**Impacts of Climate Change on Forests and Sustainable Forest Management in Azarbaijan**

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**Preamble**

Global climate change is a result of industrialization and the use of fossil fuels, which began in the 1850s and have continued till today, and the accumulation of excess carbon in the atmosphere has become the most important problem of our time. Global climate change, which threatens all living things and minimizes their possible effects, is our main problem. To solve this problem, comprehensive measures should be taken at both the individual and institutional levels.

One of the most effective ways to reduce excess carbon accumulation in the atmosphere is to increase and protect carbon in living tissues, such as forests. There is a two-way link between climate change and forest ecosystems. Although climate change has a negative impact on forest areas, forests reduce these effects by creating carbon retention zones. The possible effects of climate change on forest ecosystems are forest sensitization, reduction of forest areas, changes in distribution areas, reduction of biomass, changes in species composition in forests and an increase in the possibility of forest fires. These impacts are expected to adversely affect the economy due to the production of wood and non-wood products, increasing the risk of flooding and erosion.

The liberated territories of the Republic of Azerbaijan are among the regions most affected by climate change. Expected negative impacts of climate change include weakening and depletion of water resources, drought, forest fires, deaths due to heat waves, environmental degradation, erosion, reduced agricultural productivity, and an increase in vector-related diseases.

**Namik Khidirov, Chief of Forest Development Service**

1. **Summary**

Due to the features of environmental problems, these problems exceed national borders with increasing interdependence between countries. Now, each country's use of environmental resources affects the natural resources of another country. Disputes arising from the use of available resources within the framework of the policy of states to protect their sovereignty and natural resources are regulated by international environmental law. The fact that environmental issues are not limited to one country and the impact of environmental problems on the whole world requires cooperation between countries. Thanks to this cooperation, the international community has developed many conventions, principles, norms and protocols in order to prevent environmental problems, preserve existing values ​​and pass them on to future generations. As a member of the international community, Azerbaijan seeks to fulfill its obligations to future generations by joining to environmental conventions and bringing its national environmental legislation into line with international standards.

Azerbaijan, like many countries around the world, faces environmental problems at the local, regional, national and international levels. It takes various initiatives to find solutions to these problems and actively participates in regional and international discussions. After gaining independence, it has ratified various international environmental agreements and is actively involved in research on this issue, participating in projects as an interested party in solving environmental problems related to its region.

Environmental problems exist at the global, regional and local levels. Mankind began to take various measures, realizing that the living conditions of the world's living beings could not continue with long-term limitations if they continued with the rapidly deteriorating environmental pollution, production and consumption balance that emerged as a negative consequence of this situation.

The report provides brief information on the physical-geographical, natural and water resources, climate and its main elements of the Republic of Azerbaijan, and notes the natural risks and disasters that have occurred in the country over the past 30 years. Climate change trends and future climate change issues in the Republic of Azerbaijan have been studied. Predicted climate changes in Azerbaijan were assessed on the basis of various models. The impacts of climate change on various sectors (water resources, agriculture, the Caspian region, human health, etc.) have been studied.

Climate and risk monitoring, the results of research in this area in the country, regional climate change and reduction initiatives of disaster risk were also noted. Research has shown that the Republic of Azerbaijan does not have sufficient potential in the face of climate change and natural disasters. Therefore, decision-makers, informal leaders and civil society organizations should work together to adapt to climate change so that our country can continue to develop and prosper in the future.

**2. Existing forest policy, legislation and strategic documents and institutional structures in relation with forestry and climate change**

**Climate change**

Following the ratification of the Framework Convention on Climate Change in 1995, the Republic of Azerbaijan undertook to develop, implement and publish national and regional programs aimed at mitigation of the expected effects of global climate change. In 1997, the State Commission on Climate Change was established by the order of the President of the Republic of Azerbaijan to fulfill the obligations arising from the Convention. The commission includes all relevant organizations and ministries. In 2000, the Kyoto Protocol was ratified. Climate Change and Ozone Center has been established within the Ministry of Ecology and Natural Resources to coordinate activities in the field of the Convention.

Azerbaijan's first step in this area was the "First National Data of the Republic of Azerbaijan" project, developed with the financial and technical assistance of the United Nations Development Program and the Global Environment Facility. Measures to reduce greenhouse gases were assessed in the second step, the project "Building Capacity for Climate Change in Priority Areas of the Economy." The Republic of Azerbaijan has adopted a number of state programs and normative acts related to the Framework Convention and other related international documents, many of which are documents that help to mitigate climate change (Table).

**Normative documents adopted in the Republic**

|  |  |  |
| --- | --- | --- |
| S/S | Name of documents | Date of acceptance |
| 1 | On measures to ensure the implementation of the obligations assumed by the Republic of Azerbaijan in accordance with the UNFCCC approved by the Republic of Azerbaijan on January 10, 1995 | 30.04.1997 |
| 2 | National Program of the Republic of Azerbaijan on ecologically sustainable socio-economic development | 18.02.2003 |
| 3 | National Program on Reforestation and Afforestation in Azerbaijan | 2003 |
| 4 | State Program "On the use of alternative and renewable energy sources in the Republic of Azerbaijan" | Noyabr, 2004 |
| 5 | State program on development of fuel and energy complex of the Republic of Azerbaijan during 2005-2015 | 14.02.2005 |
| 6 | Presidential Decree on the approval of the "Comprehensive Action Plan for 2006-2010 to improve the environmental situation in the Republic of Azerbaijan" | 21.09.2005 |
| 7 | Presidential Decree ‘’On additional measures in the field of issues arising from international conventions and agreements to which the Republic of Azerbaijan is a party in connection with environmental protection’’ | 30.03.2006 |

In addition, Memorandums of Cooperation were signed between the Governments of Azerbaijan, Denmark and Germany to participate in international and regional programs in order to increase knowledge in the field of climate change, to strengthen the capacity to develop and implement projects to reduce greenhouse gases.

**International programs with the participation of the Republic of Azerbaijan**

|  |  |
| --- | --- |
| Organizations | Programs |
| CIDA (Canada) | Training programs on reduction of greenhouse gas emissions in the Caspian countries (2004-2005) |
| EU TACIS | Technical Assistance to the Caucasus Republics and Moldova in Implementing Global Climate Change Commitments (2004-2006) |
| UNDP | Increasing capacity to improve the inverting of greenhouse gas emissions (2003-2005) |
| UNDP | Preparation of I and II National Data Report |
| ECON, NORSK Energy (Norway) | Opportunities for a Clean Development Mechanism in Industrial Development and Poverty Reduction (2006-2007) |
| UNDP | Capacity Building for Clean Development Mechanism in Azerbaijan (2006-2008) |

In order to strengthen Azerbaijan's participation in the Kyoto Protocol's Clean Development Mechanism, the Ministry of Ecology and Natural Resources was appointed as the National Authorized Body (MSO) by the Presidential Decree dated April 1, 2005.

**Disaster risk reduction.**

To reduce disaster risks, commitments should be made and implemented at the national and local levels to protect people's lives and livelihoods from the effects of natural disasters. The decision-making process should take into account the impact on society and the environment. In order to reduce natural risks, policies, laws, plans, programs, projects should be developed and resources should be allocated for their implementation. The main priorities of the Azerbaijani state for the population's care include the organization of protection and safety of people from emergencies.

For many years, it was managed by the Emergency Situations Commission and the Civil Defense Headquarters in the Republic. In 2005, a unified system of ministries - the Ministry of Emergency Situations - was established in the country. At present, this ministry is a full guarantor of the protection of the Azerbaijani people from emergencies (disaster management, early warning, etc.). The Republic of Azerbaijan participates in international cooperation in the field of environmental security. Our country has joined 20 international conventions in this field. Among them are:

• Convention on Long-Range Transboundary Air Pollution (Geneva, 1979), year of ratification - 2002;

• Convention for the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), year of ratification - 2001;

• Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO, 1991), year of ratification - 1999.

**Environmental law**

One of the important tasks facing the state is the formation of domestic legislation in the field of environmental protection in accordance with international documents. Legislative acts to be prepared in this case, on the one hand, determine the domestic legal mechanisms of international legal regulation, on the other hand, should ensure the development of environmental legislation. These issues are also an integral part of the legislative system of the Republic of Azerbaijan. In general, the domestic legislation of the Republic of Azerbaijan in the field of environment can be grouped in several directions:

1. Legislation adopted on general issues:

• “Land Code” (1999-cu il);

• “Water Code” (1997-ci il);

• “Forest Code” (1997-ci il) və s.

2. Legislation on environmental protection and subsoil:

• Environmental Protection Law (June 8, 1999);

• Law on Access to Environmental Information (April 18, 2002), etc.

3. Legislation on forest and water protection:

Law on Water Supply and Wastewater (28.10.1999);

• Resolution of the Cabinet of Ministers of the Republic of Azerbaijan No. 145 of 30.09.2004 “On measures to prevent violations of forest legislation”, etc.

4. Legislation on specially protected natural areas and wildlife:

• Law on Specially Protected Natural Areas and Objects (March 24, 2000);

• Law on Animal Welfare (June 4, 1999), etc.

5. Legislation on hydrometeorological activities, natural disasters and protection of atmospheric air:

• Law on Atmospheric Air Protection (March 27, 2001);

• Law on Hydrometeorological Activities (April 17, 1998) and others.

6. Legislation on "Environmental Security and Awareness":

• Law on Environmental Security (June 8, 1999);

• Law on “Environmental education and enlightenment of the population” (10.12.2002), etc.

7. Legislation envisaging taking measures in the field of fulfillment of obligations arising from international documents:

• Order of the President of the Republic of Azerbaijan dated 23.03.2005 “On ensuring the implementation of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity”, etc.

According to the Law of the Republic of Azerbaijan "On Environmental Security" (08.06.1999), environmental security is to ensure the protection of vital interests of human and society, the environment from threats arising from anthropogenic and natural influences. The law states that every citizen has the right to protect their health from environmental hazards (accidents, disasters, etc.). Article 7 of the law states that the state ensures the environmental safety of citizens, foreigners and stateless persons of the Republic of Azerbaijan. All persons have the same right to compensation for damage caused by a dangerous environmental situation.

**Climate and risk monitoring, research and early warning**

As in all countries, hydrometeorological observations are made in Azerbaijan, a member of the World Meteorological Organization (WMO), forecasts are made, climate, agro-climate and water resources are assessed, and their changing trends are monitored. Meteorological, agrometeorological, hydrological and observations in the Caspian Sea are carried out by the National Hydrometeorological Service of the Ministry of Environmental Protection, and observations on environmental (soil, water and air) pollution are carried out by the National Monitoring Service. In addition, the State Amelioration and Water Management OJSC conducts hydrological observations in large and small reservoirs in the country. Azersu OJSC carries out environmental monitoring of drinking water sources. After becoming a member of the WTO and joining to a number of Conventions, Azerbaijan has gained the opportunity to participate in various international monitoring systems. Thus, 5 stations of the country are included in the Global Observation System, and 18 stations are directly included in the Global Climate Observation System. The global ground observation network includes one station from Azerbaijan - Astara (GJOS / GSN). The network of surface meteorological observations in Azerbaijan is based on 78 stations, 12 of which are located in the liberated area and do not operate. The results of observations conducted at 58 operating stations serve to provide the population with information on climate and to develop this information.

1. **Forest condition and greenhouse gas inventory**

The total state forest fund of the Republic of Azerbaijan is 1213.7 thousand hectares (14 percent). The forest area of this area is 1021.9 thousand hectares, which is 11.8% of the total area of the country. This figure is 44% in the Russian Federation, 41% in Latvia and 39% in Georgia. 910,580.58 hectares of the forest fund, including 772002.76 hectares of forested areas belong to the state forest fund lands. Specially protected areas are 303,119.42 hectares, of which 249,897.24 hectares are forested areas.

The reserves of firewood in the roots are 149 million cubic meters. There are 0.12 hectares of forest per capita, which is 2-3 times less than the world average. In the XVIII-XIX centuries, 35% of the territory of present Azerbaijan was covered with forests.

Today, the existing forests of the republic are unevenly distributed. 49% of the country's forest resources fall to the Greater Caucasus region, 34% to the Little Caucasus region, 15% to the Talysh zone and 2% to the Aran zone (including Nakhchivan AR).

A large area of ​​Azerbaijani forests is located on the southern and north-eastern slopes of the Greater Caucasus Mountains. These forests start in Azerbaijan and extend to the border with Dagestan. The forests cover the territory in the north-east of Azerbaijan, mainly in the south-western direction from Gusar, Guba, Devechi, Siyazan and Khizi administrative districts. In the south-western direction of Khizi region, the forest massif is gradually decreasing and being replaced by a completely forestless area. In the southern macro-slope of the Greater Caucasus, the forest massif is being restored in the Shamakhi region and extending to the border of the Republic of Georgia, establishing a complete cover with mountain slopes without interruption. The forests here mainly cover the mountainous part of Ismayilli, Gabala, Oguz, Sheki, Gakh, Zagatala and Balakan administrative districts. The forest expands continuously along the southern slope in a westerly direction towards the territory of Georgia.

One of the vast areas of forests is the slopes of the Little Caucasus Mountains. Here the forests cover the northern, north-eastern and eastern slopes of the main mountain branches in the form of separate massifs. Only in the territory of South Karabakh, the forest massif is interrupted and does not reach the Iranian border. In addition, forests are found in the form of islands in the territory of Shahbuz district of Nakhchivan Autonomous Republic, on the slopes of Kukudag.

One of the vast forests covers the slopes of Talysh.

A small part of the forests stretches along the banks of the Kura and Araz rivers and forms the striped Tugay forests.

Azerbaijan is famous all over the world for its charming beauty, rich natural resources, colorful flora and fauna. There are 4,500 species of higher plants belonging to 125 families and 930 genera. Of these, 435 species of trees and shrubs belonging to 48 genera and 135 genera grow in the forests of the Republic. This is 11 species of plants in the flora of the Republic. There are 70 regional endemic species in the dendroflora of Azerbaijan. This is 16% of the total tree and shrub species.

Despite the rich composition of the Azerbaijani dendroflora, there are few species that form the main forest. Azerbaijani forests consist mainly of broadleaf species. The main coniferous forests are Pinus Hamata, Pinus Eldarica, Taxus Bacaata, Juniperus Salina, C. Oblonga, C. Pugmaca, C. Depressa, C.Polycarpos and other types grow. Coniferous forests (juniper and pine) make up about 1.6% of the forested area of ​​the Republic's forests. There are no evergreen broadleaf forests in the Republic of Azerbaijan. Such species are found only in the greenery of settlements in Baku, Ganja, Sheki, Sumgayit and other large cities and settlements. The basis of the republic's forests are broadleaf species that shed their leaves in winter. Most of the forests consist of valuable tree species (oak, beech, hornbeam, linden, maple, etc.). Broad-leaved forests are typical for the entire territory of the republic.

The area covered by forest is distributed according to the dominant species as follows: pine-0.04%, juniper-2.37%, beech-31.68%, oak-23.4%, hornbeam-26.01%, ash-0 , 01%, maple-0.22%, poplar-3.58%, alder-1.87%, linden-1.71%, elm-1.16%, other species-7.95%. Despite the diversity of forests, deciduous forests are mainly composed of beech, oak and hornbeam species. These three species account for 85.5% of the forested area.

The distribution of forests varies by age class. Thus, young forests cover 11.2% of the forested area, middle-aged trees - 63.3%, growing trees - 13.4%, mature and old forests-12.1%.

Most of Azerbaijan's forests (85%) are located on steep slopes and are of invaluable soil protection, water purification and climate purification importance.

The distribution of forests also varies by density. 13.7% of the republic's forests are low (0.3-0.4), 2.62% are medium (0.5-0.6), 18.3% are normal (0.7-0.8) and 2.62% are high (0.9-1.0) in density. The total average density of forests was 0.56.

The distribution of forests also varies according to the bonitet class. Forests of high I-II quality account for 14.9% of the forested area, III quality - 42.3%, IV quality - 27.4% and low quality V-class forests - 15.4%. The average annual growth of forests is 1.74 m3. This increase is 1.77 m3 in hard-leaved species (beech, oak, hornbeam, etc.) and 2.12 m3 in soft-leaved species (poplar, fraxinifolia, alder).

There are 150 species of wild fruit plants belonging to 1536 genera in our forests. 30% of these fruits are important products.

There are favorable conditions for the development of beekeeping in our forests. At present, about 700 bee families are kept in forest enterprises. Bees help to pollinate forest plants, provide plentiful seed production and provide additional honey production.

The distribution of Azerbaijani forests by heights also has its own laws. Thus, oak and hornbeam forests predominate on the northern slopes. There are low-yielding oak, elm and ironwood forests in the lower mountain belt, relatively productive oak-hornbeam forests in the middle mountain belt, and higher-yielding oak-hornbeam forests in the upper mountain belt.

In the area where the forest belt joins the subalpine belt, there are low-yielding birch forests and low curved beech forests. Such regularities are peculiar to the Talysh, Greater and Little Caucasus mountains.

If illegal deforestation is not prevented in time, our country may face the threat of severe environmental disasters, the expansion of erosion, the growth of steppe areas, floods and landslides in mountainous areas, snowslides, drying of springs and rivers. Therefore, it is necessary to pay more attention to the following key areas in the field of forestry and its solution.

It is necessary to increase the extent of reforestation and protective forest strips several times in the territories of the republic, especially in low-forested and non-forested lowland areas. In this direction, large-scale work should be carried out to restore and reconstruct the Tugay forests located in the valleys of the Kura and Araz rivers, the main water arteries of the republic. In order to prevent water erosion in mountainous areas, protective forests should be established in large areas, as well as a comprehensive action plan (reforestation, agro-ameliorative and hydro-ameliorative) should be implemented for the management of large mountain river basins.

An action plan should be developed and implemented to carry out landscaping work in ravines and Caspian coastal sands in the country on the basis of special projects.

Difficulties in providing rural areas of the country with gas and other fuels have led to the use of firewood as the main fuel. It should be noted that in the past, 1.2-1.5 mln. m3 of firewood, 200-250 thousand tons of coal were almost stopped. This, in turn, has led to a significant increase in pressure on our forests. It should be noted that due to the small area and low occupancy of our lowland forests, it is impossible to carry out large-scale deforestation in these areas. As for mountain forests, it should be noted that most of them are located on high slopes, and deforestation here can put these areas at risk of erosion.

The washing of saline and re-salinized soils and the establishment of ameliorative forest strips of tree species suitable for the soil and climatic conditions in these areas may allow the return of large areas of decommissioned land to agricultural use in the future. Along with the lands of the state forest fund, the planting of greenery in large areas around large industrial enterprises is also one of the important directions.

As a result of the aggression of our country against the Armenian occupiers, many of our territories have been occupied. Our forests here, especially our mountain forests, have been severely damaged. As a result of the Armenian aggression, the occupied forest fund area was brutally cut down and looted. The deforestation of valuable tree species growing in these areas has brought the protection of biodiversity to a critical level.

At the root of the problem of climate change is the Earth's potential to absorb carbon dioxide (CO2) and other greenhouse gases (methane (CH4), nitrogen oxides, especially NO2, freons, and tropospheric ozone). Over the last 200 years, especially since 1950, human activity has led to an increase in the concentration of greenhouse gases. These gas mixtures and aerosols transmit shortwave sunlight and, like a greenhouse cover, prevent long-wave radiation, resulting in a gradual warming of the climate.

The share of carbon dioxide in the greenhouse effect is 60-64%. This gas enters the atmosphere as a result of the combustion of carbonaceous fuels (coal, oil, gas) in industry and in car engines (currently more than one billion cars are used on the ground), in thermal power plants. In recent years, more than 9 million hectares of forest have been destroyed on our planet every year. It should be noted that the forest absorbs 20 times more carbon dioxide than a field of the same area.

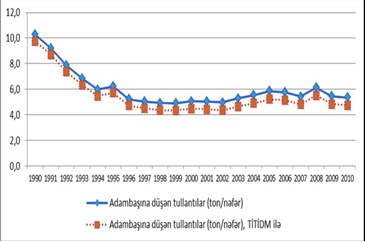
At present, there are 2.6 • 103 billion tons of CO2 in the atmosphere, and 20 billion tons (6 billion tons of carbon)of CO2 are released into the atmosphere every year. The US National Academy of Sciences estimates that by 2100, CO2 concentrations in the atmosphere will double; According to other models, the amount of CO2 will increase 3 times that year. CO2 is expected to double in the middle of the 21st century.

According to the International Conference of the UNEP, the temperature of the planet has risen by 0.60C over the last hundred years due to the increase in CO2, and by 2100 the temperature is expected to rise by 1.5-5.80C. Temperature rise in polar latitudes can reach 100C. Regular measurements of atmospheric CO2 growth began in 1959. Since that year, the 14 warmest seasons observed have fallen since the 1980s. In the last three decades, the average annual surface temperature has risen from 13.990C to 14.430C, or 0.440C, from 1969-1971 to 1998-2000. If the CO2 concentration doubles by the end of this century, the temperature will rise to 1.5-5.8, as shown above. Rising temperatures will lead to extreme climatic events, severe hot weather, associated melting glaciers, rising ocean and sea levels, and devastating storms and hurricanes.

¾ Part of the anthropogenic CO2 released into the atmosphere is associated with the combustion of organic fuels (oil, gas, coal), and the rest is due to changes in the agricultural system and the reduction of forest areas. In the 90s of the XX century, the concentration of CO2 increased by 0.2-0.8% per year. The increase in the concentration of methane (CH4) in the atmosphere began in 1750, and to this day the increase is 151% and continues to increase.

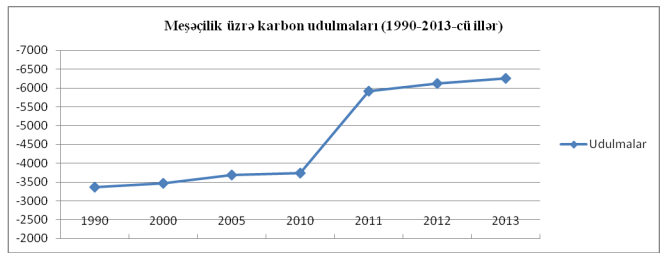
The main source of methane in the atmosphere is the burning of organic waste, the increase of livestock waste, etc. is considered. The concentration of nitrogen oxides in the atmosphere has also increased significantly in recent decades, due to the cultivation of this soil in agriculture and the development of the chemical industry. In addition, small amounts of gas mixtures as chlorine, sulfur, etc. are released into the atmosphere. All these gases enter the atmosphere continuously and form anthropogenic aerosols, which change the radiation conditions. Thus, starting from 1750, the flux of solar radiation increased by 0.3 W / m2, and most of these changes occurred in the first half of the twentieth century.

According to the results of the latest inventory of heat-generating gases in the Republic of Azerbaijan, in 1990, the base year, per capita heat-emitting gas emissions were 10.4 tons of CO2 equivalent, while in 2010 this figure was 5.4 tons of CO2 equivalent. This figure is slightly higher than the world average (4.43 tons of CO2 in 2010).



Azerbaijan ranks 80th out of 159 countries in terms of greenhouse gas emissions. Azerbaijan's carbon emissions are 47 million tons.

Changes in absorption of greenhouse gases in the forest sector in 1990-2013, thousand t, CO2 eq.



**4. Risk management and climate forecasts and scenarios of the country**

Today, even if all countries struggling with climate change significantly reduce or stop greenhouse gas emissions from causing global climate change, the accumulation of these gases will remain in the atmosphere for a long time. For this reason, lowering the sensitivity of hydrometeorological disasters in Azerbaijan should be seen as one of the key elements in adapting to climate change and reducing disaster risks. In other words, at a time when global warming cannot be stopped completely, it is time to look for ways to minimize the negative effects of climate change. Studies aimed at mitigating the negative effects of global climate change are generally referred to as “adaptation” studies (UNFCCC, 2007).

The process of adapting to global climate change helps societies to overcome these negative effects of global climate change. Adaptation aims to reduce the negative effects of climate change, but also to increase its positive effects with the necessary rules. There are many methods and techniques for adaptation, ranging from technological measures such as building flood walls or flood-resistant houses, to changing people's behavior in everyday life, to reducing water use during droughts. Other strategies include setting up early warning systems for severe climate events, better water management, risk management, improving insurance options and protecting biodiversity.

Two main factors play a role in the catastrophes becoming sharp by global climate change. The first is the existence of a danger, and the second is the existence of an object or wildlife that could be at risk by the event caused by that danger. Whether or not the threat turns into a catastrophe, a measure to reduce risk can eliminate the danger with minimal damage. In this context, it is necessary to have detailed information about the events and social factors that pose risks to life, property, health, welfare, environment, sustainability, development, natural and cultural resources. Thereafter, structural and non-structural adaptations may be undertaken to reduce or eliminate losses such as loss of life and property due to hazardous conditions and long-term effects. For this reason, adaptation and risk management for each hydrometeorological disaster should be carried out on the following:

• Threat Analysis

• Risk Analysis

• Risk Reduction

• Prevention

• Avoidance

• Risk and damage reduction

• Risk Transfer-Insurance

• Disclosure of risk

• To plan

• Forecasting and early warning

• Training

Undoubtedly, with the support of all political and financial factors, the existing risk factors should be taken into account, and local governments should be established to adapt and manage disaster risk.

In this regard, climate change mitigation and adaptation, ie “global climate change risk management”, should be one of the priorities for governments and local governments. To this end, disaster risk management and climate change adaptation strategies should be considered in conjunction with common goals and objectives as follows:

**Adaptation to Climate Change (ACC)**

Until now, IDU has sought to reduce the potential harm of human-induced climate change. The focus is now on hydrometeorological hazards and their (largely uncertain) long-term effects. Thus, preparations (including the irreversible and short-term effects of hydrometeorological disasters) began.

**Disaster Risk Management (DRM)**

Until now, DRM has been combating threats by interfering with inhumane (geological, technological, etc.) and short-term (less uncertain) events. It has now begun to reduce the risks and long-term effects of all threats (including human behavior and human origins) and to combat insurmountable risks.

Statistically, Azerbaijan has shown an increase in average annual temperature, average daily minimum temperature and average daily maximum temperature over the last century. There is a broad scientific consensus that these changes are due to other anthropogenic emissions known as carbon dioxide (CO2) and greenhouse gases (CG). All forecasts show that by the end of the XXI century, the average annual temperature will increase significantly. According to the forecasts for the A2 emission scenario in Azerbaijan, it was 3 ºC-6 ºC.

Forecasts for precipitation forecast a decrease in annual precipitation. Decrease in precipitation is forecasted at 5-23%. Using the A2 emission scenario, the projected changes in average annual temperatures in 2050 are 1.0 ºC to 1.6ºC. Similarly, the forecast for 2100 is more dramatic, from 3.6ºC to 4.1ºC.

• Increased CO2 concentrations will have a positive effect on tree growth. Because the current CO2 concentration in the atmosphere is below the optimal level for plant growth. However, any changes in productivity due to high CO2 levels in the atmosphere will be compensated for by climate change resulting from high levels of carbon and other greenhouse gases, and in most cases will be completely eliminated:

• Changes in temperature, precipitation, wind and humidity will affect photosynthesis and evaporation (resulting in development), reproduction, pollination, seed propagation, phenology, resistance to parasites and diseases, and competitiveness.

• More frequent strong winds will damage forests by uprooting trees and breaking branches of trees, as well as more frequent heavy rains will increase the risk of soil erosion and landslides. Complications caused by such events will reduce productivity in the short term and make forests more susceptible to parasites and diseases.

• Prolonged dry and hot weather will increase the risk of forest fires. Terrible fires will destroy organic matter and nutrients will disappear by evaporation. Frequent fires can increase soil erosion, reduce regeneration, and accelerate desertification in arid areas.

• Warm climatic conditions increase the risk of mass reproduction of insects. The effects of drought on trees will make forests more susceptible to attack by herbivores and fungal diseases.

• Climate change may increase the availability of fertile habitats for the development of widespread species. Dominant endemic species may not be able to adapt to the changing environmental conditions of their habitats, which may lead to gender reassignment, as well as ecosystem dysfunction and resource depletion after repetitive patterns.

While some forest formations may benefit from climate change, most formations will be affected. Against the background of more environmentally friendly greenhouse gas emission scenarios, the conditions will be more favorable for dry forests, ie beech, chestnut, ironwood and hornbeam. Against the background of less environmentally unfavorable emission scenarios, the conditions along most of the forests will be favorable only for dry forests and hornbeam forests.

Therefore, the migration and adaptation rates of most tree species are not at the same level as the projected global warming trends. If no action is taken to mitigate the effects of climate change on forests, the damage that climate indicators do to forest health, viability and productivity will have a significant impact on people living in the region. These results include:

• Total decrease in the volume of wood and non-wood products (eg mushrooms, berries and walnuts) from existing forest species,

• General reduction in the cost of environmental services provided by forests, including water quality and water flow regulation, erosion, landslides, and avalanche prevention;

• Specific reduction in biodiversity;

• Changes in the visual landscape.

**5. Impact of climate change and changes in forests over the last 30 years, including monitoring and reporting**

The Republic of Azerbaijan is located in the east of the South Caucasus. Its territory stretches from north to south from the mountains of the Main Caucasus to the Little Caucasus and the Talysh Mountains. It stretches along 400 km from north to south and 500 km from west to east, between latitudes 38º 25′-41º 55 ′ north and east longitudes 44º 50 ′ - 50º 51 ′ (Figure 1).

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Figure 1. Geographical map of the Republic of Azerbaijan

Climate change in the world, of course, affects the Republic of Azerbaijan. The Republic of Azerbaijan is distinguished by its climate diversity. According to the research, from 11 climate types known in the world, there are 8 climate types mentioned in our republic:

1. The most common type of semi-desert and arid steppe climate in the country. This type of climate covers more than 50% of the territory of the republic: Kur-Araz basins; Caspian zone - from Samur river to Gizilagaj guls; Arazboyu plains of the Nakhchivan Autonomous Republic; Closed mountain depressions in the Lankaran zone. Annual precipitation in this area is 15-50% of possible evaporation. Summers are hot, some days the temperature is above 40 ° C, winters are cold.
2. In the low mountainous areas of the southern slope of the Greater Caucasus, a mild-hot climate with dry winters is observed. Annual precipitation in this zone is 50-100% of possible evaporation. Summers are mild and warm, winters are mild and less rainy
3. The Lankaran zone of the Republic of Azerbaijan is characterized by a temperate-hot climate with dry summers. Annual precipitation in this zone is 100-150% of possible evaporation and more. Summers are mild and dry, autumns are very rainy and winters are mild.
4. On the north-eastern slope of the Greater Caucasus, at an altitude of 1000-2700 m, and in the middle and high mountains of the Little Caucasus at an altitude of 1400-2700 m, a cold, dry winter is observed. Annual precipitation here is 75-100% of possible evaporation. Summers are cool here and winters are a bit harsh.
5. In the Republic of Azerbaijan, only in the middle and high mountainous zone of Nakhchivan AR, a cold climate with dry summers is observed at an altitude of 1000-3000 m. Annual precipitation here ranges from 50 to 100% of possible evaporation. Summers are cool, winters are cold and snowy.

VI. In the zone of mountain forests on the slopes of the Greater Caucasus at an altitude of 600-1500 m in the south and at an altitude of 200-500 m in the north-east, a moderately warm climate with equal distribution of precipitation is observed. The annual precipitation here is 75-100% of the possible evaporation on the southern slope, 50-100% on the north-eastern slope, the summers are mild-hot and the winters are mild.

VII. There is a cold climate with abundant rainfall in all seasons only on the southern slope of the Greater Caucasus in the upper mountain forests and alpine zones at an altitude of 1500-2700 m Annual precipitation here is 150-200% higher than possible evaporation. Summers are cool and winters are cold.

VIII. Mountainous tundra climate exists in the Greater Caucasus and Little Caucasus above 2700 m, and in Nakhchivan AR above 3200 m. Here the precipitation is more than 100-200% without possible evaporation, summer and winter are cold. The temperature in the country depends on the regions and their relief. The Caspian Sea also has an impact on the formation of air temperature, the temperature in the coastal regions is relatively low in summer and high in winter. The average annual temperature in the central regions of the country (Kur-Araz zone, Absheron peninsula) and Lankaran zone is 14-15 ° C.

The temperature decreases in the mountainous regions of the country: at an altitude of 2000 m - 4.0-5.0°C, and at an altitude of 3000 m - 1.0-2.0°C. The absolute air temperature observed in our republic is + 46˚C. The absolute minimum was recorded in the territory of Nakhchivan AR (-32˚C). The distribution of atmospheric precipitation in the country varies depending on the region.The amount of precipitation in our country depends on the season, the relief of the region and its proximity to the Caspian Sea. The lowest average annual rainfall in the country is less than 150-200 mm in the southern zone of Absheron and Gobustan. Annual precipitation is less than 300 mm in many regions of the country (Kur-Araz and Samur-Davachi zones, Nakhchivan Autonomous Republic). The amount of precipitation in the territory of our republic is increasing west of the Caspian Sea and in the direction of the mountains. Precipitation increases at altitude of 2600-2800 m in the Greater and Little Caucasus, 2600-3000 m in Nakhchivan AR, 200-600 m in Talysh, and then gradually decreases. The maximum annual precipitation is 1400-1600 mm on the southern slope of the Greater Caucasus, 800 mm on the north-eastern slope, 800-900 mm in the Little Caucasus and Nakhchivan AR, and 1700-1800 mm in the Talysh mountains.

**Natural risks and disasters**. Due to significant differences in climate indicators in the country, changes in microclimate indicators in the regions are also varied. Microclimate change occurs for natural and anthropogenic reasons.

**Effects of heat and drought**. In recent years, summers have been very hot and winters have been mild due to climate change. Extremely hot summers in the regions and especially in large cities have a serious impact on people's health and their ability to work. Extreme heat in the summer months causes serious damage to agriculture. Due to climate change, rodents that survive the winter cause significant damage to crops in the spring and summer. Therefore, measures should be taken to improve land reclamation and plant protection in agriculture.

**The impact of rising Caspian levels**. Significant fluctuations are observed in the regions of Azerbaijan along the Caspian coast due to rising sea levels. This is partly explained by changes in the mass of water flowing from rivers to the sea as a result of climate change, and partly by changes in the volume of the basin where the sea is located. From 1998 to 2005, sea levels rose at a slow pace. As the level of the Caspian Sea rises, both the coastal zone is flooded and the groundwater level in the coastal zone rises, resulting in swamping and salinization.

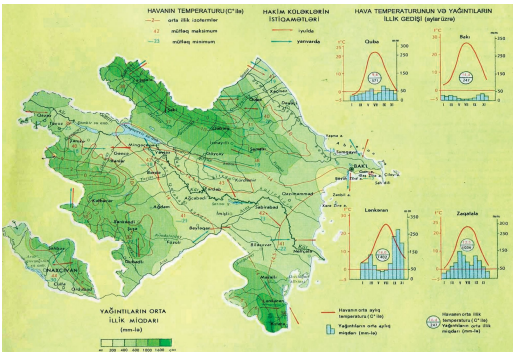
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Figure 2. Climate Map of Azerbaijan

**The effect of flooding.** Over the past 20 years, floods have intensified in the regions of the country due to climate change. This is due to the increase in rainfall norms. The increase in floods in our country is due to the large amount of water flowing into rivers as a result of melting snow in the spring. This is due to the fact that in recent decades, as a result of deforestation, increased arable land, the construction of new settlements, the water storage capacity of soils has decreased significantly. Therefore, in the spring, the snow melts quickly, and the resulting water flows rapidly into the rivers, along with rainwater. In our country, water flows mainly into the Kur, the largest river. The situation is aggravated by the fact that part of the silt carried by the Kur has sunk to the bottom of the river, and as a result, the river does not become shallower. In 2003 and 2010, the Kur and Araz rivers flooded many villages, destroying crops and livestock.

**Earthquakes.** The number of earthquakes has increased in recent years. In 2012, a 7.0 magnitude earthquake in the Zagatala region caused significant damage. On the assignments of President Ilham Aliyev, the assistance has been provided to families affected by floods and earthquakes. In addition, the repair of damaged houses and buildings at the expense of the state, modern houses were built at the expense of the state for people relocated from flooded areas, and they were provided with housing. Information on the disasters observed in the Republic of Azerbaijan over the past twenty years is given in the table.

**The largest natural disasters in Azerbaijan in 1990-2013, according to the number of deaths**

|  |  |  |
| --- | --- | --- |
| Disaster | Date | Number of deaths |
| Earthquake | November 25, 2000 | 31 |
| Flood | June 5, 1997 | 11 |
| Landslide | December, 2000 | 11 |
| Flood | October 5, 1995 | 5 |
| Minimum temperature | February, 2012 | 5 |
| Flood | May 4, 2010 | 3 |
| Earthquake | July 9, 1998 | 1 |
| Earthquake | July 4, 1999 | 1 |

**According to the number of victims of the largest natural disasters in Azerbaijan in 1990-2013**

|  |  |  |
| --- | --- | --- |
| Disaster | Date | Number of victims |
| Flood | June 15, 1995 | 1 650 000 |
| Earthquake | July 9, 1998 | 70001 |
| Flood | June 5, 1997 | 75 |
| Flood | May 4, 2010 | 70 |
| Flood | April 16, 2003 | 31 |
| Earthquake | May 7, 2012 | 16 |
| Earthquake | June 4,1999 | 9 |
| Earthquake | May 18, 2012 | 7 |
| Flood | October 5,1995 | 6 |
| Flood | September 21, 2009 | 5 |

**The largest natural disasters that occurred in Azerbaijan in 1990-2013, due to material damage**

|  |  |  |
| --- | --- | --- |
| Disaster | Date | Material damage  in thousands of dollars |
| Drought | October, 2000 | 100 |
| Flood | April 16, 2003 | 55 |
| Flood | June 5,1997 | 25 |
| Earthquake | November 25, 2000 | 10 |
| Flood | June 15,1995 | 6.7 |
| Flood | June 21, 1995 | 5.5 |
| Earthquake | June 4,1999 | 5 |
| Flood | October 5, 1995 | 4 |

Many people died as a result of these disasters.

Climate trends and future climate change. The analysis of observations on climate change in the territory of Azerbaijan for 100 years showed that during this period the air temperature in the country increased by 0.5-0.6˚C. In 1961-1990, the temperature increase was more intensive: 0.3-0.6 ° C. It should be noted that the degree of warming varies in different regions of the country. For example, in the Greater Caucasus, Kur-Araz lowland, the temperature increased by 0.50-0.65 ° C. In the mountainous areas of the Lesser Caucasus, this increase was 0.14-0.20°C. Rising temperatures over the past 100 years have also affected rainfall. The assessment of future climate change in Azerbaijan has been made possible by the use of various models.

The use of these models has shown that the following events are expected at the end of the century due to the doubling of CO2 in the atmosphere:

• average annual temperature may increase up to 2˚C;

• winter precipitation may increase by 15-21%, spring and autumn precipitation by 9-17% depending on the region, and summer precipitation may decrease by 40%;

• Water resources are expected to decrease by 5.7-7.7 km3, while water shortages will increase from 5 km3 (today's price) to 9.5-11.5 km3 by the middle of this century;

• heat resources are expected to increase by 700-1200 ˚C, while the number of days with high temperatures will increase to 25-45 days;

• The area of hot and temperate zones will be wider, the area of cold zone is expected to decrease, annual evaporation is expected to increase by 35% (180-540 mm), as evaporation will be 120-470 mm in hot periods and 200-290 mm in summer;

• Humid zones will rise to 100-200 m, in some places to 400-500 m, bioclimatic potential is expected to increase by 5-20% in most areas, depending on the region, and in Talish this figure will decrease by 7%. There will be an increase in the bioclimatic potential of the mountainous and foothill regions, and very little in the arid and semi-desert areas.

• The semi-desert and dry steppe climate zone will be wider, the boundaries will be 100-200 m, in some places it will rise to 400 m. Desertification process will accelerate in the country. Most of the semi-desert areas of the modern Kur-Araz lowland, southern Absheron and Nakhchivan Arazsahili plains will become desert climate type. The total area of semi-desert and desert climate will be 30.5-43.5 km2 and will cover 35-50% of the country's territory.

According to the scenario of the PRECIS model used in accordance with the second National Report on the UN Framework Convention on Climate Change, the average annual temperature increase in the Republic of Azerbaijan in 2021-2050 will be 1.5-1.6°C, in coastal areas and in the western regions of Nakhchivan AR while this increase will be 1.7˚C. According to the results obtained, the temperature rise in the first half of this century may be about 0.3˚C every ten years.

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• Water resources are expected to decrease by 5.7-7.7 km3, while water shortages will increase from 5 km (today's indicator) to 9.5-11.5 km3 by the middle of this century;

Precipitation is expected to decrease by 5% in 2021-2050 compared to 1961-1990 in the country, including the Kur-Araz basin and other regions.

**Impacts of climate change on natural risks and disasters.** The First National Report on the UN Framework Convention on Climate Change addresses the impact of climate change on biodiversity and makes forecasts in this area:

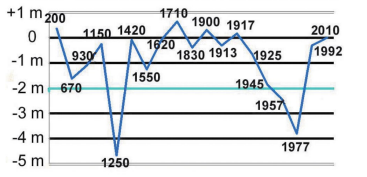
• The upper climatic limit of forests can rise to an altitude of 550-950 m in the Greater and Little Caucasus. In Talysh, the upper climatic limit of forests will fall by 100-200 m. The lower climatic limit of forests will rise to 50-200m:

• The area of oak forests may decrease by 3.0-3.5%, the area of beech forests may decrease by 15%, and the area of hornbeam forests is expected to increase by 19%. The total area of softwoods (linden, poplar, alder, etc.) is likely to decrease by 4,000 ha (20%) and the area of shrubs by 13,000-14,000 ha (70%). In general, the forest area can be reduced by 7.6 thousand hectares.

The impact of climate change in the Azerbaijani part of the Caspian Sea is already visible: rising Caspian Sea level, melting glaciers, river floods, torrents, seasonal temperature anomalies, etc. prove it. As a result of a significant increase in the level of the Caspian Sea in 1978-1995, some parts of the coastal areas of Azerbaijan were flooded. Research in 2000 showed that 485 km2 of coastal areas were flooded.

As a result of the calculations, it was found that due to climate change, the humidity in the Caspian basin may increase, which may change in the range of 26.0-25.0 cm in the coming years. As a result of the calculations, it was found that an additional 150 cm rise in the level of the Caspian Sea could cause flooding of 87,700 hectares of coastal areas. In 2030, 136.2 thousand hectares may be flooded, which will be 1.6% of the country's total area. Due to the increase in the number of heat resources and hot days due to climate change, the glaciers of Azerbaijan are melting.

Over the last 43 years, the glaciers of Tufan Mountain, one of the highest peaks in Azerbaijan, and the snow cover around Lake Tufan, the highest mountain lake, have melted significantly. As a result of climate change, the water capacity of lakes is affected by the increase in water flow due to the melting of glaciers and the intensification of the evaporation process. As a result of melting glaciers, the growing season can last up to a month. An increase or decrease in annual precipitation may occur as a result of an increase in the average daily temperature of 5˚C due to the effects of global warming. This can lead to changes in the growing season, reduced activity periods of animals and the number of generations. Studies have shown that a one-month increase in the number of hot days increases the likelihood of a critical temperature. As a result, the predominance of a semi-desert climate in the area increases the likelihood of a critical temperature rise. This, in turn, leads to the development of semi-desert ecosystems in the area.



**Figure. Comparison of the Caspian Sea with its current situation in different years**

Destruction of the flora and fauna of Azerbaijan by Armenia, especially the felling of plane trees older than 2000 years in Jabrayil, Zangilan, Gubadli and other liberated territories of Azerbaijan, the burning of the Topkhana forest, the use of banned white phosphorus bombs around Shusha, as well as the felling of trees, set fire to forests and deliberate damage to the environment should be considered serious environmental crimes.

Aggressive Armenia has committed large-scale environmental terrorist acts in the territories of Azerbaijan, which it has occupied for 30 years, causing serious damage to natural monuments, biological diversity, forests, underground and surface natural resources. During the occupation, forests were destroyed in 24% of the forest area in the Karabakh region, ie 54,328 hectares, with a total volume of 5,872,569,000 cubic meters.

Destroyed forest area in the Karabakh region

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Administrative districts | Area, ha | Voluma, thousand cubic meter | | |
| Total | For use | Wood |
| Agdam | 1248,0 | 95,82 | 45,01 | 50,81 |
| Jabrayil | 2319,7 | 139,66 | 73,50 | 66,15 |
| Fuzuli | 2,0 | 0,17 | 0,10 | 0,08 |
| Kalbajar | 16524,0 | 1963,85 | 1090,18 | 873,68 |
| Lachin | 9565,3 | 1254,24 | 670,99 | 583,25 |
| Gubadli | 6240,2 | 492,42 | 258,17 | 234,25 |
| Shusha | 2972,8 | 121,93 | 65,54 | 56,39 |
| Tartar | 1799,0 | 317,06 | 171,12 | 145,94 |
| Khankendi | 4661,0 | 635,99 | 347,69 | 288,30 |
| Khojavend | 3537,4 | 397,46 | 208,81 | 188,65 |
| Zangilan | 5458,6 | 453,97 | 238,02 | 215,95 |
| TOTAL | 54328,0 | 5872,57 | 3169,12 | 2703,45 |

The percentage of tree species destroyed by cutting or burning during the occupation is given in the diagram.

Percent value of destroyed tree species

**6. Changes in the provision of forest management, forest products and ecosystem services in the context of climate change**

After gaining independence, forestry is dominated by a broad business model aimed at maximizing income with limited forest management costs. In the 1990s, the supply of firewood in productive and accessible forests was characterized by the underutilization of less valuable tree species, the natural regeneration of forests without assistance measures, and the lack of care for young trees. In young and middle-aged trees, service felling, selective felling was carried out in unsatisfactory and insufficient volumes. This has led to a deterioration in the quality of forests, undesirable changes in species composition, and a reduction in economically available forest resources.

In this regard, it is becoming increasingly clear that new developments and innovative solutions are needed for the forestry practice. Over the last 3 years, the concept of intensive forest management has been increasingly discussed by local experts representing science, the business world and environmental organizations. The National Forest Program, which is expected to be approved in the near future, provides for sustainable forest management, which ensures the preservation of forests' biological functions through efficient restoration, rapid growth and regular thinning.

**7. Ongoing planned adaptation measures with the concept of sustainable forest management, climate change mitigation, forest management and participation (public, private sector, academy, NGO, research)**

The United Nations Conference on Environment and Development (Rio de Janeiro, 1992) highlighted the need for sustainable forest management. According to the "Forest Principles" adopted at the same conference, forest resources and forest fund lands should be used in such a way as to meet the economic, environmental and socio-cultural needs of both present and future generations.

Sustainable forest management is a management system that includes the sustainable use of forests and forest lands to ensure that biodiversity, productivity, self-sustainability, and viability play important ecological, economic, and social functions at the local, national, and global levels (Helsinki 1993).

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International associations and organizations have developed specific indicators and criteria for sustainable forest management in several processes (Montreal Process, Helsinki Process).

The UN Forest Form sets out the main priorities for sustainable forest use:

1. Assessment of forest resources and the role of forests in global carbon turnover;
2. Biodiversity;
3. Forest viability and health;
4. Productivity functions of forests;
5. Ecological functions of forests;
6. Economic and social functions;
7. Legal, political and organizational conditions ensuring sustainable use of forests.

One of the main indicators of compliance with the basic principles of sustainable forest management is the certification of forests.

In Azerbaijan, which has joined to international conventions, Azerbaijan has already identified social, economic development and poverty reduction as priorities in the field of sustainable forest management, climate change reduction and forest management. The country's mitigation and adaptation strategies are reflected in long-term government programs, the private sector, and a number of NGOs. For example, according to Article 42 of the Forest Code of the Republic of Azerbaijan, mandatory certification of forest resources is envisaged.

Preparations for the National Forest Program began in 2018, and after extensive discussions with international experts, FAO and relevant agencies of the Ministry, a new preliminary draft of the Program was completed: "The National Forest Program covers the period from 2020 to 2030. The National Program covers the country's forestry services, is based on national and international experience, and aims to ensure the active participation of government agencies and NGOs in governance.

The National Forest Program aims to achieve the following goals: "To help create appropriate institutional capacity and mechanisms for forest management, with a special focus on changing the requirements and future needs that contribute to the overall sustainable development of the country; to implement specific measures to protect and sustainably manage forests; To ensure the development and improvement of relevant policies and strategies for the implementation of specific measures for the protection and sustainable management of the forests of our country; Encourage stakeholders to work closely together, participate in planning, implementation, control, monitoring and evaluation; Strengthen the management of forest resources and their functional use, as well as to improve the living standards of the rural population that depend on forest resources; to contribute to increasing national and international financial support for forestry activities.

Nine criteria for sustainable forest use in the world were used in the development of NFP's goals and strategic priorities: "These criteria will have a positive impact on the development of the forest sector. At the same time, assessments were conducted nationwide to study the needs and expectations of local authorities. The modernization of the forest management system involves the modernization of the National Forest Policy and the development of a new road map is an important step forward in preserving the forest ecosystem, establishing new forest areas and sustainable use of forestry based on international experience.

The project to reduce the impact of climate change through reforestation in the Caucasus was implemented in the Transcaucasian Republics in 2009-2011 through the World Wide Fund (WWF). Within the framework of this project, afforestation works were carried out in Ismayilli region - 300.0 ha, Gabala region - 50.0 ha, Gakh region - 50.0 ha and Sheki region - 100.0 ha in total area of 500.0 ha.

At present, the Caucasus Regional Environmental Center is continuing the project "Promotion of a global forest review platform in the Caucasus region."

**8. Ongoing and planned projects financed by national and international organizations (forestry funds, incentives, green funds, investments**

Forest construction works have been completed in the framework of GCP / AZE / 007 / GFF - “Forest Resources Assessment and Monitoring to Strengthen Forest Knowledge Framework” project jointly implemented by the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan and the UN FAO, starting from 2018, determinating of the boundaries of forest fund lands in the Zagatala service area of Zagatala, Sheki, Barda Regional Forestry Center with a total area of 170837.3 ha, conducting geodetic-topographic works, inventory of forests by determining forest distribution, species composition, age groups, firewood reserves, forest inventory, afforestation, reclamation, protection, protection, etc. identification of the area requiring economic measures, determination of the amount of other forestry-economic measures, as well as determination of rules and methods of carrying out these measures, functions of forests, supply of additional and secondary forest products from forests, for the purpose of studying the use for recreational, tourism and logistics purposes, conducting forest-biological, forest-pathological examinations, assessing the use of forests, preparation of basic provisions for the organization and development of the economy.

This year, this work continues in the Gabala and Shamakhi Regional Forestry Centers.

The forest management work carried out in the context of the GCP / AZE / 007 / GFF - “Forest Resources Assessment and Monitoring to Strengthen Forest Knowledge Framework” project, the process of calculating carbon reserves is carried out.

In addition to the calculation of carbon reserves, the disadvantages of the ecological conditions of the area: rocky, cliffy, saline areas have been included in the nature protection zone, the main goal is to protect existing forests as they are, to transport them into the future. In addition, in order to protect water resources, to preserve the existing structure and, if possible, to establish stratified (tiered) forests depending on the biology of tree species, to make optimal use of these areas by protecting forests on reservoirs and river basins, banks and streams, intended forests have been identified and given as a separate use class.

It is very important to continue this work in the country.

**9. Examples of success both in the preparation of the report and in other countries (if any)**

Azerbaijan supports global climate conventions on global climate change, which pose a great threat to humanity. By ratifying the UN Framework Convention on Climate Change, Azerbaijan has taken a number of important measures on greenhouse gas emissions. As a result of measures such as the use of renewable energy in Azerbaijan, the opening of a plant for the production of solar panels, the cessation of fuel oil in power plants and the use of gas instead, the introduction of smart cards in gas and electricity consumption, energy efficiency, new forest areas about 650-700 million tons of carbon were reduced. All these measures were carried out at the expense of the Azerbaijani state. In this area, Azerbaijan's use of renewable energy sources in a number of sectors, agriculture, household waste management, afforestation, energy efficiency, etc. has the potential. In the future, further reduction of waste will be achieved in the implementation of a number of projects in this direction.

**10. Challenges, gaps and obstacles to sustainable forest management under the impact of climate change**

The attitude of the population accustomed to inexhaustible forest resources to forests causes significant difficulties and problems.

In general, the state underestimates the role of the forest sector, and the sustainable forest management paradigm is poorly applied in practical forest management. A number of scientific debates held in 2018-2020 identified the most important forest management issues of today. During the discussions, a number of issues were discussed below. The main problem in the forestry of Azerbaijan is the replacement of the broad operational nature of forest management with a sustainable intensive forest management model. This will allow the forest sector to achieve higher economic efficiency by increasing forest productivity and deforestation in areas with developed social and transport infrastructure, while preserving protected forests, specially protected and untouched natural areas.

Another important issue is that political, social and economic changes in Azerbaijan led to a deterioration of the country's forest management in the early 1990s. Numerous reforms, underdeveloped legislation and the failures of subsequent forestry reforms are reflected in the level and specificity of forest management in Azerbaijan.

The most important are:

* The occupation of lands by Armenians also had a negative impact on the implementation of state forest control functions and the implementation of forest protection and preservation measures within the country, such as the prevention of illegal tree felling.
* The economic and organizational conditions of forest fire services have deteriorated, and the number of aviation units and fire-chemical stations has gradually decreased.
* The system of protection of forests from pests and diseases has been significantly weakened.
* The level of information support for forestry and forest management has significantly decreased.
* Comprehensive forestry projects based on previous data have not been replaced by forest management regulations that provide a sound methodological framework, adequately funded forestry activities, and forest management quality control tools. The main sources of forest information are now obsolete, and much of the forest inventory data has not been updated for decades.
* Forest relations face many unresolved economic problems. Thus, it does not meet the strategic goals of the transition to sustainable forest management, and the necessary economic and institutional reforms have not been carried out.

The development forecast of Forest Sector until 2030 calls for new forest policies and significant investments in the forest sector.

**11. Ensuring the environment and options (legal, administrative, institutional, financial, technical and technological) required for sustainable forest management**

It is extremely important to develop and implement adaptation programs that reduce the negative effects of climate change and include the benefits of the positive effects. Taking into account the processes of climate change, in 2018, the Ministry of Ecology and Natural Resources changed the forest planning standards.

List of adaptation measures in accordance with the standard form of the forest plan

|  |  |
| --- | --- |
| Changes in forest productivity due to changes in average temperature and precipitation | Regulation of forest regeneration period and forest care rules taking into account forest productivity |
| Identification of species used in reforestation and afforestation processes |
| Take measures to use dry and damaged wood resources |
| Diversification of forest management objectives to obtain forest products and services |
| Changes in the species composition of forests | Focus on growing trees of different ages |
| Use of tree species adapted to predicted climate change in reforestation and afforestation processes |
| Establishment of specially protected natural areas for the protection of vulnerable species and habitats |
| Determining and managing the number of invasive tree species |
| Increase in the frequency of fires in forests and fire-prone areas (forests) | Improving the effectiveness of fire safety measures in forests, including the prevention of the forest fire, monitoring of forest fire hazards and forest fires |
| Regulation of forest fire extinguishing plans in connection with the frequency of fires in forests and fire-prone areas (forests) |
| Increasing the frequency of pests in forests | Improving the forest pathological examination system |
| Improving measures to prevent the spread of pests |
| Increase in the frequency of extreme weather events in forests | Regulation of reforestation period to minimize the risk of wind blowing and wind damage in forests |
| Improvement of firewood supply technologies to minimize the risks of wind blowing and wind disturbance in forests |
| Formation of trees of different ages, mixed and different tiers |

In forestry, the requirement to develop adaptation measures in forest plans are a progressive step to protect the ecological potential of forests, adapt to climate change and increase the sustainability of forests. However, the analysis of the new forest plans adopted in Azerbaijan in 2018 shows that adaptation measures do not meet the consequences and threats of the possible consequences of climate change. A common problem with the new plans is that measures to protect forests from fires or pests are being developed without taking into account climate change due to climate change and the lack of consistent forecasts. Climate change is already leading to changing patterns of disruption, including more and more catastrophic fires across the country. There is an urgent need for a program to adapt forests to future disturbances. Potential vulnerability mitigation strategies include the transition to risk-tolerant, adaptive forest management, aimed at reducing stressors, reducing vulnerability, and increasing the adaptive capacity of the forest sector and forest ecosystems. It requires the integration of vulnerability mitigation and risk management into planning processes, the selection of reliable, diversified, cost-effective adaptation measures, and the adoption of an appropriate institutional framework. The improvement of knowledge and operational monitoring are essential for the implementation of adaptive forest management.

Elements of a new forest fire protection system should include analysis of current and future fire regimes, development and implementation of more effective forest fire protection concepts. For this purpose, adaptation of forest landscapes to future climatic conditions (adapted species composition, vegetation and forest structure, control of forest fuel content, etc.), development of effective firefighting systems and creation of mobile firefighting systems, improvement of forest management legislation and institutional structures, as well as expansion of international cooperation is required.

Similarly, changes in the distribution of forest pests pose a threat. Modern scientific approaches allow the detection and prediction of pests. It is necessary to strengthen the staff and logistical support of forest pathological services and develop biological methods against pests. A common problem in existing forest plans is the development of measures for the protection or subsequent restoration of forests, taking into account the scale and size of the forests, without considering their expediency. All plans must take into account this scale and, at the same time, limited forest infrastructure, as well as the resources to implement these plans.

The mountainous and plain territory of Azerbaijan, the spatial features of the impact of climate change require the development of regional adaptation measures.

Dilution reduces water consumption and can change the species composition and structure of forests. Given the experience of selecting appropriate genetic sources, new silvicultural strategies are needed to protect dominant tree species in the face of climate change. Facilitating the migration of forest species can facilitate species change on a local and continental scale. In addition, plans for the capacity and quality of firewood supplied may be changed as natural degradation regimes are strengthened. The success of adaptation measures depends largely on the development of reforestation technologies. Reforestation should aim to create more climate-resistant plantations by reducing the risk of forest fires. After deforestation, fires, pests and diseases, lands that are temporarily not covered by forest cover should be rehabilitated naturally. According to the Bonn Agreement, more than 170,000 hectares of land in Azerbaijan require reforestation, and the annual restoration of artificial forests is less than 1 percent of this area. Natural recovery often leads to the replacement of valuable species with less valuable ones. In reforestation, greater efforts should be made to maintain or increase the proportion of species required for wood production by the forest sector.

The underdeveloped infrastructure of the forest sector currently hinders the sustainable management, use and protection of forests. It is important to invest in road networks, improve forest protection and reduce the risk of danger. Effective implementation of adaptation measures requires changes in a number of rules (forest management rules, service deforestation, reforestation, etc.). At the state level, all normative documents need to be revised to identify and edit the most important sections to ensure climate adaptation. There is a need to improve the monitoring of the condition of forests and ecosystem services, which they provide as a database to reduce the effects of climate change and make decisions on forest management in the face of climate change. For the forest sector, a decision support system and risk management related to state and regional policies for the development of the forest sector can be an important tool for addressing economic opportunities. In addition, a strategic approach to adaptation requires changes in forestry education. Existing educational standards and higher education programs on the impact of climate change on various sectors of forestry, as well as retraining courses for existing forestry workers, should be organized.

**12. Results and suggestions**

Based on the research, the followings can be noted:

• The report provides brief information on the physical-geographical, natural and water resources of the Republic of Azerbaijan, climate and its main elements. It was noted that 11 climate types are known on Earth, there are 8 similar types in the country. The air temperature regime and distribution in the territory of the Republic of Azerbaijan are in accordance with the law, and it is formed depending on the nature of the incoming air masses, the relief of the area and the proximity of the Caspian Sea to individual regions. The average annual temperature is 14-15°C in the Kur-Araz lowland, in the coastal zone south of the Absheron peninsula, as well as in the Lankaran lowland. Absolute maximum (+ 46°C) and minimum (-32° C) temperatures are observed in the country. The temperature in the country depends on the regions and the relief in them. The Caspian Sea also has an impact on the formation of air temperature, in coastal regions the air temperature is relatively low in summer and rises in winter. Atmospheric precipitation is mainly due to the intrusion of air masses into the area. The number of natural risks and disasters in the country has increased significantly in recent decades. These disasters occur for natural and anthropogenic reasons. In recent years, the high temperatures in the summer months and the mild winters in the winter are due to climate change on Earth. Extremely hot summers in the regions and especially in large cities have a serious impact on people's health and their ability to work. In the summer months, severe heat causes serious damage to agriculture, resulting in reduced yields. Significant fluctuations are observed in the regions of Azerbaijan along the Caspian coast due to rising sea levels. From 1998 to 2005, sea levels rose slowly. As a result, both the coastal zone is flooded, the groundwater level in the coastal zone rises, and swamping and salinization processes take place. In recent decades, the number and intensity of floods in small mountain rivers in the country has increased. This is due to the fact that the monthly rainfall in the area falls for several days. Many villages were destroyed, crops and livestock destroyed as a result of the flooding of the Kur and Araz rivers in 2003 and 2010. In 2012, a 7 magnitude earthquake in the Zagatala region caused significant damage.

• Climate change trends and future climate change issues in the Republic of Azerbaijan have been studied. Studies have shown that during 100 years of observations, the air temperature in the country increased by 0.5-0.6°C, in 1961-1990, the temperature increase was higher: 0.3-0.6°C. Despite the warming in the whole area, this process was different in different geographical areas of the country. Predicted climate change in the country has been assessed. This has been made possible by the use of various models. The use of these models has shown that due to the doubling of CO2 in the atmosphere, the following events may occur at the end of the century: the average annual temperature may rise by 2˚C;

* winter precipitation will increase by 15-21%, spring and autumn precipitation by 9-17% depending on the regions, and summer precipitation may decrease by 40%; water resources are expected to decrease by 5.7-7.7 km3, etc. According to the scenario given by the Second National Report on the UN Framework Convention on Climate Change, in 2021-2050 the average annual temperature in the country will be 1.5°C-1.6°C compared to 1961-1990, and precipitation is expected to increase by 10-20%. As a result of the calculations, it was found that due to climate change, the humidity in the Caspian Basin may increase, which may change in the range of 26.0-25.0 m in the coming years. As a result of the calculations, it was found that an additional 1.5 m rise in the level of the Caspian Sea could flood 87.7 thousand hectares of coastal areas. In 2030, 136.2 thousand hectares may be flooded, which is 1.6% of the country's total area.

• Vulnerability to climate change has been explored. In the last two decades, strong floods in the territory of the Republic of Azerbaijan have caused unprecedented consequences in the history of our country, destroyed dozens of settlements, villages and settlements, killed thousands of hectares of arable land. The analysis of emergencies shows that large-scale destruction and losses occur mainly in areas with low resilience. Observations have shown that the most vulnerable groups in the face of these extremes are people living in old houses in floods, landslides and seismic zones. For example, 70% of the 3,500 homes destroyed by the 2010 floods were made of mud bricks. In addition, during the USSR, more than 4,500 schools, hundreds of kindergartens, hospital buildings, etc., built on the basis of similar projects without taking into account local natural and geographical conditions, are always a source of serious danger during emergencies. As our economy strengthens, investment in this area has increased year by year. Over the past few years, 2,000 new schools and kindergartens, hundreds of hospitals, etc. have been built at the expense of state funds and the Heydar Aliyev Foundationt and put into operation, major repairs and reconstruction of old buildings were carried out. One of the most important indicators of the state's care for the population in the Republic of Azerbaijan is the organization of protection and safety of people in case of disasters. Since 2005, the security system in the country has been rebuilt and the Ministry of Emergency Situations has been established. In a short period of time, an organizational structure, excellent human resources, a strong material and technical and training base have been established in all regions of the country. Today, the Ministry of Emergency Situations is the guarantor of the full organization of the protection of the Azerbaijani people and its economy from emergencies.

• The effects of climate change on sectors have been investigated. They were selected by members of the national network established under the project and agreed sectors were identified: water resources, agriculture, the Caspian region and human health. Detailed information was provided on the current state of each sector, the plight of the effects of climate change, recommendations and adaptation measures. Information was provided on climate change awareness in the country, national policy frameworks for disaster risk reduction, normative documents adopted in the country in this area, participation in international programs and environmental legislation in the country.

• Climate and risk monitoring and the results of research in this area in the country, regional climate change and disaster risk reduction initiatives were examined.

• Climate change should focus on effective adaptation measures; For example, increasing the use of renewable energy sources (solar, wind, groundwater, etc.); efficient use of water resources; use of modern methods of irrigation (drip irrigation, etc.); Carrying out shore protection works against rising sea and river levels, etc.

It is important to strengthen the interaction and coordination between government agencies and various sectors in this area;

• It is important to ensure access to information on climate change;

• Legislation in this area should be improved and enforced;

• There should be constant communication between science, government officials and the public in this area;

• There is a need for changes in the implementation of reforestation and management;

• Tree felling service are currently carried out at a very limited level. An increase in the share of wood obtained as a result of tree felling service can lead to a significant increase in carbon accumulation in the biomass, as the forest cover is preserved, the quality of crops is improved and higher quality wood can be produced.

• The increase in tree felling service will not adversely affect the total roundwood production;

• There are many uncertainties that affect the future development of forest resources (for example, changes in future forest management, development of forest products markets, climate change, etc.). In extreme cases, the participation of vulnerable groups in decision-making should also be ensured;

• The issue of climate change should be included in both secondary and higher education programs;

• It is considered to have great potential for afforestation and reforestation in the liberated areas and in the central parts of Azerbaijan;

• Restoration, more efficient wood supply and other measures can increase carbon sequestration in forests;

• The development of regional action plans, including required investment financing, is a necessary first step;

• It is important to strengthen cooperation with neighboring countries in this area;

• The operation of an effective early warning system during extreme events plays an important role;

• NGOs should strengthen cooperation and links with other organizations working in this field;

• Participate actively in the development of legislation in this area;

• The participation of NGOs in the development of both climate change adaptation programs and strategies in this area is important;

• Enlightenment and propaganda work in this area should be strengthened;

• The participation of NGOs in disaster preparedness should be ensured;

• Liaise with vulnerable groups to learn about the needs of vulnerable groups to climate change and natural disasters;

• Strengthen relations with the media to inform the public;

• Regional and international cooperation in this area should be strengthened.

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