

The Impacts of Climate Change on Forests and Sustainable Forest Management in (Kyrgyzstan)

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Abstract

This country report provides a brief overview of the current situation in the forestry sector of the Kyrgyz Republic, information on the state forest policy related to forestry and climate change and the state of forest ecosystems, current and planned actions (measures) for sustainable forest management and climate change mitigation and adaptation. for forests through governance / stakeholder participation. The priority directions for further steps to implement measures to improve the efficiency of forestry management and create the most favorable conditions for sustainable development are noted. Presents data on ongoing projects, including international donors, operating in the forestry sector of the republic, in particular piloting the reform of the forestry sector. The report also presents management practices, use of forest lands, problems and recommendations for further effective management of forest resources in the face of increased anthropogenic pressure and changes in forest landscapes due to climate change.

Current forest policy, legislation and strategic documents and institutional structures related to forestry and climate change

By the Decree of the President of the Kyrgyz Republic "On the National Development Strategy of the Kyrgyz Republic for 2018-2040" dated October 31, 2018 No. 221, the National Development Strategy of the Kyrgyz Republic for 2018-2040 was approved, which defines a long-term vision for the development of the republic as a country with a favorable human life environment that develops in harmony with nature, preserves unique natural ecosystems and uses natural resources wisely.

This Decree recommended that the Government of the Kyrgyz Republic coordinate its strategic documents (concepts, strategies, programs) and action plans with the National Development Strategy of the Kyrgyz Republic for 2018–2040.

The Parliament of the Kyrgyz Republic approved Resolution No. 2532-VI of June 28, 2018 “On Approval of the Concept“ Kyrgyzstan - a Country of Green Economy ”and Measures to Implement the Principles of Green Economy in the Kyrgyz Republic”.

In the Government program "Unity, Trust and Creation" for 2018-2022. our state has declared its aspiration for a "green economy" at all stages of planning, decision-making, execution and monitoring.

In accordance with the obligations of Kyrgyzstan arising from joining the Convention on Biodiversity, it is planned to plant forest crops on an area of 1000 hectares annually, as well as create new and expand the area of existing specially protected natural areas to 10% of the country's territory.

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By the Decree of the Government of the Kyrgyz Republic dated May 27, 2019 No. 231, the Concept for the development of the forestry sector of the Kyrgyz Republic for the period up to 2040 was approved.

The concept is based on 12 objectives of UN Sustainable Development Goal No. 15 “Protecting, restoring and promoting sustainable use of terrestrial ecosystems, sustainable forest management, combating desertification, halting and reversing land degradation and halting biodiversity loss”.

At the moment, this is a key document, developed on a bottom-up basis, with the active participation of all stakeholders and contains the goals, objectives and strategic directions of the long-term and medium-term vision, as well as the Action Plan for the implementation of the Concept for 2019-2023.

In order to improve forestry and related legislation, taking into account the goals and objectives of reforming the forestry sector in Kyrgyzstan, work is underway to develop a new edition of the Forest Code of the Kyrgyz Republic.

According to the legislation of the Kyrgyz Republic, all forests and forest resources are in the exclusive ownership of the state and forest management is carried out by the state.

Currently, the forest management system of the Kyrgyz Republic has a four-level management: republican, regional, leshozes and forestries, which are vertically subordinate.

Over the past 17 years, the forestry system has undergone several transformations, which concerned only the republican and regional levels, but these transformations did not have a positive impact on the quality of forestry.

State of forests and GHG inventory

Forests of the Kyrgyz Republic are represented by four types: walnut-fruit, coniferous-spruce, juniper and floodplain forests.

Walnut-fruit forests. Among the forests of our republic, the most valuable are the unique walnut-fruit forests located in the Jalal-Abad and Osh regions on the western and southwestern slopes of the Fergana and Chatkal ranges of the Tien Shan mountain system.

This is the largest array of wild walnut and fruit plantations on the planet, occupying 631 thousand hectares. Walnut-fruit forests are the center of origin of cultivated plants, storage of biodiversity and genetic fund of flora and fauna.

Spruce forests of the Kyrgyz Republic are represented by the main forest-forming species - Tien Shan spruce (*Picea Schrenkiana*). The share of Shrenk spruce accounts for 116.6 thousand hectares or 13.5% of the total forest area of the Kyrgyz Republic.

The main tracts of spruce forests are concentrated in the northern part of the country along the slopes of the mountains bordering Lake Issyk-Kul and in the basin of the Naryn River. Small tracts of Tien Shan spruce are located on the Kyrgyz and Talas ridges. In the south of the republic, in the Osh and Jalal-Abad regions, spruce forests occupy only 13.9 thousand hectares.

Juniper forests are a valuable unique natural complex. These are evergreen light-coniferous low-productive sparse forests, in which the main forest-forming species is the Turkestan juniper (*Juniperus turkestanica*).

The largest tracts of juniper forests are concentrated in the Osh and Batken regions on the slopes of the Turkestan and Alai ranges. In Jalal-Abad oblast, juniper grows in Chatkal, Ala-Buka and Aksy districts. A small area of these forests is located in the Chui and Talas regions.

Floodplain forests are located along the floodplains and banks of large rivers: Naryn, Chu, Tyup, Talas, Susamyr, Jergalan, Zhazy and along many small rivers. The species composition of floodplain forests depends on environmental conditions and the competitive relationship between tree and shrub species. The Kyrgyz Republic is considered a sparsely forested country. According to the 2013 Forest Fund Accounting data, the total area of land of the state forest fund, protected natural areas of the Kyrgyz Republic and forests that are not included in these two categories is 3,766,058.3 hectares.

According to the National Forest Inventory (2008-2010), the forest area of the Kyrgyz Republic is 1,116.56 thousand hectares. or 5.6% of the total area of the country. Information on the forest area by region is presented in Table 1.

Table 1

Forested area

№	Name of regions	Total forested area		including:			
		thousand hectares	%	Forest area of SFF and SPNA		Forest area not included in SFF and SPNA	
				thousand ha	%	thousand ha	%
1	Batken	166,5	0,83	138,77	0,69	27,73	0,14
2	Osh	186,31	0,93	110,55	0,55	75,76	0,38
3	Jalal-Abad	380,25	1,9	324,8	1,62	55,45	0,28
4	Talas	61,01	0,33	28,06	0,16	32,95	0,16
5	Chui	44,53	0,22	30,96	0,15	13,57	0,07
6	Issyk-Kul	142,36	0,71	102,8	0,51	39,56	0,2
7	Naryn	135,6	0,68	103,62	0,52	31,98	0,16
	Total in the republic:	1116,56	5,6	839,56	4,2	277	1,39

According to the Forest Code of the Kyrgyz Republic, forests in the Kyrgyz Republic are nature conservation, perform soil protection, water protection, climate control, sanitary and hygienic, and recreational functions. Also, forests prevent the negative effects of global climate change by absorbing carbon dioxide.

The results of numerous studies of the Forest Institute of the National Academy of Sciences of the Kyrgyz Republic, carried out in various natural and climatic conditions, indicate the great water-regulating importance of forests.

The founder of the hydrology of Central Asia Shultz V.L. notes that glacial runoff in the total flow of rivers in Central Asia is a little more than 6%. And the main source of food for the rivers of Central Asia, overwhelming all others, is melted snow water, which forms the main mass of surface and mobile river runoff.

According to the observations of scientists from the Institute of Forestry of the National Academy of Sciences of the Kyrgyz Republic, at the same altitudes and exposures, the period of snow melting in a spruce forest, in clearings and in forest cultures is 20-40 days longer than in open areas.

Slower snow melting in the forest, with less freezing of the soil and its faster thawing, contributes to the fact that all melt water penetrates into the soil, ensures the accumulation of groundwater, which, wedging out in the form of springs, enters the rivers, feeding them with water throughout the year ... On treeless slopes, snow melts extremely intensively, so most of the melt water, rolling down the surface of the slopes, enters the valleys in the first spring days and is not used for agriculture.

In walnut-fruit forests, the total runoff is approximately 100 m³ / ha, the share of subsurface runoff is 85-90% of the total runoff. Walnut-fruit forests largely prevent erosion processes, participate in the regulation of river runoff, reduce spring floods and more evenly distribute runoff in summer.

Forests are of great ecological importance, especially in the fight against climate warming; they are the most reliable natural system for preventing the greenhouse effect.

An increase in planetary temperature by more than 1.5-2.5 ° C is associated with the threat of mass transformation of forest land into non-forest and vice versa, and this threat is further exacerbated by warming above 3 ° C.

About 45% of all glaciers in Central Asia are located on the territory of the Kyrgyz Republic, which are one of the main sources of water for rivers, and due to global climate change, forecasts for the state of glaciers are of particular concern.

According to expert estimates, there is currently an active melting of glaciers. This is due to deforestation in the spurs and local changes in the environment. The air on forested mountain slopes has a lower temperature and higher humidity than air on unforested slopes. In addition, forests smooth out temperature fluctuations.

In this connection, it is necessary to carry out research work on the territory of the Kyrgyz Republic to study the influence of mountain forests on glaciers, since this work in the future will provide comprehensive data on the influence of forest ecosystems on the dynamics of mountain glaciers.

Kyrgyzstan is prone to several types of natural disasters (high temperatures, drought, changes in precipitation, forest fires, landslides), which become natural disasters combined with the current level of vulnerability of people in rural areas and with a growing likelihood of negative impacts from climate change at present. Slow-onset natural disasters such as droughts or high temperatures, while seemingly less catastrophic than flash floods, can actually undermine progress in poverty reduction, and they will recur with increased frequency in the coming decades, creating irreparable losses to the production and livelihoods of most vulnerable people.

Observed changes in forests introduced by climate change over the past 30 years including monitoring and reporting

In recent years, the climatic conditions in Kyrgyzstan have been changing due to the reduction of the glaciers in most of the Tien Shan and Pamir-Alai mountain systems. In this regard,

there is already a real shortage of water for irrigation and watering of pastures; the natural vegetation cover is degraded, the processes of erosion, salinization are intensified, the productive capacity of irrigated lands is reduced.

One of the consequences of the negative impact of climate change is an increase in the fire hazard in the forests of Kyrgyzstan, as evidenced by the practice of recent years. From 2011 to 2016, as a result of fires, 142 hectares of forest-covered area burned out.

Another negative climatic factor of the vulnerability of forests is the expansion of the spread of foci of pests and diseases. Walnut forests annually suffer enormous economic damage.

Analysis of past temperature (min. And max.) and precipitation trends confirms the country's predicted climate change with clear and concrete evidence in four districts of Naryn, Osh and Jalal-Abad oblasts. Data from national meteorological stations and analysis of remote sensing data show a clear downward trend in precipitation on the western side of four regions, with full coverage of the Uzgen and Suzak regions with a hot spot in the northern part of the Suzak region (reduction to 8 mm or more per year). The eastern part of the target zones shows an upward trend in precipitation in the order of 1 to 10 mm / year. Recorded trends in absolute annual maximum temperature (° C) based on historical (1989-2016) time series show a change in the order of proportion of the degree spread from west (increasing) to east (stable or decreasing). Based on 27-year observations, the total period change is from 1 ° C to 1.5 ° C or more. As for the minimum temperatures (° C), the change is almost only in increasing values from west to east in the order of a fraction of a degree, with a slight increase in the western regions and the southern part of the Ak-Tala region.

Forests and pastures, already in dire straits due to anthropogenic pressures, are among the most sensitive resources affected by climate change. Decreased pasture productivity, reduced resilience of forest ecosystems and increased impact of natural disasters increase the general vulnerability of the population and negatively affect livelihoods in rural areas. At the same time, there is significant value not only of protecting these existing resources, but also the value of expanding and enhancing healthy forest and rangeland areas.

Changes in forest management and provision of forest goods and ecosystem services under climate change conditions

The Kyrgyz Republic, by adopting the Law on the Ratification of the Paris Agreement on the UN Framework Convention on Climate Change, signed on December 12, 2015 in the city of Paris, on November 11, 2019, committed itself to take effective legal, economic and political measures to help combat climate change.

For example, currently work is underway to amend the Forest Code of the Kyrgyz Republic and it is proposed to use new economic categories in it, such as “forest ecosystem services” and “payments for ecosystem services”, “high conservation value forests”. These innovations are proposed to stimulate the improvement of the forest management system.

Kyrgyzstan is only now coming to an understanding of the socio-economic consequences of climate change. In general, the following list of possible impacts on ecosystem products and services can be presented:

- Decline in wood production due to an increase in the number of extreme events such as forest fires, hurricanes, floods and droughts;
- Decrease in wood production due to changes in ecosystems and an increase in the spread of pests;
- Changes in the quality of wood and non-wood products;
- Changes in the distribution of tree species at the regional level;
- Impact on the ability of some plantation species to maintain growth rate and wood quality over the next 30-50 years;
- Indirect impacts on the timber supply chain due to changes in the volume and quality of timber offered;

- Impact on the provision and quality of services provided on the basis of forest ecosystems;
- Impacts on the livelihoods of people who depend on forest resources (including a decline in the volume and quality of food and shelter);
- Changes in land use practices due to increased demand for agricultural land;
- Impact on other sectors, especially agriculture, energy and water resources
- Increased risk of natural disasters due to weakening of forest functions (for example, the possibility of landslides due to land degradation).

Ongoing and planned sustainable forest management and climate change mitigation and adaptation actions (measures) for forests through governance/stakeholder participation (public, private sector, academia, NGOs, research institutions, etc.)

The population living near the territories of forest ecosystems is traditionally tied to any particular area of the forest, which is their source of income.

The forest is no longer considered only as a source of raw materials or as a habitat for legally protected species of animals and plants. Environmental aspects of forest sector problems include biodiversity loss through habitat destruction, species change and genetic degradation, landscape degradation, land retention and land degradation.

Natural resources of forest ecosystems significantly affect the socio-economic well-being of the country, in some cases provide the local population with livelihoods. The anthropogenic impact and pressure on forests is increasing every year, thereby giving rise to new challenges and difficulties.

In order to improve forestry and related legislation, taking into account the goals and objectives of reforming the forestry sector in Kyrgyzstan, work is underway to develop amendments and additions to the Forest Code of the Kyrgyz Republic.

A new version of the Regulation "On the procedure for leasing and using forest land plots" was developed and approved by the Resolution of the Government of the Kyrgyz Republic dated April 10, 2018 No. 192.

The Resolution of the Government of the Kyrgyz Republic dated June 16, 2015 No. 367 approved the "Regulations on the organization and implementation of measures to develop directions and approaches to reforming the forest sector of the Kyrgyz Republic" in order to develop approaches and directions for phased reform of the forestry sector, taking into account the practical experience of new approaches to forest management on the territory of experimental (pilot) forestry.

The reform of the forestry sector continues to be implemented within the framework of the World Bank / Global Environment Facility 'Integrated Management of Forest Ecosystems' project launched in April 2017 with a budget of over 16 million US dollars, the most important component of which is the institutional reform of the forestry sector. Within the framework of this project, designed for 5 years, 14 experimental (pilot) leshozes were organized in 2017.

To improve the forest management system, the implementation of integrated forest management with the involvement of all stakeholders is being carried out on a pilot basis, while the main condition for the development of integrated management plans is the active participation of all stakeholders in decision-making, planning, financing and management of natural resources of the state forest fund.

Ongoing and planned projects funded by national and international organizations (forestry funds, incentives, green funds, investments)

Currently, the following projects are operating in the forestry sector of the Kyrgyz Republic:

The project of the German Agency for International Cooperation (GIZ) "Conservation of biodiversity and poverty reduction through the management of walnut forests and pastures with the involvement of the local community", the goal is to reduce poverty by involving the local population in the management of walnut forests, the creation of plantations to reduce the pressure on natural forests; The GEF-UNDP project "Conservation of globally significant biodiversity, adjacent land and forest resources of mountain ecosystems of the Western Tien Shan and support of sustainable livelihoods", the goal is to strengthen the management and conservation capacity of protected areas in the Western Tien Shan in the Jalal-Abad region, as well as to strengthen management of high conservation value forests, support for the operationalization of two new state parks, Alatay and Kan-Achuu;

The World Bank Project "Integrated Forest Management in the Kyrgyz Republic" aims to strengthen the capacity of government institutions and communities to improve sustainable forest ecosystem management through investments in management planning, ecosystem restoration and infrastructure.

Success stories in any country, including the country the report was written about (if known)

In the process of piloting the reform of the forestry sector, international experience is also being studied.

According to a Finnish study, Europe's view of the role of forests in human life has fundamentally changed. They show that Europeans prioritize the conservation of forests (43.8% of respondents) and the fulfillment of protective functions by forests (40.8%), rather than their economic importance (8%). The most important function of forests is not even called recreational (59.9%), but biodiversity conservation (86.9%).

At the same time, the majority of the respondents believe that it is forest management that should ensure their performance of protective functions, including the preservation of biodiversity. In addition, there is every reason to believe that the role of the protective functions of forests in the eyes of society will increase due to the increasing urgency of the problem of climate change. The shift in the priorities of the society's perception of the role of forests significantly affects the priorities of forest management. Of course, Finnish forests will not lose their economic importance in the near future, but there is a clear tendency according to which the issues of biodiversity conservation, other protective functions of forests, including climatic ones, and increasing the recreational potential of forests will be given more and more attention in forest management.

The Finnish National Forest Program has six priorities:

- providing a competitive environment for forestry and timber industry;
- increasing the level of climatic and energy value of forests;
- protection of biological diversity and ecological value of forests;
- consolidation of the function of forests as places of culture and recreation;
- improving skills, experience and improving public perception of the forest sector;
- promoting sustainable forest management in international forest policy.

Finnish state authorities and administrations stimulate the maximum diversification of forest management, in particular the development of new types of products and services that are most in demand on the market, based on the use of wood and other forest resources. They provide support measures, including investments, to develop the use of wood for bioenergy, the production of chemicals and medicines, as well as the development of ecotourism. At the same time, the use of wood is increasing, and it is expected to double the production of bioenergy as a contribution to the implementation of the goals and objectives of the European Union to increase the use of renewable energy.

It is recognized at the state level that the conservation of forest biological diversity requires additional measures, primarily in the southern regions of Finland. In parallel with the National

Forest Program, the Action Program for the Conservation and Restoration of Forest Biological Diversity in Southern Finland (METSU) has been developed.

Currently, there is a growing interest in the cultivation of mixed and uneven-aged plantings, since they are much more resistant to the effects of adverse natural factors, allow better preservation of biodiversity, and are more aesthetically attractive.

Techniques for growing such plantings are more complicated, but in conditions when in the future the recreational and ecological significance of forests will begin to dominate over the economic, they will prevail. This trend is becoming more pronounced, also because more and more private forest owners live in cities and for them the recreational and ecological functions of the forest are often more important than economic ones. In Finland, recommendations have been developed to amend the Finnish forest legislation to provide forest owners with greater freedom in making forestry decisions.

Challenges, gaps and barriers for Sustainable Forest Management under the impacts of climate change

The contradictions and collisions of the norms of forest legislation have led in practice to numerous problems in forest legal relations between the subjects, to the loss of institutional balance and the real inability of forestry entities to conduct effective activities aimed at the protection, reproduction of forest ecosystems, ensuring the rational use of forest ecosystems, preserving biological diversity of forest ecosystems, increasing the ecological and economic potential of forests, etc.

The presence of the above legal gaps in forestry legislation and the absence of some basic concepts in the Forest Code of the Kyrgyz Republic led to difficulties in practice, discrepancies in legal norms and different approaches to legal regulation.

The practice of managing forest ecosystems has also shown the ineffectiveness of the simultaneous fulfillment (combination) of forest management and forestry functions by forestry enterprises, which also contradicted the basic requirements of the legislation of the Kyrgyz Republic.

In recent years, a host of new laws have been adopted in various fields, which have greatly influenced the institutional and financial sustainability of forestry entities, creating conditions that impede sustainable forest management.

In the forest management system, new problems arise in the formation of mutually beneficial economic relations between the state, the owner of the forest fund and the business in the field of forest management.

Currently, due to the lack of a conceptual plan for the development of the forest economy, the lack of an economic assessment of forest resources, an ineffective financing system and a lack of investment, the lack of modern tools for economic planning, forecasting, organization and accounting of forest use, as well as due to the low economic potential of personnel, the economy of the republic's forestry is in a state of stagnation. To enhance the economic sustainability of forestry, it is necessary to create conditions.

Required enabling environment and options for improved SFM (legislative, administrative, institutional, financial, technical and technological)

The goal of the development of the forestry sector until 2040 is sustainable forest management to ensure the economic well-being of the people, social well-being, environmental safety and a favorable environment for the lives of citizens of the Kyrgyz Republic. To achieve this goal, the Concept defines four main priorities for forestry development:

1. Environmental priorities for forestry development. The goal is to preserve forests and increase the country's forested area up to 6%. Tasks: - to improve the forest accounting

- system. - to strengthen the protection of forests from forest violations and fires. - to strengthen the protection of forests from pests and diseases. - to increase the area and improve the reproduction of forest resources.
2. 2. Social priorities of forestry development. The goal is to reduce the poverty level of the rural population in forest areas by 10%. To achieve this goal, it is necessary to solve the following tasks: - ensuring joint forest management.
 - diversification of sources of income.
 - introduction of integrated management of natural resources.
 3. Economic priorities for forestry development. The goal is to increase the contribution of forestry to GDP up to 1%. To achieve this goal, it is necessary:
 - to introduce a system of ecological and economic accounting (forest accounts).
 - create conditions for increasing the economic sustainability of forestry.
 - to implement the value chain of forest resources.
 - to ensure the rational use of the recreational potential of forest ecosystems.
 4. Reform of forestry. The goal is to create favorable conditions for sustainable forest management and increase the efficiency of the forest sector.

Recommendations and conclusion

Today, the main threat to forests comes from negative anthropogenic pressure on natural resources caused by negative economic conditions and demographic growth. In these conditions, in order to preserve forests, the involvement of local people and communities in joint forest management is an important task. To solve this problem it is necessary:

- broad involvement of all stakeholders;
- improvement of intersectoral and interdepartmental interaction;
- development of mutually beneficial partnership between the public and private sectors (rent, transfer of economic functions, etc.);
- balance between environmental, economic and social aspects of development;
- increase in forest cover and conservation of biodiversity

For effective management of forest resources, it is necessary to implement integrated management. Integrated natural resource management is the unification of all stakeholders to implement the concept of sustainable management of forest, land, water and biological resources, in which the use of forest resources is integrated with the use of other resources that form a specific productive landscape. At the same time, resources, interests and goals are integrated based on the principles of sustainability.

It is necessary to introduce integrated management of natural resources of the state forest fund through the development and implementation of integrated management plans, as well as by strengthening intersectoral cooperation at all levels. It is important for the forestry of the Kyrgyz Republic to attract investment, to promote the creation of conditions and expand opportunities for the production, processing and marketing of forest products (business with forest products).

Key strategies for adapting forestry to climate change:

- legislative initiatives and institutional changes (Forest Code, National Forest Program);
- improvement of the forestry management system (forest accounting, long-term plans for the development of forestry enterprises, including taking into account climate change, monitoring, database);
 - improving the efficiency of forestry operations (realistic work planning, regulation of livestock grazing and anthropogenic pressure);
 - increasing the personnel potential of the industry (textbooks that take into account the specifics of the country's forestry, advanced training);
 - development of applied scientific research at the request of production (targeted scientific programs, the use of accumulated knowledge, the connection between science and production).

World experience has shown that adaptation to climate change should be based on intersectoral policies. National institutions responsible for the forestry sector, forest ecosystems and climate change should establish mechanisms to enable them to coordinate with other sectors. Coordination of activities would include, inter alia, clarifying and resolving conflicts, exploiting synergies, and sharing knowledge and experience.

Climate change can affect all forest landscapes and biodiversity in Kyrgyzstan. These changes will affect the availability and quality of forest-based products and services. In addition, the projected potential positive impacts of climate change, as well as the anticipated absorption of carbon dioxide by mature forests, could be significantly threatened by exacerbating or changing forest threats such as fires, pests, droughts and heat waves that negatively affect forestry productivity.

Forestry is a unique sector that combines the potential for both adaptation and mitigation of climate change.

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