to hold trainings in communities.

- By means of systematic efforts and effective management of the environment it is possible to eliminate the consequences of disaster risk within the community and society, and by increasing the level of preparedness to decrease the level of risk.

- Improving preparedness for flooding and drought events. During natural disasters communities with weak ties are exposed to more losses as not able to take joint actions. We strongly believe that it is very important that every member of community should know what to do during flood and drought and that is one of the major ways to reduce the risk of disaster.

- Public education. It is significant to held trainings in rural communities in order to better understand the importance of forests and water sources by the population. Trainings should highlight the consequences of deforestation and sheep and cattle excessive grazing. The rules to protect population against emergency situations and environmental crises in private properties and villages; to protect lands and economy from emergency situations; to increase the role and responsibility of municipalities in eliminating the consequences of damages; special business trips were organized in Sabirabad and Zardab regions to help authorities to educate population. During trips in Sabirabad and Zardab regions the project coordinator, Ojagov H.O and experts of the project, Hacımatov G.N, Danyalov Sh.D., Gafarov E.K., met the community representatives of residential settlements along the Kura River and collected information about the causes and results of polluting factors in the villages of Kura River.

Based on observations, collected data and literature sources the volume of each topic, the necessary illustrations and duration of the project within the timeframe for two types of booklets are already specified; previously planned title of the project "The causes of pollution of the Kura River" and carefully selected topics for the booklets were developed.

On the 4th, 5th, 6th and 7th of September 2015, the round table conferences were held in the Chukhanly municipality of Salyan region and Neftchala. At the round tables experts Hacımatov G. N, Danyalov Sh. D and Sabzaliyev S.A gave a wide range of speeches about the importance and the reasons of pollution of the Kura River. Participants had coffee breaks between speeches. Speaking at the round tables, community representatives also noted the problems of water scarcity. At the end of the round tables "The causes of pollution of the Kura River" booklets were distributed to participants.

On the 8th, 9th, 10th and 11th of September 2015, the round tables conferences were held in Sabirabad and Zardab regions. At the round tables experts Hacımatov G. N, Danyalov Sh. D and Sabzaliyev S.A gave a wide range of speeches about the importance and the reasons of the pollution of the Kura River. Participants had coffee breaks between speeches. Speaking at the round tables, community representatives also noted the problems of water scarcity. At the end of the round tables "The causes of pollution of the Kura River" booklets were distributed to participants.

The problems raised in the project created an opportunity to educate the population about the emergency preparedness in disaster-prone villages surrounding the Kura River. Rural residents learned the rules of how to behave in case of emergency. The level of preparedness to disasters increased among community representatives.

The proposed project has been dedicated to the protection of population of surrounding areas of the Kura, the population and municipalities will be the main beneficiaries of this project. At the same time, the printing and distributing of booklets will increase the number of beneficiaries of the project thousands of times. In other words, the number of indirect beneficiaries of the project will be more than once.

GHHD

Introduction The Basin of Kura River, the main artery of the Caucasus, covers all three countries - Armenia, Azerbaijan and Georgia. There are many industrial, petrochemical and steel industries close to the river. In the Kura basin there are as railway, water treatment and other potential sources of pollution. At the same time in the immediate vicinity are located potential water consumers - intakes of drinking water, irrigation systems, which ultimately, considering the relatively high average flow velocity of Kura River (25-35 km/h), makes the possibility of fast accidental pollution of water users. There are many sources of water pollutants, in the Basin of Kura River from the upper reaches to Mingechauri reservoir, such as small and large manufacturing plants and agricultural utilities operating in small and large towns. Load increases by the wastewater of these settlements, although they are not related to the objects with greater risk. The average distance between the objects is 30-40 kilometers. Among the above threats the main sources of pollution in Georgian part of Kura basin should be mentioned: Kaspi cement plant, Tbilisi (Avchala) glass plant, Tbilisi Aviation Plant, Rustavi Metallurgical Plant, Rustavi Chemical Plant, Rustavi cement plant, Bolnisi Mining Plant et al., which pollute Kura River with heavy metals (Cu, Zn, Fe, Pb) and the chemical compounds (amonium sulfate, caprolactam, cyanide, etc). There is an exploration of baritepolymetal ore body (Au, Cu, $BaSO_4$, Pb, Zn, Ag) here. The deposit is located in the Bolnisi district (Eastern Georgia), 80 km south-east from Tbilisi. The main river of this area (Bolnisi) is the river Khrami and it tributary river Mashavera with its right side tributaries Kazretula and Poladauri. These rivers are really washouts of the ore body and pollute the groundwater area (Fig 1). There exists a pretty big risk due to the railway and Baku-Supsa and the Baku-TbilisiCeyhan pipelines. Here are allocated areas with a high pollution risk – the crossings of pipeline and tributaries of Kura river: Gldaniskhevy, Aragvi, Ksani, Lekhura, Mejuda, Liakhvi, East Frone and Frone where in case of an accident from 1.5 to 2 barrels of oil can be leaked. On the territory of Georgia waters of Kura River basin are used for drinking as well as for fisheries and for agricultural purposes. Along the entire length of river is built a dense network of irrigation systems (Table №1). Headworks of these systems are located on average 2-10 km apart. Among them, the largest and longest systems are Tashiskari and Gardabani, which irrigate the vast areas. With such a close proximity from each other along the river irrigation systems, water users are practically on the whole perimeter of the river. The situation is exacerbated by the high speed of the river. The average flow velocity at the site Khertvisi is 0.76 m /s, and the water discharge is 202 m3/s, during the floods, respectively, 3.2 m/s and 742 m3/s, and at low water season - 0.46 m/s and 5.50 m3/s. On the site Borjomi the average speed of the river is - 0.75 m / s, which during floods increases to 2, and at low water drops to 0.42. On the site of Gori average speed is 1.03, with floods of 3.15 and 0.92 at low water period. To Grakali area respectively -1,03-2,89-0,48. For Tbilisi 1,89-4,05-0,99 for Rustavi 1,28-4,1-1,0. The time required for distribution of contamination and, consequently, the time needed for preventing the spread of it, in such close proximity of irrigation systems and the high speed of the river is about 1-2 hours to the nearest water user. For example, during heavy floods in Kura in 1968 the maximum speed of the river was 5 m/s. The peak travel time of wave from the hydrological post Minadze to headwork Tashiskari, was 4.6 hours, to Skra-Agara headwork -7.1 hours, Dues-Grakali headwork- 9.0 hours and up to the headwork Gardabani- 17, 1hour. Currently an operating environmental monitoring system in Georgia does not provide the necessary efficiency. Namely: 1. Pollution monitoring Center of the State Department of Hydrometeorology of Georgia, conducts sampling and analysis for 6 points and 11 points over the Kura River (Table 2-4) with frequency once per month. The analysis is carried out on a large range of elements, 3 also on phenols, asphaltenes, petroleum products, caprolactam, organic and inorganic pollutants (heavy metals, and nitrogen-containing cells) and others. As you can see, this system has insufficient sampling frequency to provide early warning. 2. At the Ministry of Environment and Natural Resources of Georgia, there is a special service: National Coordinating Centre for the Protection of ecological disasters and environmental safety, which is entrusted with the mission of operational information gathering environmental disasters throughout Georgia and transfers it to higher institutions and relevant organizations. But the service due to the financial crisis really has no employees and cannot organize a dense enough monitoring network along the Kura River. 3. Several organizations, such as the Department for Emergency Situations of the Ministry of Internal Affairs, the Ministry of Health Service and others, concerned with environmental and natural disasters, really do not participate in the organization of environmental monitoring along the river, not to mention the alarm system. The only thing that the environmental control system service of the Baku-Supsa pipeline provides is the daily inspection along route and prompt action in case of oil spill: in case of pollution along the exclusion zone and in the river basin they will inform the Ministry of Environment and Natural Resources and Georgian Oil international corporation. But this program does not provide the system of control and prevention of contamination along the river in case of an oil spill and its infiltration into the river. As can be seen, the current system is fragmented, does not provide the organization of alarm systems, and in reality the system of operational analysis of the state of the river and the early warning system is absent. So it is desirable organization of independent early warning system capable of issuing real-time alarm to react on the spread of contamination with participation of existing institutions. Our investigation was concentrated around of the main source of pollution by heavy metal. It is the polymetallic quarry of Madneuli ore deposit, where the prolusion source - washing out the ore occur. The intensive biochemical and chemical processes occur also in exposed rocks and in this way pollutes water of rivers Kazretula, Poladauri and Mashavera with heavy metals. Pollution is associated to the: - Mechanical destruction of soil and plants - Contamination of soil - Contamination of surface water and groundwater - Contamination of air Poladauri gorge is a major agricultural area of the district from where the agricultural products, which contain the high value of toxins, represent the main source of Tbilisi market. The studies of ecological situation began in 1993-94 and continue to this day by various agencies. Between them is Institute of Geophysics, whuse activities focused on the compilation of historical data, additional geo-survey, laboratory analysis, GIS input and participation to everready groups creation for monitoring. The multidisciplinary studies comprised e.g. geological, hydrological, hydrogeological and –chemical data collection (both previous and new) studies in order to provide detailed data for groundwater pollution way modeling purposes. Hydrochemical sampling These studies have confirmed the severity of the environmental situation of the Madneuli area. According to their data, to the range of 20 km from the quarry, the territory (soil) is classified as contaminated. Soil contamination is more than 3 times the the maximum permissible concentration (MPC). Much worse is the condition of water in the rivers Kazretula and Poladauri, where the concentration of toxic metals in some places is more than MPC 50 or even 100 times. In one site the concentration of Cd reaches 3,8 mg/l, which is 2000 times greater than the normal value of ground water (0,002 mg/l). In the adjacent area of quarry the 4 chemical elements are presented in concentrations exceeding existing standards MPC in Georgia. Almost everywhere are registered the increasing concentrations of major pollutants: Cu, Zn, Pb, Ni, Mn, Cr, Ti, Mg, Cd, Hg; their concentration exceeds 3 MPC - 2 000 time. Figure 1. Spatial distribution of Cu and Pb concentrations in the Bolnisi area. Zonal distribution of the pollution on the territory can be easily observed on the Poladauri river catchment, which is a tributary of river Kura. The extremely high concentration of heavy metals in spring and underground waters, flowing directly from the quarries and irrigation channels from the South, is reducing on its way to the North. It is the cost of pollution of soil and vegetable in this area. At the same time lower alluvial horizons containing pressurized water are relatively clean. At the v. Bolnisi and Lower Bolnisi (Kapanakhchi) in the wells the concentrations are much lower. This can be explained by the large thickness of alluvial deposits (100-200 m) and presence of thin layers of waterproof volcanic rocks In addition, to the process of pollution Mashavera river from the natural process have added the pollution from the career "leakage" out-floe prolusion water to the river, which can explain the cause of the factory owners and technological imperfection. Currently on a quarry operates its own environmental department which is responsible for the control of wastewater and the state of cleaning structures, but unfortunately in reality the wastewater continuously drain into the river system. Besides, environmental organizations carry out the assessment of background values rarely. To the local people has given the recommendations on the usage for drinking purpose only waters from the deep boreholes and not the surface and subsurface contaminated waters. Pollution transport modelling In order to assess quantity and quality of pollution was created transport model of Poladauri catchment. According to a conceptual model acid mine drainage from banked waste rocks (150 million m3) and sulfide ore tailings of the Madneuli Cu-Au open-pit mine have created major environmental pollution problem in Bolnisi district. Intensive leaching of exposed rocks and direct discharge of mine waters to nearby watercourses have lead to strong heavy metal pollution of groundwater in Rivers Kazretula, Poladauri and Mashavera. Increased concentrations of Cu, Zn, Pb, Ni, Mn, Cr, Cd and Hg exceeding maximum permissible values by 3-2000 times, are registered almost everywhere. Polluted surface waters are used intensively for irrigation. Besides, contaminated groundwater is pumped for irrigation and drinking water supply in alluvial deposits along the rivers. Because the spread of contamination is a slow process, the adverse health effects may not yet have emerged in the investigation area. The transport modelling was used in the framework of risk assessment to estimate the direction, rate and extent of chemical migration in the contaminated site in order to support environmental 5 management and decision-making involving identification of high-risk areas, protection from pollutants, and planning of remediation work. Geochemical and contamination transport modeling conducted in this study suggest that the present contamination levels will eventually reach the total investigation area causing serious health risks to the local population in long terms. Figure 2. The current contaminated situation in the model Mineral lifetime estimates suggest that the contamination might continue for centuries with current pollution loads. Furthermore, geochemical modelling showed that there is no reason to expect the natural attenuation of the contamination. The potential impacts of preventive actions were studied by preparing a model scenario where the present heavy metal contamination level was lowered to 0.1 mg/l in two streams entering the model area. Figure 3. Results of preventive actions in the model The model results suggest that within 5 years, already significant reduction of concentrations can be reached. The adverse effects on human health could be mitigated by redirecting the extraction of drinking water in the Bolnisi region to areas locating at a sufficient distance from the polluted stream. High investment in preventive actions will become exclusively cheaper than remediation of contaminated groundwater. Without preventive remediation, the situation can be expected only to get worse. Has been selected the key areas for preventive actions and were given recommendations for the organizing the water purification systems. 6 Remediation and treatment The problem of extraction of toxic and nonferrous metals from the wastewaters is very important, both for preserving the environment and for additional reception of these irrevocably lost metals. One of the most effective ways for extracting metals from solutions seems to be the method of their sorption on various adsorbents. From this point of view, it is very interesting to study an opportunity of using cheap natural adsorbents for these purposes. The domain of natural zeolite applications is very wide due to large resources, possibility of usage without any processing, low cost and unique ion exchange and sorption properties. Selectivity of natural zeolites to cations of various metals determines additional effect during filtering of heavy metals. At the same time simultaneous sorption of nonferrous metals is observed. Subsequent self-cleaning of the zeolitic filters is provided with periodicity according to pollution receipt. Significant resemblance of natural high-silicon zeolites to cations of nonferrous metals, allows considering their use for sewage treatment of the enterprises of nonferrous metallurgy and a metalworking industry with the subsequent regeneration of adsorbent. For 95 % extraction of heavy metal that is quite sufficient for objects in view, in case of usage of Na-klynophtilolithe the volume of the cleared model water solution 150-200 times exceeds the volume of the zeolite layer; simultaneously occurs practically 100 % extraction of large cautions Pb, Ba, Sr and 93 % extraction of cations of nonferrous metals Cu, Cd, Zn, Co, Ni. It seems reasonable to introduce also new methods of cleaning using bioactive substances developed by Georgian biologists and geologists. USA, Italy and Japan carried out extensive investigations of possibility of extraction of cations Cu and Cd from the wastewater. The Hungarian scientist's study show high efficiency of natural zeolites for extraction of non-ferrous metals from the wastewater produced during mining and ore dressing. They already build a system for treatment pollution and tested it (Figure 4) Figure 4 Heavy metal extracting system using zeolites Is recommended to organize the water purification systems using of natural zeolites in the selected key areas 7 Pollution's early warning system In order to study pollution distribution in time was organized eavy metal concentration monitoring by using Neutron device (manufactured in Germany) in the sensitive areas. Testing was conducted and regime point for organizing monitoring observations was chosen, nearby River Poladauri at the borehole which reflects water flow from the waste dump to the river (Fig. 5). During monitoring everyday was measured heavy metal concentration in surface water by chemical analytic methods also. Chemical analyses of underground waters and surface were conducted in laboratories of M. Nodia Institute of Geophysics. Results of observation fixed correlation between variation of concentration of metal and precipitation, dependence on the extraction intensity of metal from rocks and with precipitation value and water level in the rivers (Fig. 6). Fig. 6. Variation of water level and pH Fig. 6. Variation of water level and pH The heavy metal pollution real-time monitoring system has been recommended as early warning system of pollution All these recommendations were delivered to the Ministry of Environment and Natural Resources of Georgia, local organization and population living in coastal regions.

References Barns H. H:, 1967. Roughness characteristics of natural channels. U.S. Geological Survey Water-Supply Paper 1849, 213 p. 0 1 2 3 4 5 6 7 8 9 10 0 20 40 60 80 100 120 140 160 7/11/1989 5/7/1990 3/3/1991 12/28/1991 10/23/1992 8/19/1993 6/15/1994 4/11/1995 2/5/1996 12/1/1996 WL in m pH Date Variation of water level and pH in river Mashavera 8 Dagan G., 1988. Time dependent macrodispersion for solute transport in anisotropic heterogeneous aquifers. Water Resources Research 11, 5, 725-741. Davis, A. D., 1986. Deterministic modelling of dispersion in heterogeneous media. Ground Water, 24,5, 609-615. EPA, 1999. Understanding variation in partitioning coefficient Kd, Values, Volume 1. The Kd model, methods of measurement, and application of chemical reaction codes. Gelhar L: W., 1986. Stochastic subsurface hydrology from theory to applications. Water Resources Research 22, 9, 135-145. Korte N., 1999. A guide for technical evaluation of environmental data. Technomic Publisin Co., Basel, 195 p. Lallemand- Barres P. and Peaudecerf P., 1978. Recherche des relations entre la valeur de la dispersivite macroscopique d'un milieu aquifere, ses autres caracteristiques et les conditions de mesure, etude bibliographique. Bulletin, Bureau de Recbercbes Geologiques et Miniéres, Sec. 3/4, p. 277-287. Neuman, S. P. 1990. Universal scaling of hydraulic conductivities and dispersivities in geologic media. Water Resources Research, 26,8, 1749-1758. Reilly T. E., 2001. System and boundary conceptualization in ground-water flow simulations. Techniques of water-resources investigations of the U.S. Geological Survey Book, Applications of Hydraulics, Chapter B8, 29 p. Xu M. and Eckstein, 1995. Use of weighted least squares method in evaluation of the relationship between dispersivity and field scale. Ground Water, 33, 6, 905-908. T. Chelidze, G. Melikadze, F. Zervos, G. Benduckidze, A.Saanishvili 2001- The Study of Heavy Metal Pollution at Madneuli Complex Ore Deposit Area. I International Conference on Ecology and environmental Management In Caucasus, Tbilisi, Georgia, 6-7 October, 2001 D. Virsaladze, Z. Sekhniashvili, D. Tsereteli, K. Nakaidze, N. MarinashviliIndustrial pollutants and diffuse goiter. Georgian Medical News, Tbilisi, #9, 2002 G.Jashi, V.Chichinadze, T.Chelidze, T.Zardalishvili, D.Kitovani, G.Dzotsenidze, Z.Amilakhvari Definition study of thickness and fractional differentiation of debris-flow sediments in r.Duruji valley by geophysical methods (are being published in) K.Nakaidze, D. Virsaladze, O. Gogiberidze, D.Tsereteli, G. Dvali. Impact of heavy metals on the thyroid gland. The first national conference/National program on enviroment and Health. Collection works. 2001: 281-283 D. Tsereteli, M. Tsverava, R. Urushadze, T.Lobzanidze, R. Tsiklauri, M. Maglakelidze, N.Tsereteli Industrial pollutants and chronic bronchitis. The first national conference/National program on enviroment and Health. Collection works. 2001: 249-252. D. Tsereteli, D. Gelovani Epidemiology of chronic bronchitis in Bolnisi region. Tbilisi State Medical University. Collection works. 2003.