AZERBAIJAN

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Review of available information, and planned or implemented measures

The territory of the Azerbaijan Republic is 8.6 million hectare. The forest fund consists of 1 213 700 ha, with the forest cover being 989 300 ha. The forest range occupies only 11.4% of the Republic's territory. Forest management is performed according to the Forest Code and to the Environment Protection Law. All the forests of the Republic are State owned, and have significant water protection, soil protection and climate regulation functions.

The forests are distributed unevenly over the country: about 95% of them are located in the mountains and about 5% on the plains. In the mountains, forest cover varies from 18 to 43%, while in the lower regions it amounts to 0.5–2%. The Eastern beech (*Fagus orientalis*) plays an important role in the forest formation, and is present on 31.7% of the forest territory. Oak (*Quercus* spp.) is widespread, both in the mountains and on the lowlands and is found on 23.4% of the forest area; hornbeam (*Carpinus* spp.) grows in the mountains and piedmonts, and occupies about 26.0% of the territory. These three tree species are the main forest forming species and occupy about 81.1% of the entire forest territory.

The age indicators of the forests differ: in the mountain area, the average age is 86 years; on the lowlands it is about 40–60 years. The yearly average wood increment in the country is 1.5 million m^3. The country's forests have a low average increment per hectare, which is explained by low forest density and poor productivity.

Nevertheless, all of the Republic's forests are of great value for their protective functions. Besides, these are stable ecosystems (when no anthropogenic influence is present); they are extremely well adapted to the specific soil and climate conditions, including natural climate variations. In the mountains, the forests prevent erosion and mud slide processes, and help to modulate river flows downstream. In the bottom-lands of Kura and Araz rivers (*tugai*), plantations perform shore protection and water preservation functions. On flat irrigated lands, the forest plantations serve as protection against the harmful action of water and wind. The forests are the source of non-wood forest products – nuts (walnut, hazelnut and almonds), fruit (apple, pear, plum, apricot, hawthorn, rosehips, barberry, etc.), mushrooms and berries, medicinal plants, tanning and colouring substances, etc. The forests serve as the base for the support of a biologically diverse flora and fauna.

In recent years forest destruction has become catastrophic; 261 000 ha of forest lands in the occupied territories have been practically destroyed due in part to overharvesting of fuelwood, which was the main source of energy for the majority of the refugees. This led to high levels of soil erosion.

At the present time, because of excessive exploitation, excessive cattle grazing, forest destruction and the use of poor irrigation methods, land degradation and desertification have become among the most important problems for Azerbaijan. This situation is caused by both economic and social factors: low population awareness; war; drought; and global climate change. The Ministry for Ecology and Natural Resources has taken considerable measures to combat desertification. The practical implementation of the National Forest Restoration Programme has begun. The execution of this Programme on one side of the Azerbaijani basin of the Caspian Sea in the Nabran region, where unique relic wooded lands (oak) are located, which are located in depressions below sea level, will contribute to climate change adaptation. In the opinion of scientists, this region is

especially vulnerable to potential climate changes. To preserve the natural biodiversity, the Samur-Yalama National Park is being created, with the help of the German Government.

Over the last few years global climate warming has became evident in Azerbaijan. Rainstorms, river flooding, floods, cold summers and weak winters are examples of that. In 2009, total precipitation in Azerbaijan's regions increased in comparison with previous years.

Azerbaijan, like other countries, takes certain measures against global climate warming. Against the background of climate warming, regional changes have also taken place. Such changes can be the identified from the 100-year observation data of the 16 most representative meteorological stations. The trend analysis results show that over the 100-year period the air temperature increased by 0.5–0.6°C. During the period from 1961 to 1990, the increase in warming amounted to 0.3–0.6°C.

In 1992, countries of the world, realizing the reality of such threat, adopted the United Nations Framework Convention on Climate Change (UNFCCC) was adopted, and in 1997 countries adopted the Kyoto Protocol under this Convention. The goal of this Convention is the stabilization of the GHG concentrations in the atmosphere at such level that will prevent dangerous anthropogenic interference to the climate system.

The Republic of Azerbaijan ratified UNFCCC on 10 January 1995. Being a non-Annex 1 Party to the UNFCCC, the Azerbaijan Republic accepted the obligations on formation, execution and publication of national and regional programmes, which include measures aimed at climate change mitigation.

Taking into consideration the importance of this issue, which requires a serious and targeted approach, a Decree of the President of the Azerbaijan Republic, dated 30 April 1997, established the State Climate Change Commission for execution of obligations under the UNFCCC, with representation from 18 ministries and departments. The project financing was provided specifically to assist the country in the execution of the climate change studies within the framework of the UNDP/GEF programme. The Initial National Communication was prepared in 2000. This was executed by the Department of Hydrometeorology of the Ministry for Ecology and Natural Resources, and its purpose was to supply information related to climate change in Azerbaijan for the world community.

The Second National Communication (SNC) was submitted in 2002. The work was executed under this project in two different directions:

- The creation of a national cadastre of anthropogenic emissions and of GHG absorption.
- Assessment of the anthropogenic GHG emission reduction in different sectors of the economy and the development of recommendations for the execution of national policy in this sector.
- A study of the impact and vulnerability of ecosystems and of the most important economic sectors, and the development of climate change adaptation measures.

Review of the Conditions and the Work of the National Research Institutes on Studies that Evaluate Climate Change in the Forest Sector

There is no scientifically based information in Azerbaijan on climate change impacts on forest plantations, such as productivity, decreased survival ability or increased mortality during the last decades. The only work in this direction was performed within the framework of the National Climate Change Communications. The country participates in UNFCCC and its Kyoto Protocol, and consented to the implementation of about 40 projects.

Climate Change Assessment on the Forests of Azerbaijan

Warming was apparent in all natural zones of the country. Maximum warming was observed in the Greater Caucasus, Kura-Arazsky lowlands (0.5–0.65°C); the minimum was observed in the mountains of the Smaller Caucasus and in the coastal areas of the Caspian Sea (0.14–0.2°C). The dynamics of more than a century-long precipitation record for the Baku station shows that, approximately, precipitation has increased over the last 50 years. The trend analysis results show that if during the 1881–1997 period, annual precipitation increased by 21%, then in the years 1971–1997 the decrease amounted to only 12%.

Figure 1. Temperature change under five scenarios as a result of a doubling of carbon dioxide levels across Azerbaijan.

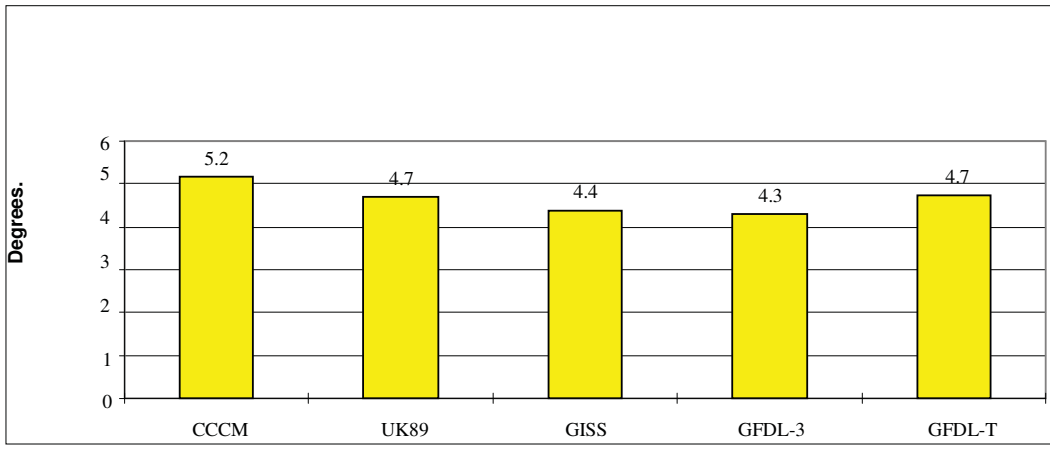
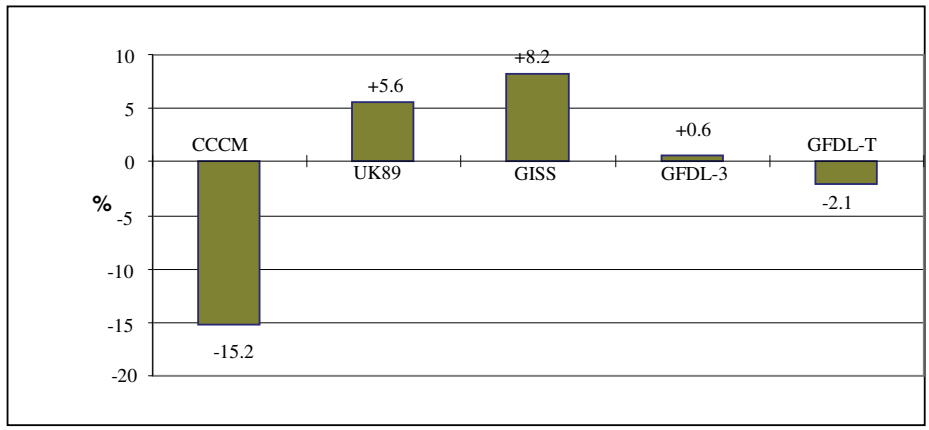


Figure 2. Precipitation changes under five scenarios as a result of a doubling of carbon dioxide concentration across Azerbaijan.



Potential opportunities for carbon dioxide absorption increase

How to best utilize the forest cover of Azerbaijan as a means to augment carbon sequestration is a question that requires a multifaceted response. Organizationally, this requires an increased level of forestry management, and detailed reporting of multiple advantages provided by the forests. The resolution of these tasks means significant increase in forestry-related expenses, and a need to find additional or alternative financing sources. The studies conducted showed that the carbon reserves of the wooded lands of Azerbaijan amount to 60 million tonnes, and the yearly

sequestration rate is 670 000 t. Analysis of results indicate a serious deterioration in the Azerbaijani forest fund over the last 10 years. The forests, disturbed by illegal harvesting, have lost their self-restoration ability. Reforestation and restoration of these forests implies significant cost and the implementation of a set of forest management measures that provide for effective use of the resource and its ecological potential. Initially, this requires the implementation of forest protection measures, expansion of forest restoration works and reconstruction of low-density and low-value plantations, coupled with improvement of the forest use system.

The execution of all these measures will allow optimization of the forest's age structure and increased productivity and, accordingly, will create the preconditions for increased absorption of carbon. These measures are forecast to additionally increase absorption by 6 670 000 t by 2025. The analysis shows that from the carbon accumulation point of view, the most important measures are an increased plantation density and the establishment of new forests. According to the calculations above, it is clear that the implementation of the forecasted forest restoration measures, the increase in integrity and biological productivity of the wooded lands, as well as the reduction of illegal forest harvesting, will result in the CO_2 absorption rate increasing by 1.5 times in the year 2025. The cost per tonne of CO_2 absorbed in 2025 in comparison with 2000 will decrease by approximately 30%. The reconstruction of low-density and low-value plantations will result in improved structure and content of forests, and the plantation of new wooded lands will allow reaching the optimal level of forests in this country. Table 1 reflects the forecast carbon dioxide absorption rates from the existing wooded lands and proposed new plantations.

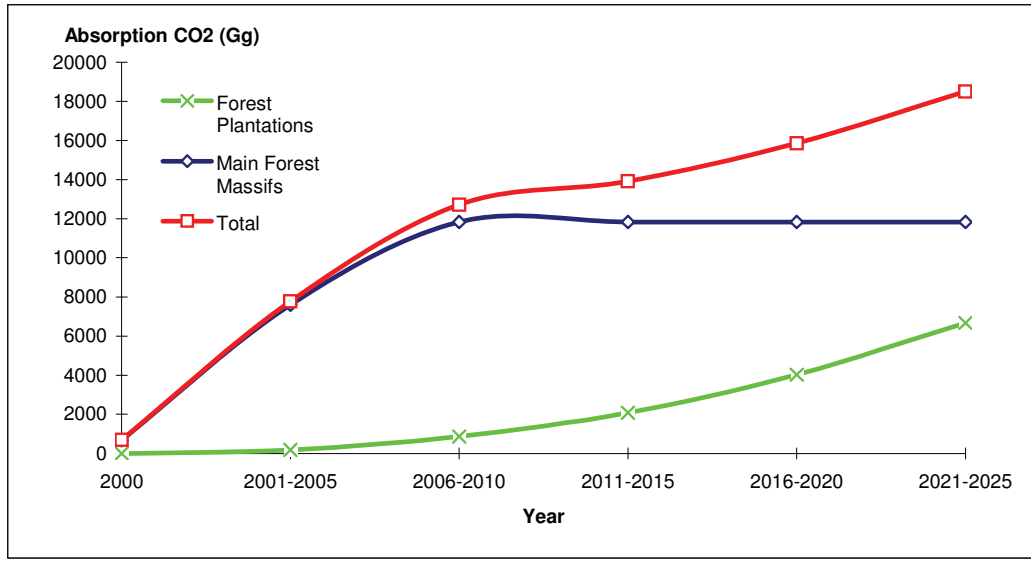
The probable forest development and forest restoration potential in Azerbaijan according to expert assessments will amount to 740 000 ha by 2025. When all these measures are implemented, the total carbon absorption from the wooded lands for 25 years will amount to 70 056 000 t, 20% of which will derive from new forest plantations and 80% from the existing forests. In comparison with the base year 1990, in 2025 the total CO_2 absorption from the wooded lands may increase by 2.1 times. It is pertinent to note that the potential land resources of Azerbaijan provide the opportunity to increase the total acreage of the forest plantations up to 1.5 million hectares.+

The low average increment and wood reserves in the national forest resource is related to the availability of a considerable acreage of low-density forests, thin areas, proliferation of low-value species, non-optimal soil and climatic conditions, and increased negative anthropogenic impact on forests. However, the climate productivity potential of Azerbaijan's forests is extremely high. The calculations have shown that the magnitude of the climatic index of potential productivity of the Republic's forests when all of the climate change scenarios are implemented may increase from 23% up to 53%.

Table 1. Execution of Forest Measures until 2025

Indicator	Period					
	2000	**2001–2005**	**2006–2010**	**2011–2015**	**2016–2020**	**2021–2025**
Forest plantations ('000 ha)	2.09	29.66	81.07	150.36	216.34	260.17
CO_2 absorption ('000 tonne)	7	174	875	2 080	4 027	6 670
Total expense (million USD)	0.93	18.18	56.13	115.69	180.12	248.91
CO_2 absorption expenses (USD/tonne CO_2)	133	104	64	56	45	37

Figure 3. Forecast absorption of CO_2 based on proposed forest management measures.



Vulnerability assessment: forest system self regulation during climate change

When assessing the vulnerability of forests to climate change, we established that noticeable changes will take place in the forests' climatic borders, which may cause even more pronounced degradation of the forest zone. The greatest changes will take place under the GISS and GFDL-3 scenarios, when the upper tree line in the Greater and Small Caucasus may move upwards by 550–950 m, while in Talysh, in contrast, it may descend by 100–200 m. The lower forest margin may move upwards, depending on the forest location, by 50–200 m. While taking into consideration the modern anthropogenic load on the upper and lower forest borders, we made the assumption that the forest border will not change significantly overall.

Certain changes will take place in species content and forest productivity. Oak and hornbeam will remain in the piedmont area. In the upper part of the mid-mountain zone, beech forests will remain, with a mix of oak and hornbeam. We can expect that the acreage of valuable oak and beech forests will diminish; the acreage of hornbeam forests will increase. Across the country, especially in the piedmont zone, the proportion of drought-resistant tree and shrub species will increase. The replacement of oak and beech by hornbeam and other species began several decades ago. Thus, according to 1953–1988 data for certain forest management stations, the oak and beech forest decreased by 7 to 53%. However, anthropogenic factors are the reason for such species change, as it was these tree species that were used for fuelwood. However, as a result of forest restoration activities, nationally the area covered by non-state forests increased by approximately 70 000 ha, while the state forests increased by more than 90 000 ha.

The current forests of the state forest fund of Azerbaijan comprise 87.8% hardwood tree species, 2.2% softwood species, 1.6% acerose, 6.2% other tree types and 2.2% bushes. If the anticipated climate warming occurs as under the GISS and GDFL-3 scenarios, we can presume that the acreage of the hardwood tree species will decrease by approximately 2–2.5%, with oak species decreasing by 3–3.5% and beech by ca 15%, while hornbeams could increase by ca 19%. Thus, the total acreage of hardwood species may decrease by approximately 17 000 ha. Softwood species could be expected to decrease by about 4 000 ha (ca 20%). The acreage of other tree species may increase by 12–12.5% and bushes by 70%, equal to 13 000–14 000 ha.

Table 2. Carbon deposit changes

Tree species	Total acreage ('000 hectares)	Carbon reserves ('000 tons)	Yearly Increase ('000 tons)
Hard-leaf species	-17.3	-956.3	-11.2
Soft-leaf species	-3.8	-111.7	-2.2
Other species and bushes	13.5	208.6	3.1
Total	-7.6	-859.4	-10.3

Thus, because of species compositional change on 13 500 ha and the decrease of the forest acreage by 7 600 ha, the total carbon reserves will decrease relative to the base level by 859 400 t, and the yearly increment in deposited carbon will decrease by 10 300 t (ca 2%). This magnitude is insignificant and lies within the possible calculation error margin, reflecting ambiguities in the source material. The results obtained confirm our thought that the upcoming climate changes will not have significant influence on the current borders, content and productivity of the forests.

Forestry adaptation strategy to climate change

The low average increment in the national wood reserves is related to the presence of a considerable acreage of low-density forests, thin areas, proliferation of low-value species, non-optimal soil and climatic conditions, and increased negative anthropogenic impact. However, the climatic productivity potential of Azerbaijan's forests is extremely high. Calculations show that the magnitude of the climatic index of potential productivity of the Republic's forests when all of the climate change scenarios are implemented may increase from 23% up to 53%. The implementation of forest stabilization measures will attenuate the climate change consequences through:

- observance of the forest protection legislative acts;
- assistance to natural restoration;
- bans on cattle grazing;
- fight against parasites and diseases;
- introduction of highly productive forest tree species; and
- increased forest acreage.

Taking into consideration the exclusive environment-forming and the nature protective functions of the forests, the adaptation strategy for the forest sector to the upcoming climate changes should be directed at forest restoration. Preliminary calculations with due consideration for different economic sectoral interests (primarily the agricultural sector) show that the optimal forest coverage of Azerbaijan equals 18–20%. There is potential for increases up to 5–7% in the Kuro-Arazsky lowlands; 20–25% in the piedmont part of the Greater and Small Caucasus; and 35–40% in the mountain forest zones. The acreage of the forest fund that is not covered by forest could serve as a reserve for future forest expansion, in particular those lands that are unfit or marginal for agriculture, as well as those lands subject to re-cultivation. There is a significant reserve for forest restoration in old forest harvesting sites, since covered by low-value tree and bush species, glades, rough pastures and burnt-over areas. Two factors that need to be considered when executing forest restoration activities are obtaining an optimum balance between the economic sectors, while increasing forest productivity.

The first task may be solved by using areas for forest plantations that are of little or no use to other economic sectors. The second task may be achieved by the selection of highly productive tree species, capable of adapting to the upcoming climate changes, by improving the structure and the productivity of the existing forest. For these purposes the most suitable tree and shrub species should be selected for forest restoration measures.

For mountain conditions in Azerbaijan, the species with best potential are oaks, eastern beech, hornbeam, hackberry (*Celtis* spp.), birch, pine and others. In the steppe zone, preference should be given to Araz oak, Eldar pine, turpentine tree, ailanthus, Chinese elm and other drought-resistant species. The best companion tree species for the mountain conditions include maple, great maple, Caucasian linden, common ash, alycha, cherry and cobnut. For the steppe region, species include the Araz maple, Japanese pagoda tree, English field maple, hawthorn and mulberry.

For cover loss on the mountain slopes and sandy land, protective plantations of several shrub species have considerable potential: locust, black locust, squawbush, European elder, rosehips and oriental hornbeam. When using plants to fix sands, it is expedient to use the Baku calligonum, narrow-leaf oleaster, Eldar pine, smoke-tree, fig, *Tamarix* spp., astragal, pomegranate, Persian bindweed and melur. The most stable and effective species for salinized soils are locust, black locust, mulberry, *Tamarix* spp. and pomegranate.

In order to achieve the set objectives by 2020, the forests should be restored to the extent of 200 000 ha. Low-value plantations should be replanted to the extent of 190 000 ha. More than 100 000 ha of the low-density forests could contribute to natural restoration by planting into the forest bed plantlets of valuable tree species, so as to systematically upgrade those areas to the category of high-density forests and increase forest productivity 2 to 3 times. In order to protect agricultural lands from water and wind erosion, and plantations from droughts and dry hot winds, it will be necessary to create about 16 000 ha of protective forest bands, increasing this acreage in the future by 9 000–10 000 ha.

The Main Forestry Adaptation Strategy to Climate Change comprises:

- Legislative initiatives and institutional changes (Forest Code; National Forest Programme).
- Improved forestry management (performing forest inventory, prospective forest station development plans, including climate change monitoring, database development).
- Increased forest activity efficiency through realistic work planning, regulation of livestock grazing, and mitigating anthropogenic stress.
- Increased human resources potential in the industry through training manuals that take into consideration the specific national forestry characteristics, and improved personnel qualification.
- Development of applied scientific studies requested by the production sector (targeted scientific programmes, use of the accumulated knowledge, linkages between science and production).

Review of future tasks and research topics, and lack of knowledge applicable to the international activity threats

Where activities remain at the "business as usual" level, we can expect several threats to the development of forestry in the country in the foreseeable future. These threats include:

- A lack of objective and comprehensive information on the condition of the forests on the national territory will prevent scientific planning of the development of the forestry sector.
- Worsening of the survival ability and general condition of existing plantations due to traditional reasons (lack of materials and financial resources, use of primitive technologies, unregulated livestock grazing, unauthorized forest harvesting, materials, parasites, diseases, etc.), as well as the new and increasing negative climate change impact.
- Change in forest growing conditions on the mountain territories under the influence of changing climate will result in shifts in the area of existing forest formations; in other words, the border between tree and shrub species will move upwards, with various consequences, including the loss of biodiversity.

- A decrease in the acreage of forest cover, degradation of the tree species mixture, deceased reserves and forest productivity, and deterioration in the age content of forests due to the combination of traditional threats and global warming.

Climate Change Projects in forestry

Fostering Community Forest Policy and Practice in Mountain Regions of the Caucasus
See: www.rec-caucasus.org/recc/index.php?f=12&su=12060010012&t=index

- The overall objective of proposed action is fostering community forest policy and practice in mountain regions of the Caucasus to address deforestation and climate change issues, secured land tenure and forest rights, rural poverty reduction, diminishing regional and national tensions and the risks of insurrections let by alienated elements, conservation and sustainable development needs of local communities.
- The project's specific objective is to respond to current demands of the countries in 1) elaboration of relevant to institutional, legal and technical set-up for community forest management, 2) awareness raising and capacity building of local communities and local authorities on sustainable forest management and 3) demonstration of best approaches/methods of immediate reforestation and landscape restoration in areas affected by land-slides, mudflows, avalanches and other natural disasters preventing measures.

The project was supported by EU funds.

World Bank – Country environment protection project

- Project objective: Creation of the "Shardag" National Park; preservation of the biodiversity between the greater and smaller Caucasus; and the expansion of the existing "Ordubad" National Park.

Bank KfW – The creation of the "Samur Yalama" National Park

- Project execution timeframe: 2008–2010
- Project objectives: Climate change contribution in the southern Caucasus; forest restoration activities on 350 ha, for which the project execution timeframe is one year.

World Wildlife Fund (WWF) Leopard protection in the Caucasus ecological region

- Project execution timeframe: 2009-2010

Asian Development Bank – Anti-mud slide measures in the Kishsky gorge of the Shekinsky region

- Forest restoration activities on 550 ha.

Review of the conditions and the work of the national research institutes in their studies evaluating climate change in the forest sector

Azerbaijan one research institution performing forest management research, namely the Republic Scientific Research Institute of Forestry. The institute made a study of "What impact do forest plantations have on the climate change?" but there was no theme directly related to climate change impact on forestry.

Summary list of issues for international cooperation, as proposed by consultants

- Supporting FAO in the study of positive world experience on:
    - Forest ecosystems vulnerability assessment. For the forest ecosystems vulnerability assessment of Azerbaijan's forests, an original procedure was used that has both strong and weak spots. The study of other vulnerability assessment methods will allow us to adopt useful experience and improve the forest ecosystems vulnerability assessment quality.

- Practical forestry adaptation measures to climate change in similar natural and climatic conditions, taking climate changes into consideration in prospective plans for forestry development. Studying world experience in planning and executing a set of practical climate change adaptation measures.
- Preparation of a lecture course for educational institutions and organizations, aimed at qualification improvement on the issue of the climate change impact on forestry through adaptation. Studying other country experiences in educational institutions and with qualification improvement courses where climate change impact on forest ecosystems and adaptation measures to such changes have been studied.

- The execution of a small demonstrational CDM project on forestry.
- The reorganization of forest management and forest statistics. At the present time, because of the unsatisfactory condition of the forest management service, forest statistics do not have sufficient credibility. To be well grounded, any decisions or calculations on forestry should be based on real statistical data. This applies also the statistical data required for GHG absorption inventory in the forestry sector.
- The execution of a demonstration pilot project on pasture turnover in the mountain and desert zones. On the territory of the State forest fund, including wooded lands, livestock overgrazing is observed everywhere. This factor can be considered as one of the most important ones, influencing degradation of the forest ecosystems. This is why the creation of sustainable model of the forest fund use in the mountainous and desert zones for pastures is a task of current concern.
- Knowledge dissemination on climate change impact on forestry among both experts and the general population.

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