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Integrated use of water reserve and green energy potential of rivers in Eastern Zangezur and Karabakh economic regions

***Mammadov Ahmad Shirin, Javadzade Elshad Baylar, Bayramov Arzuman Avaz**

"HIDROLOG" Limited Liability Company, 34 Tbilisi Ave., 53 Apart, Baku AZ1102, Azerbaijan

****For correspondence:** ahmad.m@hidroloq.az*

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The water resources formed in the territory of Eastern Zangezur and Karabakh region freed from the occupation are of special importance for the sustainable water supply of the republic. Efficient and comprehensive use of these water resources will contribute to the connection of fertile lands located in the freed Karabakh and East Zangezur economic regions to the agricultural cycle and the population can be settled quickly. Before settlement, irrigation and water supply systems should be established using the water and hydropower potential of the rivers located in this area. It is necessary to efficiently use the water resources of these rivers, during the autumn and spring high-water period. These rivers have a huge energy potential, and by building hydrotechnical facilities of various purposes on them, it is possible to fully satisfy the electricity demand of the population living in these economic regions, as well as to create a water management system that can be controlled in a self-flowing mode, which is more economically favorable. Engineering hydrological studies were carried out on the development of a more optimal water management system, taking into account the factors of natural conditions and relief indicators of the area, and the location of fertile land suitable for cultivation outside the river basins. In the article, the design solution for the creation of two derivative-type hydroelectric power plants outside the Okhchuchay riverbed in order to obtain green energy from the seriously polluted water resources of this river, which has a large hydropower potential, is presented. In the HPPs to be built on the Okhchuchay river, 80.0 million kWh of electricity can be obtained during the year, which will allow the permanent supply of electricity to more than 120,000 people. Besides, the article proposed project solutions related to the construction of water reservoirs on the rivers Hekari, Bargushad, Gargar (Zarisli tributary), and Guruchay, regulation of their flow regimes and use in the sustainable water supply of the region. The water management system to be created will allow providing a permanent drinking water supply to more than 4.0 million people and provide irrigation water to almost 80 thousand hectares of agricultural land.

***Keywords**: water supply, river, water resources, reservoir, riverbed*

INTRODUCTION

The water resources formed in the territory of Eastern Zangezur and Karabakh region freed from the occupation are of special importance for the stable water supply of the republic. Efficient and comprehensive use of these water resources will contribute to the connection of fertile lands located in the freed Karabakh and East Zangezur economic regions to the agricultural cycle and the population can be settled quickly. Before settlement, irrigation and water supply systems should be established using the water and hydropower potential of the rivers located in this area. It is necessary to efficiently use the water resources of these rivers, during the autumn and spring high-water period. These rivers have a huge energy potential, and by building hydrotechnical facilities of various purposes on them, it is possible to fully satisfy the electricity

demand of the population living in these economic regions, as well as to create a water management system that can be controlled in a self-flowing mode, which is more economically favorable.

Engineering hydrological studies were carried out on the creation of a more optimal water management system, taking into account the factors of natural conditions and relief indicators of the area, the location of fertile land suitable for cultivation outside the river basins. The Okhchuchay river, which is 83 km long and has a water catchment area of 1175 km^2, begins from Gapijik Mountain (3285 m) of the Zangezur Range. The annual water reserve of the Okhchuchay river is 317.0 million cubic meters. The average water flow is 10.0 m^3/sec. The river enters the territory of our republic at an absolute level of 630.0 meters and after 30 km flows into the Araz River at an absolute level of 300.0 meters (Rustamov and Kashkay, 1989; Museyibov, 1998; Mammadov, 2022).

The cities of Gafan and Gajaran, the main industrial areas of Armenia, are located on the banks of the river. The city of Zangilan and the settlement of Minjivan of Azerbaijan are also located on the banks of this river. The annual hydropower potential of the river is 110 mln kw/h. The water of this river, which is a large water resource of the region, has been polluted for many years by industrial wastes from copper-molybdenum mines located in the territory of Armenia. The pollution of the river exceeded all norms and became extreme, and its fauna was completely destroyed. Currently, the Okhchuchay river is included in the list of the most polluted rivers in the world. Using river water for water supply and irrigation can cause serious consequences for people's health. In January-March 2021, water samples taken from Okhchuchay were found to be highly contaminated with heavy metals. According to the report of the Ministry of Ecology and Natural Resources of Azerbaijan, the amount of copper-molybdenum compounds in the water exceeds the norm twice, the amount of iron - four times, and the amount of nickel - seven times. Water samples taken from the Okhchuchay river show a serious threat to the environment. The water of the river is colored either white or yellowish periodically. Using only the hydropower potential of this river is considered more appropriate from economic and ecological points of view.

The water resources of the Hekari River, which is located in Eastern Zangezur and is mainly formed in the territory of the republic, in not currently used efficiently. The water of this river fully meets drinking water standards in terms of quality and is of great importance in ensuring the safety of the water supply for the population of the republic. Khochaz and Shalva tributaries of the river are formed entirely due to spring and snow waters located in the mountain range of the Lesser Caucasus and are not exposed to any pollution. The location of the main part of the water catchment basin of the river at a higher elevation gives a wide opportunity to use its hydropower potential to obtain electricity and to use the water in the self-flowing mode for water supply in the big cities of the republic.

The Bargushad river is one of the rivers of the Eastern Zangezur region, which has the most abundant water. Up to 85% of the water resources of this river are formed in the territory of Armenia, 4 reservoirs and hydroelectric power stations have been built on the river in the territory of Armenia, and its annual flow is fully regulated and enters the territory of the republic. Extensive studies have been conducted on the use of the water resources of this river for providing irrigation water to the surrounding areas. The conducted hydrological reports show that it is appropriate to build a reservoir at the absolute level of 540.0 m above Gubadli city. Up to 80,000 hectares of fertile land located in the Gubadli, Zangilan, Jabrayil, and Fuzuli regions will be supplied with water taken from the reservoir to be built at this level. It will be possible to provide irrigation water without using pumps.

The water resources of the Guru and Gargar rivers located in the Karabakh zone are not used efficiently. It is possible to use the autumn-winter-spring flow volumes of these rivers more efficiently by collecting them in reservoirs. The location plan of the main rivers in the territory of the Eastern Zangezur and Karabakh economic regions is given in Figure 1.

During the Soviet period, 35.0 thousand hectares of the 100 thousand hectares of arable land in the Zangilan, Gubadli, Jabrayil and Fuzuli

regions were provided with irrigation water through 47 pumping stations built along the Hekari River, Hasanli, Maralarkh and Bash Mil canals. Irrigation water was raised to some parts of the areas by 2-stage pumps.

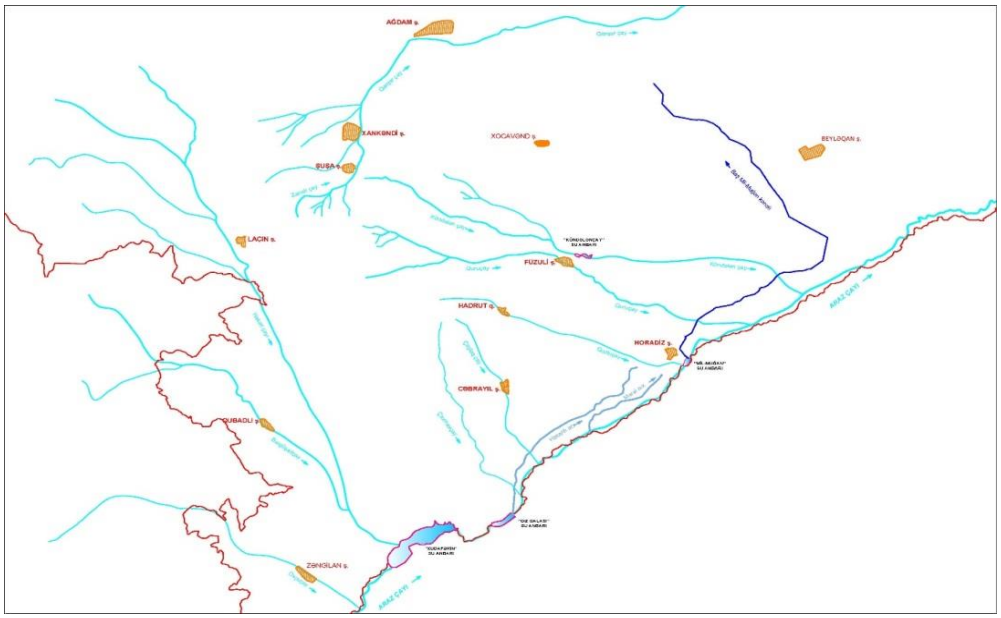

Fig. 1. The main rivers in the territory of Eastern Zangezur and Karabakh economic regions

From 3 high-pressure pumping stations (Balasultanli, Hamzali and Mammadbeyli pumping stations) built along the Hekari River, about 3.3 m^3 of irrigation water was raised to the Gayan Plain in one second. Using this water reserve, land plots belonging to the Gubadli (2500 ha), Jabrayil (3300 ha) and Zangilan (3400 ha) regions were irrigated in the Gayan plain. Through 17 pumping stations (total productivity 3.6 m^3 per second) on the Hasanlı and Maralarkh canals connected to the Araz River, irrigation water supplied up to 8,600 hectares of farmland located in the Jabrayil region. 27 pumping stations were built on the Bash Mil and Yukhari Mil canals to provide irrigation water to the agricultural fields located on the Harami plain in the Fuzuli region. Up to 20,000 hectares of farmland were irrigated in the Harami plain until the 1990s by using these pumping stations with a total productivity of 13.6 m^3 per second. Currently, many of these pumping stations are operating. Figure 2 describes the scheme of irrigation of cultivated fields till 1990.

It should be noted that since the 1980s, groundwater has been widely used for irrigation in order to develop viticulture in these areas. In total, more than 517 deep subartesian wells were dug in the Fuzuli and Jabrayil regions, from which 150 million cubic meters of precious, potable water was extracted and used for irrigation. According to the calculations, in total, 260 million kw/h of electricity was used to provide irrigation water to 45,000 hectares of agricultural land located in these regions. 200 million kw/h of this energy was used in pumping stations that raise water from canals.

Thus, efficient use of the water resources of the abundant rivers located in the region will create ample opportunities to provide the population with high-quality drinking water and the fertile soil of Karabakh with irrigation water without pumps.

Proposals regarding the use of hydropower potential of the Okhchuchay river. Protecting the ecosystem of the Okhchuchay river and using its hydropower potential can be solved within the framework of one project.

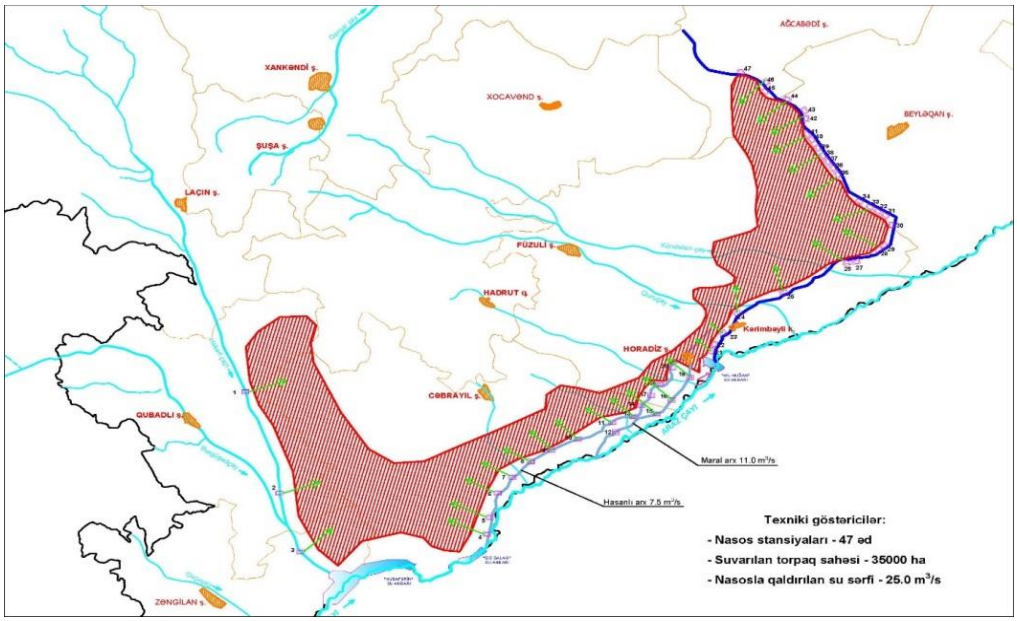

Fig. 2. Territories irrigated using pumps till the 1990s

For this, at the place where the river enters the territory of the republic, a regulatory reservoir with a volume of 5-6 million m^3 should be built at the level of 630 meters, and highly polluted river water entering the territory should be removed from the riverbed. The river water collected in this reservoir will be transferred to the "Zangilan-1" HPP, which will be built near the city of Zangilan at a level of 470 meters, with a total installed capacity of 9.0 MW, by diverting it from the channel through a derivation pipe with a diameter of DN 2200 mm and a length of L=13.0 km. It will be possible to produce 90 million kWh of electricity per year through this HPP. The river water from the first HPP will be diverted from the riverbed by means of a derivation pipe with a diameter of DN 2200 mm and a length of L= 17.0 km and transferred to the "Zangilan-2" HPP, which will be built on the bank of the Araz river at a level of 300 meters, with a total installed capacity of 6.5 MW. It will allow producing 65 million kWh of electricity per year using this HPP (Figure 3). It is possible to provide more than 120,000 people with continuous GREEN ENERGY through the electricity produced in both HPPs.

Transferring the river water out of the riverbed and transporting it in transit will create ample opportunities for the protection of the ecosystem. The riverbed will mainly contain clean water originating in the territory of the republic, which is of great importance for the protection of underground water. With the implementation of the envisaged project, it is possible to achieve substantial mitigation of the environmental disaster that has occurred around the Okhchuchay river and to obtain a sufficiently large amount of electricity.

Plan of integrated use of water resources of the Barghusad and Hekari rivers. Currently, the water resources of the Hekari and Barghusad rivers are used very little. According to the hydrological point where the rivers merge, the annual water reserve of the Bargushad River is estimated to be 500 mln m^3 (except for 250 mln m^3 used in the territory of Armenia), and the annual water reserve of the Hekari River is 500 mln m^3. Thus, a total of 1.0 billion m^3 of flow enters the Araz River every year through these rivers.

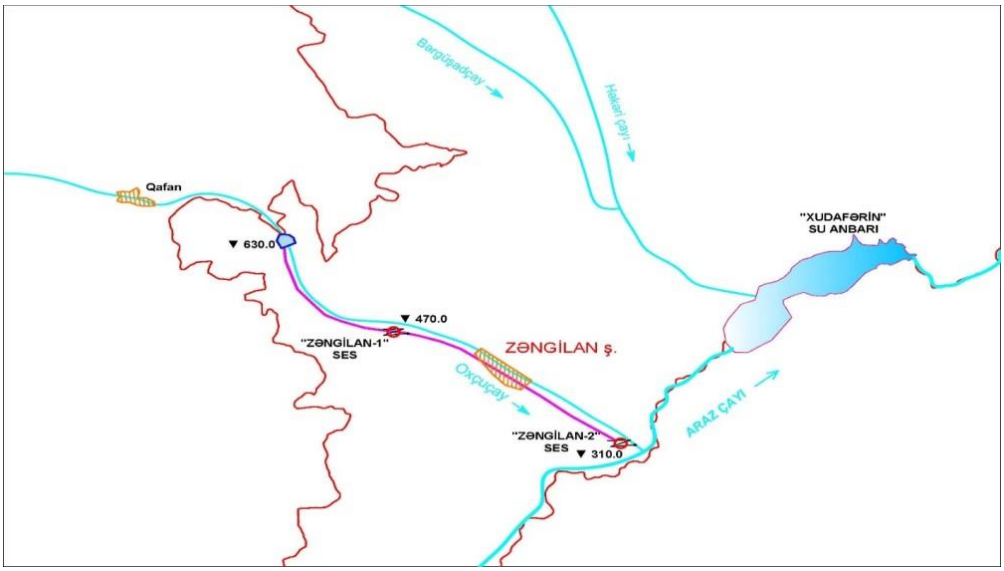

Fig. 3. The location plan of HPPs envisaged being built on the Okhchuchay river

According to the agreement signed with the Islamic Republic of Iran on the joint use of the water resources of the Araz River, 50% of the water resources of this river are to be used proportionally for each republic. According to this agreement, we can use only 500 million cubic meters of flow entering the Araz River through the Barghusad and Hekari Rivers.

The Bargushad River, which is 178 km long and has a basin area of 2711 km², begins from Zalkha Lake, located at an altitude of 3040 m, on the northern slope of the Zangezur range. The Bargushad river enters the territory of our republic near the Eyvazli village of the Gubadli region and merges with the Hekari river near the Garalar village of the district and flows into Araz. At the place where it flows into the Hekari river, the average annual water flow of the river is 24.0 m^3/sec. A part (2.0 m^3/sec) of this flow is formed in the territory of Armenia. The multi-year average water flow of the river in the Eyvazlar district is 22.0 m^3/sec (Rustamov and Kashkay, 1989; Mammadov, 2022).

The main part of the river flow is formed in the territory of Armenia. The annual flow volume has been fully regulated by building four reservoirs and several HPPs on the Bargushad river in the Armenian territory with a total volume of 300.0 mln m^3. The last of this cascade of created reservoirs is the Shamb reservoir and the derivative-type Tatev HPP. Tatev HPP, which is considered to have the largest pressure (static pressure 569 m) in the former USSR, currently occupies one of the main places in the energy network of Armenia and is mainly used during peak energy demand. According to the data of recent years, the average daily flow of water passing through this HPP is 18.5 m^3/sec and the maximum flow is 33.0 m^3/sec.

It should be noted that a part of the flow volume (about 167.0 mln. m3 per year) from the Spandaryan reservoir, which is the largest of the reservoirs built on the territory of Armenia on the Bargushad river, is planned to be discharged to the Ketchuk reservoir built on the Arpa River and from there to Goycha Lake. For this purpose, the 18.5 km long Vorotan - Arpa tunnel has been built and used since 2004. If this tunnel is used, the average flow rate entering the Azerbaijan side from the Bargushad River will be 14.0 m^3/sec. This tunnel, which has a maximum water release capacity of 30.0 m3/sec, is currently not in operation. If this tunnel is used in the future, taking into account other local needs, 250.0 mln m^3 of water is expected to be used in the territory of Armenia in a year. In this case, approximately 440.0 mln m^3 flow is expected to enter our republic. After the border, in the water accumulating part of the Bargushad river, taking into account the flow of about 60.0 mln m^3, the

total annual flow volume of the river can be estimated as 500.0 mln m^3 (until it joins the Hekari river). As we mentioned above, the Barghushad river is mainly regulated in the territory of Armenia and enters the territory of the republic, and for this reason, the flow of the river has very little bottom and suspended sediments, and the flow enters the territory of the republic in a clear state. The high-water period is almost non-existent in spring and autumn. Using the water resources of the Bargushad river as follows can create an opportunity for the rapid development of the economy in the region:

- *Construction of the "Bakhtiyarli" water reservoir, which will have a volume of 50 million m^3, near the village of Bakhtiyarli in the riverbed;*
- *Construction of the "Bakhtiyarli-1" HPP with a capacity of 10.5 MW using the 120.0 m descent in the river between the village of Eyvazli and the "Bakhtiyarli" reservoir;*
- *Measures related to the use of 200.0 mln m^3 of the total water resources of the river in the local area and the lower part of the reservoir for ecosystem protection.*
- *Measures related to diverting 300.0 mln m^3 of water resources to irrigate agricultural fields of Zangilan, Jabrayil, and Fuzuli regions.*

There is a natural descent of 120 m in the 15 km long riverbed from the state border to the envisaged "Bakhtiyarli" reservoir, which constitutes a sufficient hydropower potential. In order to effectively use the hydropower potential of the Bargushad river, which enters the territory of the Republic under regulation, there is a wide opportunity to build a derivation-type HPP. It is possible to create a pressure of 120 meters by building a daily regulating reservoir-water intake device in the riverbed near the Eyvazli village of the Gubadli region, directing the river flow to the derivation pipe with a diameter of DN3000 mm and bringing it to the "Bakhtiyarli" reservoir. The capacity of the derivation-type "Bakhtiyarli-1" HPP will be 10.5 MW. Working continuously during the day, this HPP allows producing about 110.0 mln kWh of electricity, which will supply more than 80,000 people with continuous electricity. To use the water resources of the river more efficiently, it is planned to build the "Bakhtiyarli" reservoir above the city of Gubadli, at an absolute level of 540 m. According to the preliminary hydrological estimations, 200.0 mln m^3 of the total water resources of the Bargushad river is planned to be stored for ecosystem protection and local use in the lower part of the "Bakhtiyarli" water reservoir.

It should be noted that the Gubadli and Zangilan regions are located mainly in mountainous areas and there are few arable land areas. In these areas, there is no way to sufficiently use the abundant water resources of the Bargushad River for irrigation purposes. Using a part of the river's annual water reserve for irrigation in the Jabrayil and Fuzuli regions, which have larger agricultural fields and fertile lands, is considered more appropriate from an economic point of view.

The preliminary hydrological studies show that the annual flow of about 300 mln m^3 can be used to irrigate almost 80,000 hectares of farmland located in the Jabrayil and Fuzuli regions. Hydraulic estimations show that for this purpose, the construction of the self-flowing "Barghusad-Fuzuli" water pipeline with a length of approximately 97 km and a diameter of DN 2500 mm is considered an economically viable variant. The end of this water pipeline, which will provide irrigation water to the fertile lands located along the road, was chosen as the "Ashaghi Kondelanchay" reservoir located in the Fuzuli region. Preliminary hydrological estimation shows that the volume of the " Ashaghi Kondelanchay" reservoir - 9.6 mln m^3- can be increased to 25.0 million cubic meters by raising the earthen dam by an additional 10 meters. Within the framework of this project, it is planned to build "Bakhtiyarli-2" HPP with a capacity of 4.8 MW at the outlet of the irrigation system from the "Bakhtiyarli" reservoir.

The Hekari River, with a length of 113 km and a basin area of 2570 km^2 begins from the southern slope of the Mikhtoken range, at an altitude of 2580 m, joins with the Bargushad River and forms the Bazar River near the village of Garalar in the Gubadli region (340 m absolute level). The annual water reserve of the Hekari River at the confluence with the Bazar River is 500.0 mln m^3. The annual average water flow of the river (Abdallar district) until the confluence of

the Zabukh River was estimated at 10.2 m^3/sec. The main water supply of the river (up to 300.0 mln m^3) begins from the confluence of the Shalva and Hojazsu rivers (950 m). The average annual water flow of the Zabukh River was estimated at 5.15 m^3/sec. In spring and summer, melting snow causes floods in the river. During the flood period (April-June), the annual flow of the river is more than 60-70%. The lowest water flow in the river is observed in the winter months. The average mineral level of the water is 200 mg/l. The spring high-water period is the main water regime phase of the Hekari river. The role of groundwater in the water balance of the river is very large. In the Abdallar district of the Hekari river, groundwater accounts for 48% of the annual flow, in the Khochazsu tributary, 63%, and in the Zabukh tributary, 88%. The river contains 10-15% rainwater. The high-water period begins in March and ends in June. In September - October, autumn floods are observed in the river. The degree of mineralization of the water in the upper flow of the river is low. Mineralization in the flood regime phase in the Lachin area is 170-270 mg/l. The water of the Hekari river fully meets the standards of "Drinking water" due to its mineral composition (5,6). In order to use the water resources of the river more efficiently, it is considered appropriate to use the annual flow volume (approximately 270.0 mln m^3) formed at the confluence of the Shalva and Khojazsu rivers (at an absolute height of 950 m) within the borders of the republic for the water supply of the population. It is planned to build the Hekari water reservoir in this part of the river with a volume of 70.0 mln m^3. By using 270.0 mln m^3 of water resources from the "Hekari" reservoir during the year, it is possible to substantially improve the supply of drinking water to the more than 4.0 million people living in the republic. By using the water resources collected in this reservoir, it will be possible to create the "Hekari-Aghdam" water pipeline and provide drinking water to the residential areas of the Aghdam region in a self-flowing mode. About 230 mln m^3 of the river's water resources are planned to be kept for ecosystem protection and local use in the lower part of the water reservoir. However, the Zabukh river, which has an annual water supply of almost 165 mln m^3, needs to be regulated after joining the Hekari river. Taking this into account, it is planned to build the Zabukh reservoir in the bed of the Hekari river, at an absolute level of 775 m. It will be possible to divert part of the water collected in the Zabux reservoir (approximately 90 mln m3 per year) to the "Barghusad-Fuzuli" water pipeline in a self-flowing mode. After the construction of both reservoirs along the Hekari riverbed, the annual flow regime of the river will be partially regulated and about 140 mln m^3 flow will remain.

Thus, after the partial regulation of the flow regime of both rivers, the total annual flow volume coming to the Araz river will be approximately 340 mln m^3. 130 mln m3 of this flow volume is intended to be used for technical and irrigation purposes in the villages located along the road (along both rivers) (about 20 thousand ha of cultivated land). Taking into account the release of 70 mln m^3 of sanitary flow to the Araz river during the year, for the protection of fisheries, about 140 mln m^3 of flow volume will be created at the confluence of the rivers for irrigation. This water reserve is also intended for irrigation. At the confluence of the Hekari and Barghushad rivers, at the absolute level of 340 m, it is planned to build the "Hekari-Barghushad" reservoir with a total volume of 80 mln m^3 to regulate the residual flows that occur throughout the year. There is a need to build a pumping station with a productivity of 18 m^3 per hour and an installed capacity of 5.8 MW in the lower part of the "Hekari-Barghusad" reservoir. The flow collected in this reservoir during the year is planned to be pumped and transferred to the pressure regulating chamber of the "Barghusad-Fuzuli" water pipeline, which will be located at the level of 500 m near the village of Veysalli. The General Plan for the integrated use of the water resources of the Barghusad and Hekari rivers is given in Figure 4.

Hekari-Aghdam water pipeline. Our research on the water balance of the Hekari River showed that the water reserve of the river of about 270.0 mln m^3 (refers to flows formed entirely within the borders of the republic) can be used mainly for the water supply of the population.

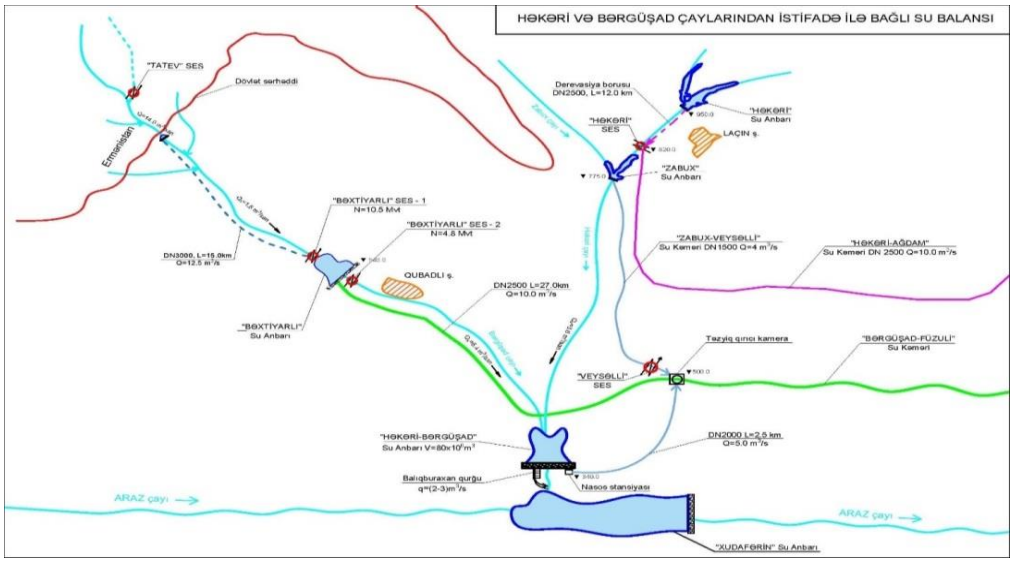

Fig. 4. General plan of integrated use of water resources of Barghusad and Hekari rivers

By using this amount of water resources, it is possible to provide a permanent water supply to more than 4.0 million people living in the territory of the republic. Preliminary studies show that water from the newly built "Hekari" HPP (820.0 m absolute level) will be self-flowing through a steel pipeline with a flow rate of 10 m^3/sec, a diameter of DN2500 mm, and a length of 34.0 km. It is possible to bring this water up to the absolute level of 775.0 m (to the upper level of the existing Chullu reservoir) in the Gayan plain of the Jabrayil region. The hydraulic calculations show that it will be possible to supply water from the water distribution chamber, which will be built at an absolute level of 775.0 m, to the water reservoir at an absolute level of 450 m, in the west of the Marzili village of the Aghdam region, with a total volume of 10.0 mln m^3 in a self-flowing regime without pumps. For this, it is necessary to build 44 km long, DN2000 mm "Gayan-Juvarli" and 60 km long, DN1200 mm "Juvarlı-Aghdam" water pipelines (*in general, the length of the Hekari-Aghdam water pipeline is planned to be 160 km, with a diameter of DN2500-1200 mm. The exact hydraulic parameters of the water pipeline and reservoirs will be specified during the development of the projects*).

To regulate the volume of flow in small reservoirs along the route of the water pipeline and to ensure that it is used locally for the water supply of the population, it is planned to build 6 water reservoirs with a total volume of approximately 152.0 million cubic meters along the water pipeline. In order to provide water supply to the cities of Gubadli and Zangilan and other settlements in a self-flowing mode, without pumps, it is planned to create the "Injachay" water reservoir with a volume of 7.0 million cubic meters in the riverbed of the Injachay at an absolute level of 610 m, where the newly built water pipeline reaches the Geyan plain (east of Chullu village of the Jabrayil district). By using the water reserve collected in this reservoir, it will be possible to provide an uninterrupted drinking water supply to the settlements located in the surrounding area independently of the hydraulic operation mode. The creation of such a small-scale local water source in the area is of strategic importance in terms of the sustainability of the population's water supply. Sustainable management of the system and minimization of operating costs will be possible only by cleaning and disinfecting the water supplied to the population only in one place. In all hydraulic modes of the water pipeline, it will be possible to supply water to the "Injachay" reservoir in a self-flowing manner. It is planned to build "Inja" HPP, which will have a capacity of 1.5 MW, using the large pressure that will be generated during the filling of the reservoir.

To provide a sustainable water supply to Jabrayil city and about 25 villages of the region by

using the constructed water pipeline, it is planned to build the "Suleymanli" reservoir in the valley (640 m absolute level) where the Suleymanli village of the district is located. The water reservoir, which will be created by building an earthen dam, with a total volume of 8.0 mln m^3, will be able to provide a sustainable water supply to the local population. In case of an accident in the water pipeline, this reservoir will provide uninterrupted drinking water for more than 100,000 people living in the vicinity for almost 4 months. The NPL (Normal Pressure Level) in the reservoir is expected to be 680.0 m, which is below the piezometer level that will be created in the water pipeline. In all hydraulic modes of the water pipeline, it will be possible to supply water to the reservoirs in a self-flowing manner. The construction of "Suleymanli" HPP with a capacity of 2.0 MW at the outlet of the water intake facility is also considered. It is planned to build the "Hadrut" reservoir with a volume of 12.0 mln m^3 for the purpose of water supply and tourism at an absolute level of 550 m in the forested valley of Gozluchay in the east of the Hadrut settlement using the constructed water pipeline. It will be possible to provide a permanent water supply to the population living in about 15 villages of the Fuzuli region using the water resources collected in this reservoir. The NPL level in the reservoir is expected to be 620.0 m, which is below the piezometer level that will be created in the water pipeline. In all hydraulic modes of the water pipeline, it will be possible to supply water to the reservoirs in a self-flowing manner. This reservoir, which will be created by building an earthen dam, will be able to provide a sustainable water supply to the local population. In case of an accident in the water pipeline, this water reservoir will provide permanent drinking water to more than 150,000 people living in the surrounding area for almost 5 months. It is considered to build the "Hadrut" HPP with a capacity of 4.2 MW at the outlet of the water intake facility.

It should be noted that the "Hekari" reservoir, which is planned to be built on the Hekari river, is designed to collect mainly the river's spring flood by seasonal regulation. The reservoir is located in the region of the republic with a relatively harsh winter climate. In the winter months, in some years, the air temperature drops to minus 20ºC and the rivers completely freeze (Madatzade and Shikhlinski, 1968; Hasanov and Zamanov, 1973; Museyibov, 1998).

The population density in the area where the reservoir is being built and its immediate surroundings is very low, and there is no need to use large amounts of water. It is considered more strategic and operational to collect a part of the Hekari river's water resources in the reservoir in the densely populated area using the "Hekari-Aghdam" water pipeline. The preliminary hydrological studies show that in the area of the Fuzuli region, where the population will be more densely distributed, there are suitable valleys that can regulate the volume of flow up to 40.0-50.0 mln m^3. In terms of relief and level, the most suitable place was chosen in the valley where the Juvarli village of the Fuzuli region is located. The "Juvarli" water reservoir, which will have a volume of approximately 45.0 mln m^3, can be placed at an absolute level of 420 m in the west of the village of Juvarli. It will be possible to provide a permanent water supply to the population living in about 30 villages of the district, including the city of Fuzuli, by using the water resources collected in this reservoir. The NPL in the "Juvarli" reservoir is expected to be 500.0 m, which is below the piezometer level that will be created in the water pipeline. In all hydraulic modes of the water pipeline, it will be possible to supply water to the reservoir in a self-flowing manner. The construction of "Juvarli" HPP with a capacity of 5.4 MW is envisaged in the outlet of the water intake facility.

The "Juvarli" water reservoir is in a self-flowing mode in terms of height and will be able to provide water to Baku city, including settlements located in the Kura-Araz plain, without the use of self-flowing pumps. The level of the "Juvarli" water reservoir will allow water to be transferred to the "Alatava" water reservoir located in the highest area of Baku (location level 152.0 m) at a rate of 5.0 m^3/s in a self-flowing mode. It is possible to build the "Juvarli-Baku" water pipeline with a diameter of DN2000 mm and a length of 330 km for this purpose. It is possible to supply drinking water to the Hajigabul, Sabirabad, Saatli, Shirvan, Salyan, Neftchala, and Bilasuvar regions by building a new "Juvarli-Hajigabul" water pipeline from the

"Juvarli" reservoir to the city of Hajigabul and connecting the water supply to the existing Kura Water Pipeline. This reservoir will enable optimal management of the "Hekari-Aghdam", "Juvarli-Hajigabul", and "Juvarli-Baku" water pipelines. The "Juvarli" water reservoir is also able to supply water to 3.5 million people without interruption for a month during repairs and accidents that may occur in the "Hekari-Juvarli" (the part of the Hekari-Aghdam water pipeline up to the reservoir) water pipeline. Thus, the "center of gravity" of the water supply source will be the "Juvarli" reservoir, which will be built in the territory of the Fuzuli region, where the population will be more densely distributed, which will allow the transportation and distribution of water to the surrounding settlements in the self-flowing pressure mode, as well as ensure the stability and reliability of the system.

The establishment of a sustainable water supply system for the city of Aghdam and other villages of the region is considered one of the most strategic issues for our republic. As surface water resources are very small in this area, underground water is mainly used for water supply and crop irrigation. It is considered appropriate to create the "Aghdam" reservoir with a volume of 10.0 mln m^3 at an absolute level of 450 m in the west of the Marzili village of the Aghdam region, using the water reserves that will be collected in the "Juvarli" reservoir. The "Aghdam" water reservoir will allow the population living in 15 villages, including the city of Aghdam, to have a high-quality and sustainable water supply. The NPL level in the reservoir is expected to be 450.0 m, which is below the piezometer level that will be created in the water pipeline. The General plan of the "Hekari-Aghdam" water pipeline system that will be created is shown in Figure 5.

It should be noted that in all hydraulic regimes of the Hekari-Aghdam water pipeline, it will be possible to supply water to the reservoirs planned to be built along the road in a self-flowing manner. This water management system will provide ample opportunities for a sustainable water supply for the population of the republic by using the water resources of the Hekari River in the most comprehensive way.

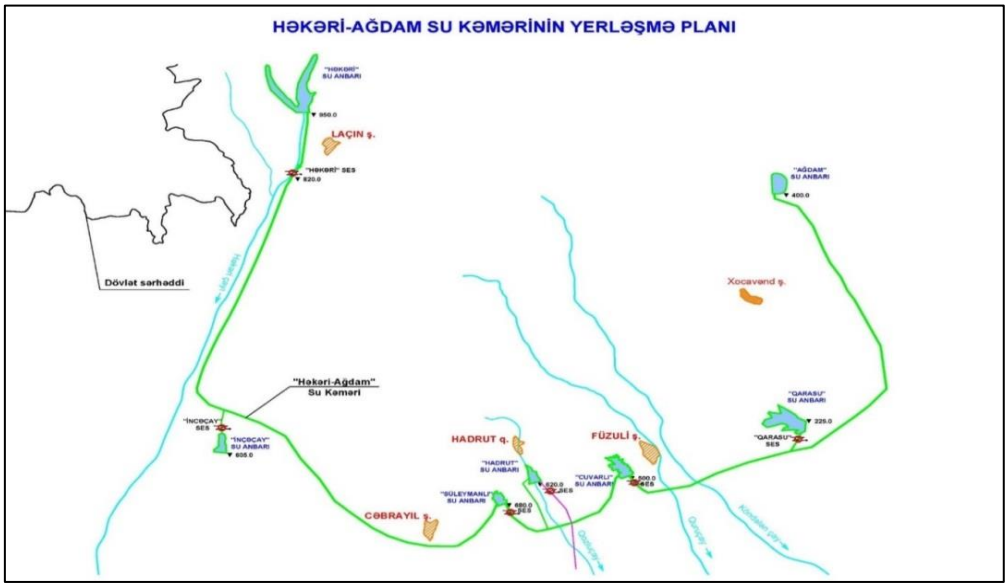

Fig. 5. General Plan of the Hekari-Aghdam water pipeline system

Barghusad-Fuzuli water pipeline. As shown above, a flow of 14.0 m^3 per second will enter the "Bakhtiyarli" reservoir after the Azerbaijan state border. 10 m^3 / sec of this flow is planned to be released for irrigation and the remaining part (4.0 m^3/sec) into the riverbed for local use and sanitary flow. It should be noted that approximately 2.32 m^3 of water is formed per

second in the part of the riverbed from the "Bakhtiyarli" reservoir to the point of confluence to the Hekari river (at the expense of the tributaries of the river). Thus, after the "Bakhtiyarli" reservoir, there will be approximately 6.32 m^3 of flow per second in the bed of the Bargushad river, which is enough for local use. The preliminary hydraulic calculations show that it is possible to transfer irrigation water up to 10.0 m^3 per second from the "Bakhtiyarli" Reservoir, from an absolute height of 540.0 m to the "Ashaghi Kondalanchay" reservoir located in the territory of the Fuzuli region in a self-flowing regime without using pumps. Preliminary studies show that the irrigation water from the Bakhtiyarli reservoir (540.0 m absolute level) at a flow of 10 m^3/sec through a steel pipeline with a diameter of DN2500 mm and a length of L= 27.0 km in a self-flowing mode in the west of Goyarchin Veyselli village of Jabrayil district, at an absolute level of 500.0 m will be taken to the pressure regulation device. The construction of this water pipeline from 2 steel pipes with a diameter of DN 2500 mm (L=70.0 km) after the pressure regulating device to the "Lower Kondalanchay" water reservoir is considered appropriate.

To regulate the discharge of the unused volumes of the flows intended for local use in the beds of the Hekari and Barghusad rivers into the Araz river, it is planned to create the "Barghusad-Hekari" reservoir at the confluence of these rivers. Up to 140 mln m^3 of the annual residual flow collected in this reservoir is planned to be directed to the "Barghusad - Fuzuli" self-flowing water pipeline through pumps. Taking into account the additional flow volumes from the "Hekari-Barghushad" reservoir and the "Zabukh" reservoir, the annual productivity of the "Barghushad-Fuzuli" water pipeline will be 500-530 mln m^3. It is also planned to build 3 HPPs with a total capacity of 19.8 MW on this system to be created. The General plan of the "Berghusad-Fuzuli" water pipeline system is given in Figure 6.

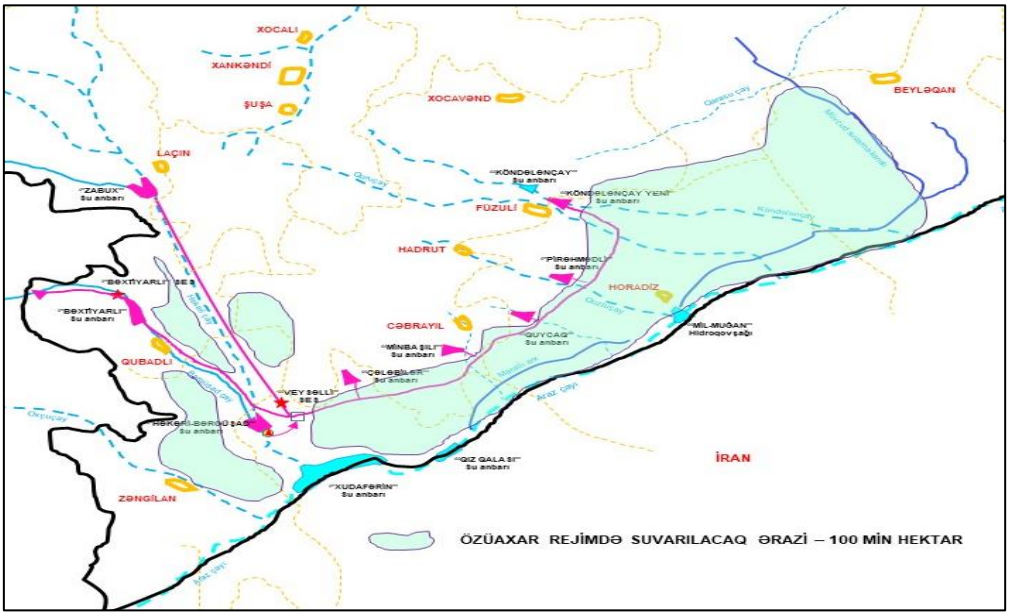

Fig. 6. General plan of "Berghusad-Fuzuli" water pipeline system

The preliminary hydraulic calculations show that the "Bargushad-Fuzuli" water pipeline will provide irrigation water to more than 80,000 hectares of agricultural land in the Gubadli, Zangilan, Jabrayil, and Fuzuli regions in a self-flowing regime without the use of pumps. The main goal of the proposed project is the use of the water resources of the Bargushad River to irrigate the fertile lands of the region without using electricity. While preparing the project, the creation of several regulatory reservoirs along the water pipeline is considered the main priority to

reduce the volume of the "Bakhtiyarli" reservoir and create a self-flowing irrigation system using smaller diameter pipes.

To regulate the unregulated flows of the rivers Barghusad and Hekari, to ensure the reliability and stability of the irrigation system, to implement the emergency and planned stoppages in the pipelines, operation and service procedures, and to regulate the irregularities in the irrigation water demand of plants depending on the vegetation period, according to the location and relief of the areas to be irrigated, it is planned to build 5 reservoirs of appropriate volume along the route of the main water pipeline from the "Bakhtiyarli" reservoir to the existing "Ashaghi Kondalanchay" reservoir ("Chelebilar", "Minbashi", "Guyjag", "Pirahmadli" the existing "Lower Kondalanchay" is planned to be reconstructed).

It is considered appropriate to use a pressure system to supply water to the cultivated fields in a self-flowing mode. It is considered more purposeful from the point of view of hydraulics, technical economics and operation, to collect the volume of flow generated in the autumn-winter months in locally important water reservoirs near the agricultural fields and use them independently in the summer months. These water reservoirs, which will have a total volume of approximately 240.0 mln m^3, will collect the flow of the Bargushad River in the winter months and allow it to be used independently for irrigation in the summer months.

"Chelebilar" and "Minbashili" reservoirs that will be created along the water pipeline will ensure irrigation of about 13.5 thousand hectares of agricultural land (watered by pumps from the Hekari river and Hasanli canal during the Soviet period) in the Jabrayil region, mainly in the Geyan plain, with the application of new techniques and technology in a self-flowing pressure mode. The "Guyjag" water reservoir will provide irrigation of 8.5 thousand hectares of agricultural land (watered by pumps from the Hasanli and Maralarkh canals during the Soviet period) located in the south-eastern part of the Jabrayil district in a self-flowing pressure mode. The "Pirahmadli" water reservoir will provide irrigation of 7.2 thousand hectares of agricultural land located in the south-western part of the Fuzuli region (which was irrigated by pumps from the Bash Mil canal during the Soviet period) in a self-flowing pressure mode.

The end of the water pipeline is chosen as the existing Ashaghi Kondalanchay reservoir with a volume of 9.3 mln m^3, which is located at an absolute level of 360.0 m in the Fuzuli region. Hydrotechnical calculations show that by raising the earth dam of this reservoir by 10.0 m, it is possible to increase its volume to 25.0 mln m^3. With the reconstruction of the existing " Ashaghi Kondalanchay" reservoir, it will be possible to increase the volume of the reservoir, which will create the basis for more areas to be included in the irrigated crop cycle. By using the water reserves collected in this reservoir, there will be ample opportunities to irrigate up to 50,000 hectares of farmland located in the south-eastern part of the Fuzuli region and in the Harami plain (which were irrigated by pumps from the Bash Mil canal during the Soviet period) in a self-flowing pressure mode, with the application of new techniques and technology.

The proposed "Barghusad-Fuzuli" water pipeline system will allow the water source to be changed from the "Bakhtiyarli" reservoir located in the mountainous part of the Gubadli region, where arable land is scarce, to the existing "Ashaghi Kondalanchay" reservoir located in the Fuzuli district, where the region has more arable land. Thus, the "center of gravity" of the water source will be the "Ashaghi Kondalanchay" reservoir, which is surrounded by more agricultural fields, which will allow water to be transported and distributed in the fields mainly in a self-flowing pressure mode and will also ensure the stability and reliability of the system.

Creation of reliable water source for Shusha city and Dashalti settlement. The existing sources that supply the city of Shusha with drinking water have been studied and the problems that have arisen have been identified. Currently, the city of Shusha is supplied with surface water taken from Kichik Kirs and Zarisli water intake facilities. The source located in the village of Zarisli is located 10.7 km west of the city. In the bed of the Zarisli river, a water intake device with a concrete spillway was built at an absolute level of 1627 m. Depending on the flood level in the river, the flow of water taken by the device varies in the range of 5-25 l/sec. The second water source of the city is located in the Asgar valley in the northern part of the Kichik Kirs

mountain, at an absolute level of 1652 m. In this source, a catchment device was built in the riverbed, and the water taken is transferred to the city in a self-flowing mode through a steel pipeline with a length of 11.2 km and a diameter of DN 300-500 mm. Depending on the water level in the river, the flood of water taken by the device varies in the range of 5-35 l/sec. Taking into account global climate changes and the prospective development of the city, we have conducted extensive research on creating a more sustainable source of water supply (Madatzade and Shikhlinski, 1968; Mahmudov, 2009).

According to the General plan of Shusha city, the population of the city will be about 25,000 in 2040. A water flood of 85-90 l/sec is needed for a sustainable water supply for this large population that will live in the city. Existing water sources do not allow for a sustainable water supply for such a large population. In the summer months, it is possible to supply water to the city from both sources at a rate of 10-15 l/sec. Creating a reliable and stable water source for the city of Shusha and the village of Dashalti is considered one of the most important issues of the day. Since the underground water in the area is very limited, the option of using the water supply of the Zarisli river, which is located around the city, was preferred for the population's water supply.

Using the hydrological data of the Aghakorpu station of the Gargar river for the years 1939-1988, the hydrological parameters of the stream in the Nabiler station of the Zarisli river were restored. Taking into account global climate changes and the prospective development of the city, creating a more sustainable source of water supply for the population is of strategic importance. The Zarisli tributary of the Gargar river is considered the most reliable water source for this area. The annual water supply of the Zarisli river passing through Dashalti village is estimated at 12-14 mln m^3. The preliminary studies show that it is possible to create a water reservoir with a volume of 7.5 mln m^3 on the Zarisli river, above the Nabilar village, at an absolute level of 1210.0 meters. In the "Galaba" water reservoir, it will be possible to collect two years' supplies of drinking water for Shusha city and provide the city with high-quality water continuously. Using the water resources of the Zarisli river, it is also considered appropriate to create the "Zafar" water reservoir with a total volume of 15 mln m^3 in a deep river valley with hard rocks, located in the lower part of the Jidir plain, below the village of Dashalti. It will be possible to supply water to other villages of the Shusha district in a self-flowing mode using the water reserves collected in the "Zafar" reservoir. "Victory" and "Zafar" water reservoirs, which will be created in a charming river valley surrounded by forests, will be a reliable source of water for Shusha and surrounding settlements and will create great opportunities for the development of winter and summer tourism in the area.

Integrated use of Guru Chay river water resources. One of the rivers formed in the territory of Karabakh is the Guru Chay river. Guru Chay river, with a catchment area of 201.0 km^2, is formed mainly in the Khojavand region. The main tributaries of the river, formed from the Big and Small Kirs mountains, merge near the village of Tugh and Boyuk Taghlar, and pass through the territory of the Fuzuli region and join the Araz river. The water resources of the river are partially used for irrigation. The average annual water supply of the river is estimated at 50 mln m^3. It is considered appropriate to use the water resources of the Guru river, which is formed due to spring and snow waters located in the mountain range of the Lesser Caucasus and is not subject to any pollution, to supply drinking water to the population living in the Fuzuli and Khojavand regions. The water of this river fully meets drinking water standards in terms of quality and is of great importance as a source of sustainable water supply for settlements located in this area.

Preliminary hydrological calculations show that it is possible to build the "Guruchay" reservoir with a total volume of 35.0 mln m^3 in order to use the water resources of the river more efficiently in the riverbed, near the village of Boyuk Taghlar.

It is planned to build the "Guruchay" reservoir in the lower part of the village of Boyuk Taghlar, in the valley of the river surrounded by forests, at an absolute level of 750 m. The main priority is to use the reservoir in a complex manner, taking into account the requirements of water supply, fishing

and tourism requirements. For this purpose, the useful volume of the water reservoir should be 20.0 mln m^3, which will allow for the constant supply of drinking water for more than 120.0 thousand people living in the vicinity during the year. The area chosen for the construction of the water reservoir is surrounded by forests and monuments with ancient history (Azikh cave and numerous Albanian temples are located nearby), which is considered very suitable for the development of tourism. According to the developed General plan of the city of Fizuli, it is assumed that the population of the city will be almost 50,000 in the future. For irrigation of Fuzuli city, surrounding villages, industrial areas and greenery, approximately 350-600 l/sec of water is needed. Fuzuli city and large villages are mainly located in areas below 450.0 m level, which is about 300.0 meters below the location of the mentioned reservoir.

It will be possible to provide a permanent water supply to the city of Fuzuli and its surrounding settlements using the high-quality water reserves that will be collected in the "Guruchay" reservoir. It is also possible to create a 1.2 MW "Fuzuli" hydropower plant using the surplus water taken from the reservoir, which will be located 19 km from the city of Fuzuli. It should be noted that the "Guruchay" water reservoir is located 1.5 km away from the currently under construction Fuzuli-Shusha (Zafar road) highway. The road infrastructure will allow reaching the recreational facilities that will be built around the reservoir in a very short time.

The location plan of the reservoirs to be built on the Zarisli and Guru rivers is given in Figure 7.

The main benefits of the reservoir to be built in the channels of Zarisli and Guru rivers:

- New reservoirs will regulate the water supply of Zarisli and Guru rivers, minimize potential flood and environmental risks;
- It will create new opportunities for the development of tourism in the Karabakh region and the republic as a whole;
- It will create a foundation for the creation of recreation and leisure centers;
- With the construction of the "Galaba" water reservoir, a source of sustainable drinking water supply will be created for the city of Shusha and the village of Dashalti;

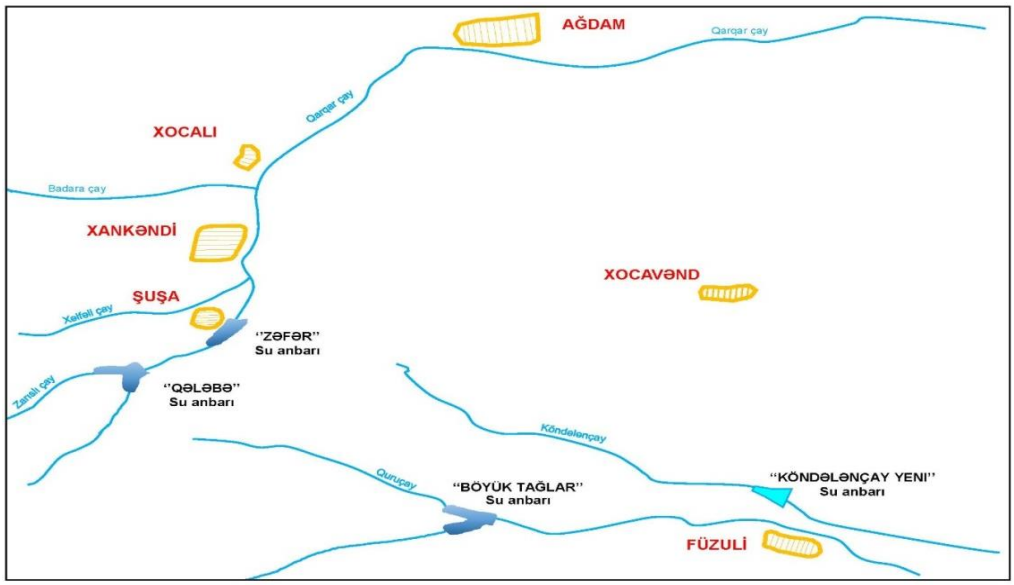

Fig. 7. Location plan of reservoirs to be built on Zarisli and Guru rivers

- The construction of the "Guruchay" water reservoir will create a wide opportunity to fundamentally improve the supply of drinking water to the villages of Khojavand and Fuzuli regions;
- "Guruchay" reservoir will create ample

opportunities for the development of intensive horticulture in the area;
- A favorable environment will be created for the development of fishing (mainly trout);
- The creation of reservoirs will greatly support population settlement in the area;
- Conditions will be created for the development of water sports;
- It will support the socioeconomic development of the region;
- It will allow mitigating the risks caused by global climate change;

CONCLUSIONS

1. Since the flow of the Bargushad river is fully regulated in the territory of Armenia and enters the territory of the republic, spring-autumn flow regimes are not observed in the river (the flow of the river mainly fluctuates in the range of 11-33 $m^{3/}$sec during the day).
2. In order to supply 80,000 hectares of fertile arable land located in the Gubadli, Zangilan, Jabrayil, and Fuzuli regions with irrigation water in a self-flowing mode without the use of pumps, it is considered appropriate to create the "Berghusad-Fuzuli" water pipeline system that will start from the "Bakhtiyarli" reservoir and end at the existing "Lower Kondalanchay" reservoir (about 300.0 mln m^3 of the river's flow will be used during the year).
3. In the summer months, it is considered appropriate to build 5 locally important, off-channel water reservoirs with a total volume of more than 220.0 mln m^3 to ensure independent irrigation of agricultural fields located along the aqueduct.
4. With the creation of the new "Bakhtiyarli" reservoir and the "Berghusad-Fuzuli" water pipeline system, it is possible to build 3 HPPs with a total capacity of 19.8 MW on this system, which will provide more than 120,000 people with GREEN ENERGY during the year.
5. The "Hekari" reservoir, which will be built in the bed of the Hekari river, at an absolute level of 940 m, will create ample opportunities to regulate its flow regime and provide more than 4.0 million people with high-quality drinking water.
6. The "Hekari-Aghdam" aqueduct, which will be created using the relief height of the area, will allow the population living in settlements located in Gubadli, Zangilan, Jabrayil, Fuzuli, Aghdam, Aghjabadi, and Beylagan districts and Kura-Araz plain to be provided with drinking water in a continuous, self-flowing mode. The envisaged water management system will create ample opportunities for a water supply in the Aghdam region in a reliable, self-flowing mode.
7. "Juvarli" water reservoir, which will be built in the area of the Fuzuli district, where the population will live more densely, at an absolute level of 500 m, will enable the reliable and sustainable operation of the envisaged water management system and will be able to provide water to Baku city in a self-flowing mode.
8. It will be possible to build 5 HPPs with a total capacity of 21.1 MW on the envisaged "Hekari" reservoir and the "Hekari-Aghdam" water pipeline, which will allow generating approximately 160.0 mln kw/h of electricity.
9. It is possible to provide a sustainable water supply to Shusha city and Dashalti village by using the water reserve of the Zarisli river (annual average flow volume is about 12-14 million cubic meters). By building the "Galaba" reservoir with a total volume of 7.5 mln m^3 in the riverbed above the village of Nabilar, it is possible to create a reliable and stable water source for a continuous water supply for the city of Shusha.
10. Using the water resources of the Zarisli river, it is considered appropriate to create a "Victory" reservoir with a volume of 15.0 million cubic meters, which can support the development of tourism in the lower part of the Dashalti village, under the Jidir plain, in the river valley surrounded by rocks on all sides. In addition to serving winter and summer tourism, this reservoir will be a sustainable source of water for the villages located along the Gargar river in the Shusha district.
11. In order to more efficiently use the water resources of the Guru Chay river, which has an annual water supply of 50.0 mln m^3, it is considered appropriate to build the "Guruchay" reservoir with a volume of about

35.0 mln m^3 in its bed, in the lower part of the village of Boyuk Taghlar. Using the water resources collected in this reservoir, it will be possible to supply water to the villages of Fuzuli city and Khojavand region in a self-flowing mode, and there will be ample opportunities for the development of tourism in the region.

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Şərqi Zəngəzur və Qarabağ iqtisadi rayonlarındakı çayların su ehtiyatı və yaşıl enerji potensialından inteqrasiyalı istifadə

Məmmədov Əhməd Şirin oğlu, Cavadzadə Elşad Bəylər oğlu, Bayramov Arzuman Əvəz oğlu

"HIDROLOQ" Məhdud Məsuliyyətli Cəmiyyəti, Bakı, Azərbaycan

İşğaldan azad edilən Şərqi Zəngəzur və Qarabağ iqtisadi rayonları ərazisində formalaşan su ehtiyatlarının respublikanın dayanıqlı su təminatında xüsusi əhəmiyyəti vardır. Burada yerləşən münbit torpaqların bu su ehtiyatlarından səmərəli və komples şəkildə istifadə etməklə əkin dövriyyəsinə qoşulması və əhalinin sürətli şəkildə məskunlaşması həyata keçirilə bilər. Məskunlaşmadan öncə bu ərazidə yerləşən çayların su və hidroenerji potensialından istifadə olunmaqla suvarma və su təchizatı sistemləri yaradılmalıdır. Payız və yaz gursululuğu böyük olan bu çayların su ehtiyatlarından səmərəli istifadə etmək zəruridir. Bu çayların çox böyük enerji potensialı vardır və onlar üzərində müxtəlif təyinatlı hidrotexniki qurğular tikməklə bu iqtisadi rayonlarda yaşayacaq əhalinin elektrik enerjisinə olan tələbatını tam ödəmək, həmçinin iqtisadi baxımdan daha əlverişli olan özüaxımlı rejimdə idarə oluna bilən su təsərrüfatı sistemi yaratmaq mümkündür. Təbii şərait və ərazinin relyef göstəriciləri, əkinə yararlı münbit torpaq sahələrinin çayların hövzələrindən kənarda yerləşməsi amilləri nəzərə alınmaqla daha optimal su təsərrüfatı sisteminin yaradılması ilə bağlı mühəndisi hidroloji araşdırmalar aparılmışdır. Məqalədə, böyük hidroenerji potensialı olan Oxçu çayın ciddi şəkildə çirklənmiş su ehtiyatından yaşıl enerji almaq üçün onun məcrasından kənarda, iki ədəd derevasiya tipli su elektrik stansiyasının yaradılmasının layihə həlli verilmişdir. Oxçuçay üzərində tikiləcək SES-lərdə il ərzində 80.0 mln kvt/saat elektrik enerjisi almaq olar ki, bu da 120 min nəfərdən çox əhalinin daimi olaraq elektrik enerjisi ilə təmin etməyə imkan verəcəkdir. Eyni zamanda məqalədə Həkəri, Bərgüşad, Qarqar (Zarıslı qolu) və Quruçay üzərində su anbarlarının tikilməsi ilə onların axım rejimlərinin tənzimlənməsi və regionun dayanıqlı su təminatında istifadə olunması ilə bağlı layihə həlləri təklif olunmuşdur. Yaradılacaq su təsərrüfatı sistemi 4.0 mln nəfərdən çox əhalinin daimi içməli su təminatını aparmağa və 80 min hektara qədər əkin sahəsini suvarma suyu ilə təmin etməyə imkan verəcəkdir.

Açar sözlər: *Su təminatı, çay, su ehtiyatları, su anbarı, məcra*

Комплексное использование водных ресурсов и зеленого энергетического потенциала рек Восточно-Зангезурского и Карабахского экономических областей

Мамедов Ахмед Ширин оглу, Джавадзаде Эльшад Байлар оглу, Байрамов Арзуман Аваз оглу

Общество с ограниченной ответственностью"ГИДРОЛОГ", Баку, Азербайджан

Водные ресурсы, формирующиеся на освобожденной от оккупации территории Восточного Зангезура и Карабахской области, имеют особое значение для устойчивого водоснабжения республики. Эффективное и комплексное использование этих водных ресурсов будет способствовать подключению плодородных земель, расположенных в свободных Карабахском и Восточно-Зангезурском экономических районах, к сельскохозяйственному циклу и быстрому расселению населения. Перед заселением должны быть созданы системы орошения и водоснабжения с использованием водного и гидроэнергетического потенциала рек, расположенных в данной местности. Необходимо рационально использовать водные ресурсы этих рек в период осенне-весеннего половодья. Эти реки обладают огромным энергетическим потенциалом, и, строя на них гидротехнические сооружения различного назначения, можно полностью удовлетворить потребность в электроэнергии населения, проживающего в этих экономических районах, а также создать систему управления водными ресурсами в самотечном режиме, что более выгодно с экономической точки зрения. Проведены инженерно-гидрологические исследования по разработке более оптимальной системы водопользования с учетом факторов природных условий и показателей рельефа местности, расположения плодородных земель, пригодных для возделывания вне бассейнов рек. В статье представлено проектное решение по созданию двух гидроэлектростанций производного типа вне русла реки Охчучай с целью получения зеленой энергии из сильно загрязненных водных ресурсов этой реки, обладающей большим гидроэнергетическим потенциалом. На строящихся на реке Охчучай ГЭС в течение года можно получить 80,0 млн кВтч электроэнергии, что позволит обеспечить постоянное электроснабжение более 120 тысяч человек. Кроме того, в статье предложены проектные решения, связанные со строительством водохранилищ на реках Гекари, Баргушад, Гаргар (приток Зарисли), Гуручай, регулирование режимов их стока и использование в устойчивом водоснабжении региона. Создаваемая система водного хозяйства позволит обеспечить постоянным питьевым водоснабжением более 4,0 млн человек и обеспечить оросительной водой почти 80 тыс. га сельскохозяйственных угодий.

Ключевые слова: *Водоснабжение, река, водные ресурсы, водохранилище, русло*