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# **The role of ecosystems of Azerbaijan - forests and wetlands - as water suppliers**

Rafiq Verdiyev  
ECORES NGO



Azerbaijan is one of the countries in the South Caucasus and has a territory of 86,600 km<sup>2</sup>. The range of elevation within the Republic varies from 4,480 m. in the Major Caucasus Mountains (Bazarduzu crest) to -26.0 m (Caspian Sea level). The average altitude of the area is 384 m with 18 per cent of the area below sea level, 39.5 per cent is between 0 and 500 m, 15.5 per cent is between 500 and 1,000 m., and 27 per cent is greater than 1,000 m. Sharp changes of altitudes due to the orographic structure of the Major and Minor Caucasus Mountains and the location of the Kur-Araz lowlands form the unique climate in the Republic. Climate conditions and relief of the area plays special role in formation of the water resources of the republic.

Forests and wetlands of Azerbaijan play an important role in formation and distribution of water resources of the country. In this regards their protection, sustainable use and restoration are essential for the sustainability of water resources management.

### **Wetlands of Azerbaijan and their role as water provider**

Wetlands of Azerbaijan perform functions such as flood control, water purification, water regulation, production of fish and etc. They exist at all elevation zones from marches in river deltas, to swamps, lakes, and creeks in alpine regions.

There are 250 wetland areas, including mountain lakes with total area of 250 km<sup>2</sup>. Ten of which have the surface area more than 5 km<sup>2</sup>. Some of the lakes are freshwater and others are saltwater lakes.

Wetlands are been categorised as followings:

1. Wetlands of Kura araz lowlands
2. Wetlands of Absheron;
3. Mountain wetlands

Ramsar Sites of Azerbaijan Ag-Gol and Ghizil-Agaj and many other wetlands in the Kura floodplain play important role for flood mitigation and water supply for fish. Most of the wetland areas are located on the Caspian Sea Coast and Kuta –Araz lowlands. Before their area made up 80,000 ha ( in the middle of last century). Now area of wetlands has been dramatically decreased in result of antropogenic activity, including construction of cascade on water reservoirs on Kura and Araz rivers .

The largest wetland in Kura-Araz lowlands is Sarisu. It is located in lowlands with an area of 65.7 km<sup>2</sup> and capacity of 59.1 million m<sup>3</sup>. One of the wetlands formed as a result of easy meandering of Kura River is stagnant at Hajigabul Lake. The area of it is 8,4 km<sup>2</sup>, and average depth is 1.4 m, length is 4.2 km., the capacity is 12.1 million m<sup>3</sup>. Ag-Gel(56.2 km<sup>2</sup>), and Mekhman(35.0 km<sup>2</sup>) lakes are also main wetlands of this area. The total area of these 4 wetlands of Kura-Araz lowlands make up 165 km<sup>2</sup>

As it is mentioned, the construction of water reservoirs negatively affected the wetlands. Level of water at Shilyan, Bostanchala, Garasu, Mahmudchala, Agchala and other wetlands has significantly decreased and most of them had died because of non sufficient amount of water. Four mentioned large wetlands which are separated from Kura now get water from the collector-drainage system of Kura-Araz lowlands.

In result number of flood increased and fish reserves have been decreased. People also can not use wetlands so wide as they did before. Now wetlands of this area receive the Kura waters at the period of maximal flooding and do not allow the flood to spread to large areas.

There are more than 50 reservoirs in Azerbaijan. Although most of them were been built for irrigation purposes. Because of absence of safe drinking waters people use their waters also for drinking.

Water reservoirs has also created their own ecosystem. They changed climate at sites where they are built and made it more moderate. Number of dry years and strong winters has been decreased.

Reservoirs are being used for different purposes including water supply for population, irrigation fish industry, energy production and etc.

Cascade reservoir systems on Kur River include Mingechevir, Shamkir, Yenikend, and Varvara Reservoirs. The “Araz” water junction on the Araz River and the Sarsang Reservoir on the Tartar

River also produce energy. The Jeyranbatan Reservoir supplies Baku and Sumqayit cities with potable water. Water to this reservoir comes through Samur-Absheron Canal from Samur River. The total amount of water taken from Samur River by this canal is estimated at 0.80 to 0.85 km<sup>3</sup>. The total capacity of operating water reservoirs in the country is about 20.6 km<sup>3</sup>, the net storage volume is 12.4 km<sup>3</sup>, the total area is 877 km<sup>2</sup>, and the total capacity of hydroelectric power station (HPS) is 978,500 kilowatt.

Number of wetlands of Absheron reaches 150. Their total area makes up 50 km<sup>2</sup>. Only 6 wetlands are large( Boyuk Shor, Masazir, Binagadi, Kurdakhani, Khoja Khasan and Krasnoe). At XVII-XVIII centuries wetlands of Absheron were been used for salt production and medical treatment. Now they are strongly polluted.

Wetlands of Lesser Caucasus mountain are situated at 1400-3000m above sea level Their number is 20 and total area is 12 km<sup>2</sup>. Largest wetlands are Alagol, Garagol and Gou-gol. Their waters are clean. These wetlands are good places for tourism development.

Jandargol Lake is located on the border with Georgia and has an area of 10.6 km<sup>2</sup> and capacity of 51 Mm<sup>3</sup>.

Number of Great Caucasus mountain wetlands reach 70. Their total area is 2km<sup>2</sup>.In this areas number of population is not high and waters of wetland are clean.

People of Great and Lesser Caucasus use waters of the wetlands for drinking purposes. Many rivers of this territory have their origins in the mountain wetlands. They provide many of settlements use their water for drinking, irrigation, agriculture and etc. The highest mountain lake is Tufangol Lake (3,277 m) located in Demiraparan River basin. Its area is 0.1 km<sup>2</sup> and the capacity is 0.11 Mm<sup>3</sup>. The most picturesque and freshwater lake of Azerbaijan is Goy-Gol that was formed as a result of earthquake in the Agsu River at an elevation of 1,556 m in 1139. Others lakes (Maralgol, Zaligol, etc.) were also formed as a result of that earthquake. Goy-Gol is running water pond. The area is 0.79 km<sup>2</sup> and the capacity is 24 Mm<sup>3</sup>.

Wetlands also take an active part in formation of beautiful ecosystem of Greater and Lesser Caucasus mountain areas including climate of the territory. Most of rivers because of them are regulated and do not have rear frequency run-off characteristics.



**Photograph 1. Goy-Gol Lake**

The water resources of Azerbaijan are limited in comparison with other countries in the South Caucasus and is only 15 per cent of the all water resources in the region. Water per area and per person in Azerbaijan is 7.7 and 8.3 times less than in Georgia and 2.2 and 1.7 times less than in Armenia, respectively. From the water supply point, the Republic is considered to be one of the driest regions of the world with approximately 100,000 m<sup>3</sup>/year of water per km<sup>2</sup>, and the annual amount of water per person is 950 to 1,000 m<sup>3</sup>/year. The total of water resources of the republic varies from 28.5 to 30.5 km<sup>3</sup>. The number is further

reduced in arid years to approximately 27.0 and 22.6 km<sup>3</sup>. The water resources of the Republic are shared unequally.

There are 8,359 rivers in the Republic and two of them (Kur and Araz Rivers) have a length of more than 500 km. Another 22 rivers have length of 101-500 km, 40 rivers have a length of 51 to 100 km, and 107 rivers have a length of 26 to 50 km. There are 5,141 rivers in the Kur River basin and 1,177 are of Araz River basin. Common river network density is about 0.36 km/km<sup>2</sup>.

Groundwater provides only about 5% of the total water abstraction. It plays an important role, however, for irrigation and water supply to provincial towns and rural areas, especially in the foothills of the mountain ranges. Groundwater resources are mainly restricted to the foothills and intermountain plains of the Greater Caucasus, Lesser Caucasus, Nakhchivan and Talysh. The total groundwater resource is estimated at 24 million m<sup>3</sup> per day (8.8 km<sup>3</sup> per year). At present 5 million m<sup>3</sup>/day or 20% is exploited. Groundwater is mainly used for irrigation (78%), 3% is used by industry and 19% for water supply to provincial towns and rural areas. The underground waters of the republic are characterized by high quality. It is generally used in agriculture and common industries. In Ganja-Gazakh and Garabagh-Mil confined groundwater basins, the underground waters are mainly used for irrigation purposes in different regions of the area. Total capacity of exploitative underground water reserves is estimated to be 8 to 9 km<sup>3</sup> per year, which may play significant role in sustainable water supply of Azerbaijan.

In summary, the water resources of Azerbaijan are distributed as following:

- River waters: 28.5 to 30.5 km<sup>3</sup> of which 9.5 to 10.0 km<sup>3</sup> belong to internal rivers and rivers flowing into the Caspian Sea
- Freshwater wetlands: 0.03 to 0.05 km<sup>3</sup>
- Water reservoirs: full capacity of 20.6 km<sup>3</sup> and a useful capacity of 12.4 km<sup>3</sup>
- Exploitation capacity of underground waters: 8.0 to 9.0 km<sup>3</sup>
- Water resources of glaciers: 0.080 to 0.085 km<sup>3</sup>

Wetlands play important role in water supply at low water period. They are critical components of water cycle that delivers our freshwater. Capturing and storing precipitation they slowly release water and act as regulators. Most of Azerbaijan wetlands too merit designation as Ramsar Wetlands of International Importance.

Wetlands also need some water input in order to exist and fulfil its objectives. That is why river basin management should be based at ecosystem approach. Run-off of rivers, basins of which have significant wetlands is distributed more proportionally and amount of water in such rivers is higher. For example, Ganjachay river, Kurakchay river and Tartarchay river may be considered rivers with high wetland areas.

### **Forests of Azerbaijan and their role in water conservation**

The total forest area of Azerbaijan is 860,000ha or 10% of its territory. Specialists estimate that 5 hundred years ago forest cover made up 40-50%.

Forests play the main role in preventing soil erosion, protect waters and provide habitat for most of the terrestrial animal species.

The forests are classified for five ecological regions in Azerbaijan: the Greater Caucasus Mountains, the Lesser Caucasus Mountains, the Kura-Araz valley and floodplain, the Talish-Lenkeran zone, and the Caspian Sea.

The Caucasus Mountains (Greater and Lesser) consist of mountain forests at altitude of 500 to 2500 m. These are dominated by Georgian oak mixed with, for instance, hornbeam, Caucasian lime, sweet chestnut, ash, and others, at lower altitudes. Broadleaved oak, beech and maple dominate in the higher zones. 90% of forest (800,000ha of which 134,000ha belong to Talish mountains, 360,000ha to Greater and 250,000ha to Lesser Caucasus ) belong to mountain area. The up border of forest should be about 2500m, but because of antropogenic influence in many places this figure is less than 2000m.

The forest coverage in Sheki Zagatala zone makes up 27%. That is why run-off coefficient here is highest. Quality of water is high and waters are sweet. Observation shows that humidity of soil under forest is 2,5-2,8

times higher than it is in area which is not covered by forests. These areas also are characterised with high and stable level of ground waters.

20% of basins of Agstafachay, Tovuzchay and Zayamchay rivers is covered by forest. This leads to 4-5 times increase of their run-off.

In the basins of rivers of the South slope of Greater Caucasus (rivers of Shirvan) and many rivers of Nakhchivan forest does not exceed 5%. In these rivers annual run-off is low and in summer they dry. During the period of intensive rainfall of snow melting because of absence of forest often occur floods maximal discharges of which dozen times exceed their average values. Absence of forest also create suitable condition for soil erosion and landslides.

The role of ground waters in rivers of Gobustan because of absence of forest ground waters make up 5% of total, but at the river Pircagat of neighbouring territory with higher forest areas this figure exceed 15%.

The subalpine zone is mainly covered with low spruce, pine, fir and beech forests, including endemic birch species, *Betula medwedewii* and *Betula megrelica*. Beside grassland, tall herbaceous vegetation can be found in this zone, which is typical for very few mountain ecosystems (Alps, Himalayas, Pamirs). In the alpine zone, from 2500 to 3000 m, grass meadows prevail, and areas of rhododendron and rock vegetation can also be found.

Results of research of specialists show that in the subalpine zone mountain slopes mainly are steep and most of waters of rainfall and melting snow flow through the surface and create plenty of tributaries. But below at the forest zone these waters become captured by forests and transferred to grounds. In lower elevations water appear at the surface like small springs.

Mountain steppes cover lower altitudes, and are used for agriculture (crops, vegetables, fruit trees and fodder plants). There are many species that are remote ancestors of domestic fruit trees (e.g. pear and almond trees). Dry scrub forests of Juniper, pistachio, maple, and almond are combined with scrub species.

In these areas run-off occurs only during the period of snow melting or rainfall. In summer rivers dry. At the areas with no forest or other plants often soil erosion and landslides occur.

The Kura-Araz valley and floodplain includes semi-desert vegetation (dominated by wormwood). Steppe vegetation occurs in the lowlands and foothills, dominated by grass and thorny shrubs, within which small areas of endemic pine, *Pinus eldarica*, can be found. This zone is also used for agriculture. Total forestry makes up 0.8% and no run-off.

Riparian (*tugay*) forests occur along riverbanks. Wing nut, oak and poplar prevail. These forests are especially endangered in the Kura valley, because the water regime has been changed by the construction of a hydropower plant. Now in the Kura valley this figure has decreased to 23,000 ha.

Forests help to conserve river bed stop its deformation and soil erosion and protect wetlands of the area from drying.

The Talish-Lenkeran zone is found along the western part of the Caspian coastline and the Talish Mountains. This area is well known for relict forests (*Quercus castanifolia*, *Zelkova carpinifolia*, Caucasian persimmon, Girkan poplar and hornbeam).

In mountains forests help to increase the run-off coefficient.

Forests play important role in formation, distribution and conservation of water resources. About 60,000 ha forests (5% of total) carry water conservation functions, of which 40,000 ha is situated at plain areas.

Results of research show that run-off of rivers with high forestry coefficient basins in summer months is higher. Role of ground waters in formation of run-off of these rivers also is higher.

In order to provide all year run-off of rivers the area of forest at their basin should be 25-30%. In this regards forest areas should be increased And density of forest at southern exposition and steep slopes should be higher.

Trees to be planted should be different because of high conservation property of mixed forests.

In Azerbaijan, forests are degraded owing to two major problems. These are illegal logging and grazing, both caused by economic problems and poverty.

Construction of the hydropower plant in the Kura-Araz river catchment system (Mingchevir) also changed the water regime and contributed to the degradation and loss of tugay forests. The natural flood cycle on which these forests depended was lost and no biodiversity conservation measures were taken. Another hydropower plant, which is currently under construction in the Kura river valley (Enikend), could add to the habitat degradation. Tugay forests are among the last original white poplar habitats, and provide nesting and wintering sites for waterfowl species. The Ministry of Ecology and Natural Resources is considering measures for the restoration of these areas, including pumping and irrigation systems that would keep changes in the water levels close to natural ones. Although it is not possible to assess the size of the

impacted area without a thorough EIA, the fact is that the few remaining tugay forests are very endangered and should be preserved.

Local communities, including large numbers of refugees, try to solve their economic problems by raising cattle, over which there is no control. Too many animals per unit of area degrade pastures and forest areas, especially young trees and shrubs. Forest regeneration is thus endangered, and overgrazed pastures turn to barren soil exposed to erosion. An integrated approach to forest and rangeland management is needed.

Forestry inspectors report that illegal logging is widespread, amounting to 30,000 to 40,000 m<sup>3</sup> annually (no statistics were available to verify these figures). Owing to the energy crisis, local people and refugees cut forests to provide their households with firewood. Inspection is very weak; there is one forest inspector per rayon (34 altogether) and they lack equipment (primarily vehicles and communication tools).

### **Water ecosystem conservation activities in Azerbaijan**

Since 2002, forest management plans have been developed by the Forest Management Agency, which is financed by the State budget, and the plans are approved by the Forestry Department of the Ministry of Ecology and Natural Resources. Lack of institutional experience in both forest inventory and planning is considered a major institutional problem in dealing with forestry.

The protection and rehabilitation of forests are financed from the Forest Fund, administered by the Forestry Department. Its sources of revenue are fines imposed for violating the Forestry Code and donations. It was reported that the Fund was mostly used to cover the salaries of employees in rayon offices, and there is not enough for other reforestation expenses. According to the National Programme for the Restoration and Expansion of Forests (approved by the President in 2003), about 64,000 ha should be reforested by 2008, but only about 3000 ha will be completed in 2003, owing to insufficient financing.

During 2002-2003 years reforestation activities were carried out at more than 15,000ha.

Two measures for combating forest degradation are being implemented. The first one is fencing of forest areas in which there is young growth, which needs to be preserved, to keep livestock out. The other is reforestation .

Protected area categories defined by the Law on Specially Protected Natural Areas and Objects (2000) include those that are international (some natural reserves), national (State reserves and national parks) and local (natural reserves, natural monuments, zoological parks, botanical gardens and dendrological parks, health resorts). Private landowners or long-term lessees can also establish local specially protected areas. National parks, natural parks, ecological parks and zoological parks have the status of nature protection and research institutions. There are no provisions on the organization of these institutions. Protected areas are established for protection, research, monitoring, training and tourism purposes. Banned activities are listed for each protection category.

Currently, there are 34 protected areas, of which 14 are strict nature reserves (*zapovedniki*) and 20 are nature reserves (*zakazniki*) . *Zapovedniki* correspond to the first protection category of the World Conservation Union (IUCN). According to the National Report on the Ecological Network (2001), they occupy 192,761 ha (2.2% of the country). Each *zapovednik* is managed by a director and has 20 to 25 permanent staff. *Zakazniki* and other protected categories (including endemic and relict forests) occupy 379,000 ha or 4.3% of Azerbaijan's territory. They have a weaker conservation status and are managed either by *zapovedniki* managers or by the regional authorities.

According to the National Report on the Ecological Network (2001) of the Committee of Experts for the Development of the Pan-European Ecological Network, submitted to the Council of Europe, the establishment of the national ecological network – AZECONET (specially protected natural areas) – is expected to be one of the most efficient measures for conserving biodiversity, because it would comprise the most important terrestrial ecosystems/habitats that need preservation. The existing protected area system will be expanded by 500,000 ha to encompass types of habitats that are not sufficiently represented. This programme will run until 2010.

Another important for sustainable rural development measure, is the national park development.

By the decrees of the President of Azerbaijan Republic Ordubad, Shirvan, Aggol and Hikran national parks are been created. Many wetland an forest areas are been preserved at these parks.

Creation of Shah-dag National Park in the Northern Caucasus within Azerbaijan is supported by the World Bank, the Global Environment Fund (GEF) and other donors. The national focal point is the Minister of Ecology and Natural Resources. The core park area will be under strict biodiversity conservation, mainly:

Integrated forest, rangeland and protected areas management. The park management plan will be developed in a participatory process, targeting particularly capacity-building of the public sector and improvement of environmental knowledge of local communities. It will be based on intersectoral cooperation and focused particularly on forest and tourist components and management.

Rural energy supply and conservation. Measures for reducing unsustainable firewood use will be introduced by developing a rural energy strategy and public awareness campaign.

Environmental management capacity-building and environmental education. This component will assist the Ministry of Ecology and Natural Resources to improve protected area management, forestry management and environmental management, including education programmes for civil servants in environmental situations

To ensure that the project is sustainable, appropriate incentives are planned to involve the local communities and demonstrate local benefits (e.g. local income-generating activities, such as ecotourism). The institutional and public capacity-building component is assessed as critical, because the Ministry, regional and park staff should maintain and replicate the project's outcomes once it has been completed. Pilot testing of the newly developed management tools and timely dissemination of the results to local communities are also intended to reduce the project's risks.

Shah-Dag National Park (World Bank) project will also envisage building databases and software. This would serve as a basis for biodiversity monitoring and significantly contribute to the development of a national information system and biodiversity management.

Several environmental NGOs are involved both in projects and in awareness-raising. For example, the Birdlife Organization works on high mountain ecosystem protection; the Ecological Education Organization is engaged in the development of the Caucasus mountain tourism route; and the Azerbaijan Society for the Protection of Animals cooperates with the World Wide Fund for Nature (WWF) to improve veterinary services, implement the Aarhus Convention, develop public education programmes on the environment and monitor the seals in the Caspian Sea.

Regarding to river ecosystem protection it is worthy to note that within the South Caucasus water management project of USAID as a pilot project in the Alazan river basin was developed the Integrated River Basin Plan. In this plan wide stakeholder participation is considered and series of necessary projects have been identified. Some of them are directed at water resources, wetlands and forests conservation. During last two years some NGOs of Alazan river basin implemented 8 public awareness project in this sphere. NGOs, local population and schoolchildren attended field work on river bed cleaning, forest planting and etc.

In order to increase public participation in water ecosystem management group of stakeholders was created and instructions in the field of water resources conservation were been prepared and submitted to the basin population through organised training.

This experience gained there may be used by other river basins of the country.

All above mentioned show that unsustainable management of wetlands and forests of the country since the middle of the last century negatively effected on water, people, flora and fauna, and on society. It was also connected with low level of awareness of population, and decisions made have often caused destruction of these ecosystems with negative consequences for the water resources.

Crucial aspects are the monitoring and assessment of the efficiency of protection and restoration measures with regard to water management and the definition of future measures needed to meet the set performance objectives



Water resources are important elements of development processes, and their management should be based on integrated ecosystem approach combining land and water management with the needed collaboration of all stakeholders.

The role of wetlands and forests in this regards should be taken into account.

When developing strategies it is necessary to relate many of other wetlands of Azerbaijan to important categories accordingly with the Ramsar convention. Planting of forests should be sufficient to cover the demands of river ecosystems.

Public awareness campaigns about the role of wetlands and forests as water suppliers among the different stakeholders in the whole watershed (national authorities, the public and the private sector) should be carried and stakeholders, including the public, NGOs should be involved in the planning and implementation of basin-wide water-related projects to guarantee integration of forests, wetlands and water management policies, their efficiency and sustainability.