Forestry Development and Best Practices
of Forest Management in Tajikistan

Asia−Pacific Network for Sustainable Forest
Management and Rehabilitation

Forestry Development and Best Practices of Forest Management in Greater Central Asia
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Map of the World

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MALAYSIA
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PACIFIC OCEAN
NOUAKCHOTT
CAPE VERDE
SENEGAL
MALI NIGER CHAD SUDAN
Al Khurtûm
AFRICA
GUINEA
N'Djamena
NIGERIA
Abuja
CÔTE D'IVOIRE GHANA
LIBERIA
CAMEROON
CENTRAL AFRICA SOUTH SUDAN ETHIOPIA
Addis Abeba
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GABON CONGO
D.R. CONGO
Kinshasa
KENYA
ANGOLA
Luanda
TANZANIA
Dar es Salaam
SEYCHELLES
Chagos Arch. (U.K.)
ANGOLA
ZAMBIA
Lusaka
MOZAMBIQUE
ZIMBABWE
MADAGASCAR
Antananarivo
MAURITIUS
NAMIBIA BOTSWANA
Windhoek
SOUTH AFRICA
Pretoria SWAZILAND
Maputo
LESOTHO
ST. HELENA (U.K.)
ATLANTIC OCEAN
INDIAN OCEAN
AUSTRALIA
Canberra
NEW CALEDONIA (Fr.) Nouméa
VANUATU
NEW ZEALAND
ANTARCTICA
ROSS

MEDITERRANEAN SEA
YELLOW SEA
EAST CHINA SEA

C E A N

150° 120° 90° 30° GREENLAND (Den.) 75°

Queen Elizabeth Is. Arctic Circle

Nuuk (Godthåb) 60°

UNITED STATES

C A N A D A

BERING SEA

Bering Strait

NORTH AMERICA

G. of Newfoundland 45°

Aleutian Is. (U.S.)

Ottawa

Azores (Port.)

UNITED STATES

Washington

BERMUDA (U.K.) 30°

Mississippi

Hawaiian Is. (U.S.)

G. of Mexico

Tropic of Cancer

MEXICO

BAHAMAS

La Habana CUBA

DOMINICAN REP.

HAITI

Cd. de México

JAMAICA 15°

HONDURAS CARIBBEAN SEA

GUATEMALA NICARAGUA

COSTA RICA

Caracas TRINIDAD AND TOBAGO

PANAMA

VENEZUELA GUYANA SURINAME

P A C I F I C O C E A N

P O L Y N E S I A

Bogotá

COLOMBIA

Arch. de Colón (Ec.) (Galápagos Is.)

Equator 0°

Quito ECUADOR

Amazonas

MARSHALL IS.

SOUTH AMERICA

B R A Z I L

P E R U

O C E A N I A

SAMOA

Lima

VANUATU FIJI

Suva

FRENCH POLYNESIA

COOK IS.

Brasília 15°

BOLIVIA

Sucre

NOUMÉA

Nouméa

PARAGUAY

Asunción Tropic of Capricorn

NEW ZEALAND

Wellington

Santiago

C H I L E A R G E N T I N A

Buenos Aires URUGUAY 30°

O C E A N 45°

IS. MALVINAS (FALKLAND IS. BY U.K.) (Claimed by Arg. & U.K.)

Drake Passage

180° W 150° 120° 90° 60° 30°

ROSS SEA

BELLINGSHAUSEN SEA 60°

Antarctic Circle

75°

F R I C A

LEGEND	
⊙	Capital
•—•—•—•—	Continental boundary
___Undefined___	International boundary
-------------	Regional boundary
+++++++++++++	Military demarcation line

Map of the Asia

Astana

KAZAKHSTAN

Bishkek

Tashkent

UZBEKISTAN

KYRGYZSTAN

TURKMENISTAN

TAJIKISTAN

Ashgabat

Dushanbe

PEOPLE'S

Irtysh

LEGEND

● Capital

Continental boundary

Undefined International boundary

Regional boundary

Military demarcation line

MONGOLIA

Ulaanbaatar

'S REPUBLIC OF CHINA

Beijing

Huang He

Chang Jiang

YELLOW
SEA

EAST
CHINA SEA

SOUTH
CHINA SEA

Foreword

Strong social, economic and cultural connections exist among economies across Central and Northern Europe, Central Asia, the Middle East, North Africa and Greater Central Asia (GCA). The GCA region, in the widest sense, encompasses Kazakhstan, Tajikistan, Uzbekistan, Turkmenistan, Kyrgyzstan, Mongolia and western China and harbors unique biodiversity. Various species of fauna and flora mingle with endemic species not found elsewhere.

Forests in this region are vital natural resources that provide important environmental services including climate regulation, soil protection, clean water supply and many more. They also play a leading role in socio-economic development, supplying people with food, fuel, medicinal plants and recreational areas. Meanwhile, forests are suffering the effects of increasingly severe land degradation and desertification due to a host of natural and human factors. The most significant of these factors include overgrazing, land clearing for agricultural use, illegal logging and poaching, firewood collection, excessive water consumption, and insufficient financial and technical support.

Economies in GCA are actively involved in international and regional commitments focused on climate change adaptation, biodiversity conservation and desertification control. However, a comprehensive overview of the history, status and outlook of forestry development in GCA has been lacking.

Given this, the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation (APFNet) identified the GCA region as one of its seven geographical priority areas for strategic interventions. Desk research and field surveys have been conducted since 2014 with the financial support of the Department of Science and Technology (DST) of the State Forest Administration of China (SFA), the active involvement of officials from different forest authorities, as well as consultants from international organizations, which has culminated in a series of six books being published.

This book, one of the six, gives a holistic overview of the current state of forests and forestry, the contribution of forests to economic development, forestry policies and legislation, and forestry education and research, in Tajikistan. In particular, sustainable forest management best practices in relation to soil and water conservation, desertification control, forest fire and disease prevention, biodiversity conservation and rehabilitation of degraded forests etc., are covered in-depth.

We hope that this book will be of value to foresters, from policy makers to grass root practitioners and those working in forest authorities, academia, international organizations and civil society organizations who have an interest in forestry development in Tajikistan.

APFNet Executive Director

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Abbreviations

BWC	Biological Weapons Convention
CAFT	China-ASEAN Free Trade Area
GDP	Gross Domestic Product
KfW	Kreditanstalt für Wiederaufbau
NEAP	National Environmental Action Plan
PRSP	Poverty Reduction Strategy Paper
SPNAs	Specially-Protected Natural Areas
TLS	TajikLes Service
UNCCD	United Nations Convention to Combat Desertification

Chapter 1　Current state of forests and forestry

1.1 General information of the economy

Tajikistan is a typical mountainous economy, 93% of the territory represents the mountain systems of Pamir-Alay and occupies about 143,000 km². The territory of the economy stretches for 700 km from West to East and 350 km from North to South (Figure 1-1).

The altitude ranges from 300 to 7,495 m and about half of the territory is located in an area of more than 3,000 m.

The ridges and elevation changes affect the range of temperature, humidity and precipitation. Average temperature in the south in the desert zone exceeds 17℃ , while average temperature in the mountains of the Eastern Pamirs is - 6℃ . Maximum temperature is up to 48℃ in July in the south, while minimum temperature is - 63℃ in January in the Eastern Pamirs.

Precipitations mainly occur during the cold season, which account for approximately 75% of the annual amount. Maximum rainfalls are in the mountains of the Central Tajikistan, where their number exceeds 1,000 mm per year, and minimum rainfalls are in the extreme South of the economy, the Eastern Pamirs and some high-altitude regions of the Northern Tajikistan, where the total amount of the annual precipitations varies from 100 to 150 mm.
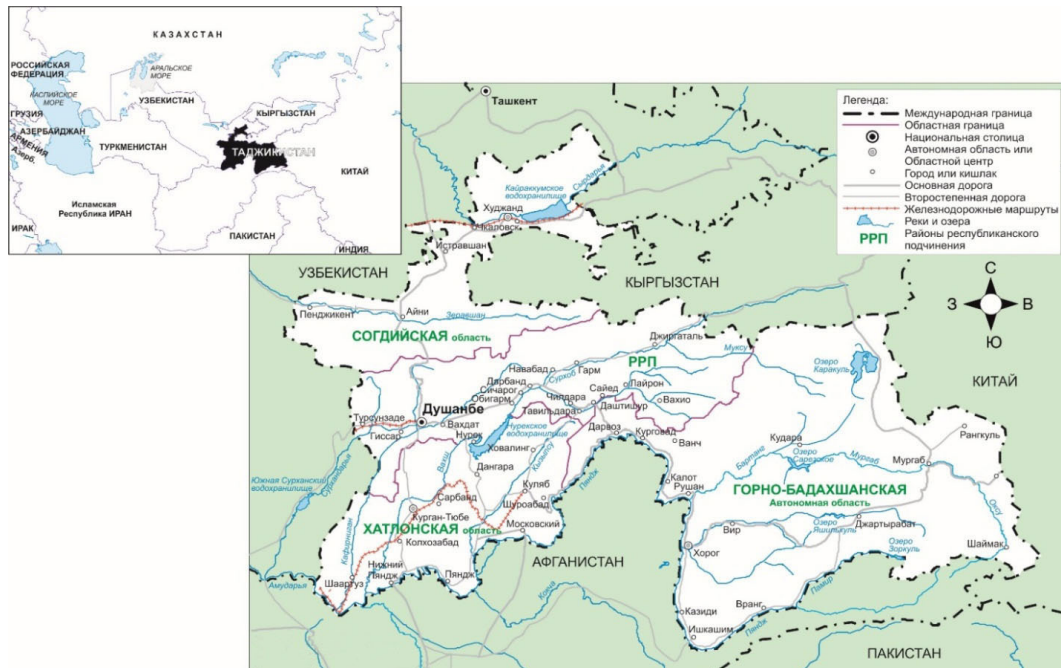
Source: Tajikistan Forestry Bureau.

Figure 1-1 Map of the Republic of Tajikistan

Civil confrontation of 1992-1993 led to civil war and economic collapse has resulted in an economic and social crisis. Termination of functioning of industrial enterprises, and the decline in agriculture and in the energy sector led to massive unemployment and a sharp decline in the living standard.

According to the data of the year 2000 when the economy had recovered from the consequences of war and economic collapse, and embarked on the path of reforms in key areas of social and industrial activity, the GDP per capita was 292.2 somoni, employment 54.8%, actual rate of unemployment 24.2% and the poverty rate 83.5%.

The GDP and employment have increased several times and poverty has decreased almost threefold by now.

The most stable sectors are nonferrous metallurgy (aluminum production), cement production, housing and road construction, light and food industry and agriculture.

The most active working population in search of jobs leave to other countries, primarily to the Russian Federation for temporary or permanent residence. Their have a populotion of about 1 million. That is 15%-20% of the total population. Unfortunately, this trend has taken a permanent nature and will probably continue for many years.

In forestry, as well as in other areas of industrial activity, production levels decreased by several times and a significant portion of people lost their jobs. The number of permanent workers in the forestry sector is 4,500 and about the same number of seasonal workers.

The level of life is inextricably linked with the environmental situation in the economy and is closely interdependent and mutually influencing relation to the overall environmental situation in the economy.

1.2 Land use status

4,546,100 ha of the territory of Tajikistan is used for agricultural production, which is 31.2% of the total area of the economy. The main part of farmland (9,212,087 ha or 65%) is used by land users engaged in agricultural production. The remaining area (5,054,021 ha or 35%) is used by the state land fund (425,451 ha) and the State Forestry lands (560,938 ha), and 238,573 ha of land are classified as non-agricultural land values.

The total area of arable land is 734,300 ha, which is 7,000 ha more than that in 2015, but is almost 70,000 ha less than that in the previous years. Large arrays of fields in the south of the economy in recent years have remained without plowing. The reason for the decline of arable land is economic instability, lack of technical equipment, fuels and lubricants, seeds, etc.

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The surface irrigation network constitutes 548,869 ha from the total useful land area or 12%, and only 4% of the overall area of the economy.

Forests and shrubs occupy 421,200 ha, or nearly 3% of the total area of the economy. This category of land relates to a number of useful lands, which can be used not only in forestry, but also as a pasture in agriculture.

Thus, the total area of Tajikistan in terms of its use in agriculture, taking into account forests and shrubs, makes 4,700,100 ha or 33%.

The land categories in the land fund (14,255,400 ha) are as follows:
● Agricultural land 8,179,200 ha.
● Settlements land 52,300 ha.
● Industry, transport, communications, etc. land 180,300 ha.
● Environmental, recreational, historical and cultural assignment land 3,104,800 ha.
● State Forest Fund (SFF) free land 641,500 ha.
● State water fund land 37,600 ha.
● State land reserve 2,059,700 ha.
● Total land 14,255,400 ha.

Agricultural lands are:
● Arable land 737,900 ha, including irrigated land 503,700 ha.
● Perennial plants 102,700 ha, including irrigated land 79,200 ha.
● Deposits 21,200 ha, including irrigated land 11,700 ha.
● Hayfields 22,700 ha, including irrigated land 900 ha.
● Pasture 3,716,400 ha, including irrigated land 3,300 ha.

By the decision of the Government of the Republic of Tajikistan, a significant part (about 1 million ha) of the territory of the SFF is assigned to agricultural enterprises for long-term use as pastures. Moreover, these areas have the richest forest herbaceous vegetations, which for decades have traditionally been used for transhumance.

There is overgrazing and depletion of grass, trees and shrubs. At the same time, virtually nothing has been done to preserve and restore the destroyed plant communities. Pasture rotation is not respected, burden on the pasture land is not limited, and grass or shrubs to enrich the flora are not planted.

1.3 million ha of land (from the total SFF) in a free SFF are hardly suitable for forestry, where it is difficult or even impossible to cultivate forest stands that is in direct forest management bodies.

The main types of soils in the lower mountain belt are dark soils (dark, typical or ordinary and light). These soils are relatively rich in humus, and constitute the main land fund of bogharic

and irrigated agriculture. Midlands and highlands are dominated by mountain brown soil, and are relatively poor humus and largely exposed to water erosion.

In the Pamirs, there are common desert, rare humus, carbonate soils and meadow marsh in flood plains.

The vast space with a sharp terrain is dominated by talus and rocks, the soil cover is very weak and is in its infancy.

The SFF, consisting of land, forests, water areas and other natural wealth, is state properties and transferred to forest enterprises for permanent use for their intended purpose for the development of forestry.

According to the *Law No. 449 "On Land Payments"* adopted by the Government of the Republic of Tajikista from 15.05.1997, land users to whom land plots for perpetual, short-term or long-term use are assigned pay land tax.

The rent is determined by agreement between the primary landholder and the tenant.

The amount of land tax is established in the form of stable payments per unit of land area in the calculation for one year and does not depend on the results of economic activities of land users.

The average land tax rates in the administrative regions of the economy are approved annually by the Government of the Republic of Tajikistan on the proposal of the State Committee on Land Management of the Republic of Tajikistan.

Above mentioned Law exempts the land users, whose activities are funded by the state budget. So forestry enterprises are exempt from tax in cases where they carry out forestry activities: sowing and planting of forest and forests fruit, establishment of tree nurseries, antierosion and other crops and plantations, and are not exempt from paying tax when the land of the SFF is used for growing crops or grazing cattle, regardless of whomever these work are carried out.

Protected areas: parks, nature parks and national parks are free from the land tax, since they form the area of land of conservational value, and are financed from the state budget.

Tajikistan is an agrarian economy. More than 70% of the population lives in the rural areas. Agriculture is the leading sector of the economy. Although forestry is not economically decisive link in the economy, but since the main wealth of the land and the SFF has 13% of the territory of the economy, forestry to a certain extent has the capacity to provide the overall impact on the national economy.

1.3 Forest resource

The current state of forest and non-forest ecosystems was documented insufficiently for a proper evaluation. The last forest inventory was carried out before 1991. Geospatial and map data are missing or out of date. Since 1991, the forest ecosystem monitoring has been inconsistent and database on forested, uncovered forest areas and the forestry does not exist (Figure 1-2).
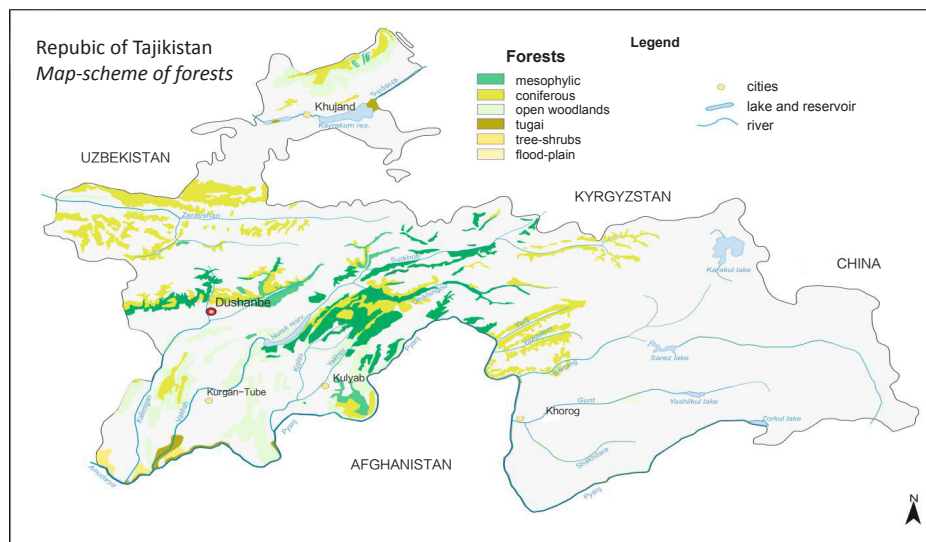
Source: Tajikistan Forestry Bureau.

Figure 1-2 Forest map of of Tajikistan

Assessment of the current status and trends in forestry, as well as the achieved progress in recent years is hardly possible due to the widespread lack of reliable, accurate and updated data on forest resources. Forest ecosystem services are not limited to the provision of natural resources such as timber and firewood (which still remains the most important fuel for rural households and consequently for the predominant part of the population of Tajikistan) or non-timber forest products which are important as a source of means of livelihood such as meat of commercial animals, fruits and nuts, wild berries and herbs, oils and honey.

Forests perform important ecological functions associated, for example, with the regulation of water balance and climate, soil conservation, prevention of water and wind erosion, and strengthening of the slopes. Forest ecosystems are of particular importance for mountainous economy with a dry subtropical and semi-arid continental climate like Tajikistan.

The disappearance or thinning of forest cover can lead to desertification, landslides, mudslides and other natural disasters, reducing the profitability of agricultural activity and a

threat to human settlements. Mitigation of these negative effects is not always possible, but always associated with high costs. Thus, the rational use of the remaining forest resources through proper forest management, reforestation and the spatial expansion of the forested areas can not only prevent the occurrence of natural disasters, but also reduce public spending on risk management, protection measures and the measures for the elimination of consequences of emergency situations, thereby providing significant savings in the limited resources of the state budget.

Forest management in Tajikistan for more than 20 years is based on outdated credentials and approximate estimates, which do not always reflect the real situation. Such estimates may not take into account the rate of the ongoing deforestation. In particular, the process of reducing the degree of density of the forest canopy results in that most of the remaining closed forests are gradually turning into sparse forests (with the fullness of the stand below 40%), which is typical for the area where forest landscapes are replaced by treeless landscapes.

In addition, estimates of forest cover are overstated due to the allocation of plantations of fruit trees and areas covered by shrubs, to the "forest" category.

Similarly, statistics provides information about the area of territories where it is planned to carry out afforestation and reforestation, but does not contain information on the results of these measures, such as indicators of the survival rate of seedlings (percentage of seedlings surviving in the first years after planting) or square areas where the activities of afforestation and reforestation gave successful results (Figure 1-3).
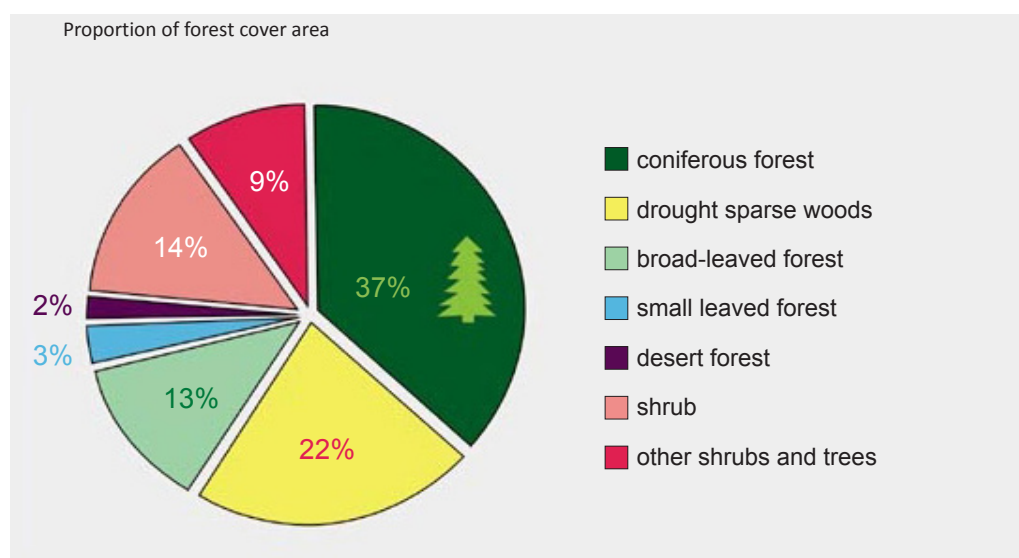
Figure 1-3 Proportion of different forest types

1.4 Distribution and characteristics of forests

Distribution and characteristics of forests are shown in Table 1-1. The total area of lands of state forest fund of Tajikistan is estimated at 1.85 million ha on January 1, 2016, which are run by state institutions of the forestry agency under the Government of the Republic of Tajikistan.

Table 1-1 Distribution and characteristics of forests

The main characteristics of forests	Unit	Indicators
Area covered by forests in the economy	ha	421,100
Natural forest	ha	340,000
Artificially-created forest	ha	81,100
Average forest density	In tenth	0.4
Total stock of standing timber	Million m³	5.1

1.5 Forest fund changes

The area and reserve of forest plantations are shown in Table 1-2.

Table 1-2 The area of forest plantations

Indicators	1990	2000	2012	2013	2014	2015
The total area of the forest fund (including forests, transferred to long-term use / million ha	1.8	1.8	1.8	1.8	1.8	1.8
Forested area / thousand ha	408.5	410.0	412.0	412.4	412.4	421.1
Including areas supervised by forestry management bodies / million ha	392.3	402.0	402.0	408.0	408.0	408.0
The stock of standing timber / million ha	5.6	5.6	5.10	5.0	5.10	5.11
Forest cover area in percentage (%)	2.7	3.7	3.0	3.0	3.0	3.0

1.6 Fragmentation of forest land

Distribution of the State Forest Fund is as follows:
- Forested land 421,000 ha.
- Pasture (summer and winter) 741,700 ha.
- Hayland 21,800 ha.
- Non-forest area 19,200 ha.
- Land under water (rivers and lakes) 17,700 ha.
- Cattle track 1,200 ha.
- Sands 7,800 ha.
- Unsuitable lands (stony, rocky, landslides) 589,000 ha.

- Gardens 3,600 ha.
- Nurseries 700 ha.
- Plough-land (bogharic) 2,000 ha.

Forested area in view of major dominant species, whose growth is associated with absolute elevation of the surface of different regions, is distributed as follows:
- Juniper 150,000 ha. The Northern areas of the economy with absolute heights from 1,500 to 3,000 m (middle and high mountainous regions);
- Pistachio 79,000 ha. The southern regions with relatively low rainfall (400-600 mm per year) and a hot summer, at elevations between 600 and 1,200 (1,300) m above the sea level;
- Almond 12,000 ha. Almond is widespread in the economy. The range of species is limited to the Pamir-Alai and Western Tien Shan. Within the area are grown at altitudes from 600 to 1,700 m, and in some areas are rising much higher, more than 2,000 m above the sea level;
- Hazels 8,000 ha. The middle mountains of central Tajikistan (1,000-2,000 / 2,200 m above the sea level);
- Maples 44,000 ha. The midlands area of central Tajikistan with altitudes of 1,000-2,200 m above the sea level;
- Saxaul 8,000 ha. The extreme South of the economy, arid desert areas;
- Tugai forests 38.4 ha. Below the river Vakhsh, Panj, Sirdarya Zarafshon (mainly in "TigrovayaBalka" nature reserve);
- Birch 3,000 ha. Hissar and Darvaz ridges;
- Poplar 7,000 ha. Almost all the territories of the SFF;
- Forest covered area with a predominance of shrubs 58,400 ha. All florocoenotypes;
- The share of other plantation accounts 13,200 ha.

The main forest forming species of Tajikistan are shown in Table 1-3.

Table 1-3 The main forest species of Tajikistan

#	Name of the species	Forest area / thousand ha	Stock of trees / million m³
1	Juniper	150.0	346
2	Pistachio	79.0	0.3
3	Hazel	8.0	0.06
4	Birch	3.0	0.03
5	Poplar	7.0	0,05
6	Willow	11.0	0.08
7	Maple	44.0	0.68
8	Almond	12.0	0.1
9	Plum	2.6	0.02
10	Saxaul	8.0	0.04

(Continued)

#	Name of the species	Forest area / thousand ha	Stock of trees / million m³
11	Tugai forests	38.4	0.26
12	Other species of shrubs (barberry, ephedra rosehip, sea buckthorn, tamarisk (Tamarix) soulas and others)	58.0	0.1
	TOTAL	**421.0**	**5.11**

Although the Republic of Tajikistan is a sparsely wooded economy, the role of forest resources is particularly important at present in connection with global climatic changes and social transformations in the economy. The majority of the rural population, which is not less than 70%, is directly dependent on natural resources. Forest plantations have not only important environmental functions, protecting mountain slopes from erosion, landslides and other natural disasters, and also form water flow of transboundary rivers such as Amudarya and Syrdarya.

The local population is largely self-sufficient in firewood, fruits, medicinal and food plants due to the presence of forest resources. In addition, forest areas are the habitat of numerous wildlife species. They concentrated the main species of fauna biodiversity. In addition, many forestlands are rangelands for livestock, which generally cause an adverse effect on the condition of forest resources and the wildlife that live in forest areas.

Thus, the forest ecosystems condition also depends on the condition and fertility of soil, the availability of hydro resources, biodiversity of flora and fauna and the well-being of the population of the economy.

Despite the insignificance of the forest resources of the economy, diversity of tree species and shrubs is quite rich. Moreover, in the composition of the dendroflora of Tajikistan, there are more than 50 species of wild fruit plants that represent a unique gene pool for scientific and selection work. The loss of any species of the dendroflora is the national irreparable loss, which is still not really perceived by our society.

The major forest types in the forest-forming tree species are shown in Table 1-4.

Table 1-4 Forest types

The main forest types	The areas covered by each type of forest / thousand ha	Main species for each type	
		Forest forming species	Related species
Juniper forests	150.0	Juniperusseravschanica, semiglobosa, turkestanica	Betulaturkestanica, Populustajikistanika, Berberis
Pistachio	79.0	Pistaciavera	Amygdalusbucharica
Maple	44.0	Acerturkestanica	Populustajikistanika

(Continued)

The main forest types	The areas covered by each type of forest / thousand ha	Main species for each type	
		Forest forming species	Related species
Hazel	8.0	Walnut	Populustajikistanika, Acerturkestanica
Almond	12.0	Amygdalusbucharica	Pistaciavera Cercis
Saxaul	8.0	Haloxylonpersicum, Haloxylonaphyllum	Salsola, Cherkez
Seabuckthorn	2.0	Commonseabuckthorn	Ivafrutescens
Poplar forest, Salix	2.0	Poplar, Salix	Commonseabuckthorn

Due to the climate change, the most vulnerable forests types grow in extreme conditions. These include, first of all, saxauls in the desert zone in the extreme south of the economy, then some pistachios in the lowlands of southern Tajikistan, where the climate is characterized by high temperature and low rainfall, as well as in the highlands, in the upper part of the belt of juniper forests, where there is very little rainfall, poor soils and low temperatures.

In connection with the development of mountain slopes and scarcity of fuel and energy resources, the scale of deforestation is increased by unauthorized cutting. Over the past 20 years, illegal logging in many places had thinned large areas of forests.

Particularly poplar, saxaul, pistachio, almond and nut trees were affected and their area significantly reduced. In many areas, different types of shrubs replace economically valuable tree species.

In addition, uncontrolled grazing on the territory of the SFF without compliance of pasture rotation and without improvement of pasture productivity measures is the main cause of forest land degradation across large areas.

The weakening of the protective functions of forest plantations has led to the fact that large areas of forest plantations are now covered with mass outbreaks of insect breeding areas (pests and diseases of forest and fruit trees), which greatly reduces the productivity of forest plantations and effects very negatively on the state of forest genetic resources.

Desertification takes place, primarily, under the influence of human activities and is stimulated by climate change. One of the major causes of desertification is excessive grazing.

In connection with the intensive and increasing agricultural activity in the territory of the State Forest Fund, particularly relevant problem at the moment is protection of rare and endangered species of plants and animals.

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The most effective and most commonly used method of preservation of rare species of forest ecosystems is their protection in Specially-Protected Natural Areas (SPNAs). However, nature parks and reserves do not meet modern requirements. Economic activity around them and state of conservation of flora and fauna in national parks and nature reserves are low.

As a result, there is a decrease in the number of rare species of animals and plants. Frequent violations of environmental and reserve status including poaching unfortunately become commonplace and even the "norm" for today. For example, grazing of livestock in the reserve "Romit" and all other reserves became commonplace.

One of the main reasons for reduction of the area of forest plantations and worsening of their conditions, in addition to the illegal logging, is a sharp decline in forest cultural work and their poor quality.

The volume of reforestation work undertaken by forestry in recent decades has significantly decreased. In 1990, 4,500 ha of forest plantations were created by sowing and planting. Currently, the average area is 1.5 ha that is the three times less. Moreover, the quality of forest cultural work has dropped significantly; caring and protecting them from damage and other violations are also in poor condition.

1.7 Forest resources in pastures

From the total state forest fund land area of the Republic of Tajikistan, more than 500,000 ha are now used as pastures. Basic tree, shrub species in pastures are juniper (Juniperus), pistachio, Bukharian almond, saxaul and maple.

Forests in the pastures are mainly sparse with the density of 30%. Pastures in forestry are assigned to agricultural enterprises (farmers) for the long-term use for 10 years. Besides, forestry authorities define the territory under an agreement with local residents for pastures use.

Pastures are monitored by the protection authorities of the Ministry of Agriculture, environmental protection and forestry authorities. Monitoring is carried out in accordance with the requirements of the *Law "On pastures"* and the Rules of cattle grazing in the woods.

1.8 Afforestation and reforestation

Over 10,000 ha of new forests have been established to improve forestry capacity and environment in accordance with the program of forestry development for the period 2006-2015 approved by the Government of the Republic of Tajikistan (Figure 1-4).

Figure 1-4 Afforestation and reforestation of Tajikistan

Comparison table for the indicators is at the Table 1-5.

Table 1-5 Comparison of indicators for afforestation and reforestation

Years	1991	2000	2010	2012	2013	2014	2015
Afforestation and reforestation / thousand ha	4.0	1.0	2.2	2.1	2.2	1.9	1.9
Including planting and sowing / thousand ha	3.9	1.0	2.2	2.1	2.1	1.9	1.9
Promotion of natural regeneration / thousand ha	0.1	-	-	-	-	-	0.36
TOTAL / thousand ha	**4.0**	**1.0**	**2.2**	**2.1**	**2.2**	**1.9**	**1.9**

1.9 Urban forestry and eco-tourism

In Dushanbe, there is a Forest and Park Enterprise "Pobeda" with an area of 900 ha, which belongs to the Hukumat (City Hall). The main purpose of the forest park is recreation activities.

The most visited period is summer, when thousands of citizens rush to rest on nature in the weekend. Existing forest plantations are presented with evergreen species: cypress, pine Eldar and junipers; ornamental deciduous: pistachio, almond, elm, Siberian elm, acacia, hawthorn and ailanthus; and fruit trees: plum, cherry, apple, walnut, pomegranate, vine, etc.

By the order of the President of the Republic of Tajikistan, the project for creating new forests on the territory of the Forest Park was developed and 240 ha of forest plantations were planted in the period 2005-2008 and thus 43,000 pieces of different seedlings species were planted.

Earlier, in the Soviet period of the Government of Tajikistan, recreation area over 12,000 ha had been allocated in a mountain gorge Varzob in 1973 for the residents of Dushanbe.

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Varzob valley is directly adjacent to the city of Dushanbe, extremely picturesque and is represented by numerous sites of natural forests, consisting of evergreen coniferous, nut trees, platanaceous, maple and other deciduous.

In addition, the Varzob gorge is one of the most beautiful hiking trails leading into the mountainous northern regions of the economy and there is tourist complex "Varzob" 12 km from Dushanbe.

Extraordinarily beautiful mountainous nature of Tajikistan, charming with its originality and diversity, attracts many tourists, climbers, and lovers of water tourism.

Tajikistan is all recognized region of tourism and mountaineering.

One of the most popular holiday destinations is a tourist center "Iskanderkul", which is located on the banks of the picturesque mountain lake Iskanderkul (Lake of the Great Alexander, Figure 1-5).

Figure 1-5 Lake of the Great Alexander

"Tajik Sea", a camp site 20 km from the city of Khujand, is always crowded in summer.

Moreover, there are some mountain-hiking routes: "Fan Mountains", "Blue Lake", "The Ancient Silk Road," "Paths of Sogdiana", etc.

In order to develop tourism and mountaineering in the economy by the Government of the Republic of Tajikistan, the state program of tourism development in Tajikistan and the *Law of the Republic of Tajikistan on Tourism* were adopted.

1.10 Community-based forest management

1.10.1 General information of Community-based forest management

- The legal property rights of farmers and tenants for lifelong and/or long-term use of the land, based on a land certificate or lease terms.
- The knowledge of the farmers and tenants of their rights and powers, in accordance with the existing legislative and legal framework (*Land code, Forest code, Tax code, Law on dehkan* (*farmer*) *farms, Law* "*On lease*", provisions on the powers of local authorities, etc.).
- Collective planning for the establishment of small tree nurseries, conducting erosion control, agroforestry activities and discussion-making on developing more effective and efficient methods for joint activities.

1.10.2 Potential achievements of agroforestry in community-based forest management

Agroforestry involves the planning and use of agricultural lands for growing trees or shrubs, and alternating with different agricultural cultures to be planted. This method of land use would contribute to environmental sustainability of agricultural systems and increasing the productivity of agricultural lands through creation of sustainable agrophytocenosis.

Farmers and tenants would have an opportunity for obtaining additional agricultural products to cover their domestic needs in firewood and in timber for household purposes, harvesting fruits, nuts and various berries as well as having highly productive hay lands.

It should be noted that agroforestry system provides many important economic and environmental advantages and benefits for farmers and tenants.

1.11 Production, consumption and trade of forest products

1.11.1 Timber harvesting and firewood rates

The volume of authorized timber harvesting in Tajikistan is about 7,000 to 8,000 m³. The standard rate of payment for harvesting industrial roundwood in 2015 was 245 somoni (US$ 37) per m³, but the applied rates vary widely depending on the specific areas.

Official domestic supply of firewood is based on the annual calculated felling rate (for intermediate felling and sanitary felling). In recent years, the corresponding limit ranged from 7,500 to 8,500 m³. This limit, however, is quite insufficient to meet much higher demand for fuelwood, on which, as an energy source for heating and cooking, about 70% of the population is dependent.

Illegal logging covered the gap between the low level of supply and considerably higher level of demand to a greater or lesser extent. According to official estimates, the volume of illegal logging varies from 1,000 to 1,500 m³. However, other estimates suggest that the actual

annual volume of fuelwood is up to 10 times higher than official limits.

Officially supplied by state forestry authorities, fuelwood is sold to private households and to other persons; forestry enterprises have the right to sell it at reduced prices to ensure its availability, especially for the population. The standard price for firewood is relatively high, and in 2015 was about 105 somoni (about US$ 15.5.) per m³ excluding transport costs.

1.11.2 Hunting fee

Lands of the national forest fund are also used for creation of hunting farms, but most of the wild animals that are important for hunting live outside forests. Hunting on the territory of forest is managed and controlled by the forestry authorities. Hunting outside the SFF is mainly organized in the framework of private hunting concessions.

For the purposes of promoting the conservation of threatened species of game animals, the government in recent years has been supporting wildlife management approach at the community level. These communities manage the populations of species such as markhor (screw-horned goat), Siberian ibex and Pamir argali under the project for the conservation of mountain ungulates in Tajikistan. This mechanism provides a source of income for the local population due to the conservation and sustainable use of wildlife, i.e., in order to prevent unsustainable hunting.

Hunting animal species for meat is the main motivation for the local population, but hunting is also a source of income for local hunters, engaged in international hunting tourism as guides. The fee for the right to hunt has also become an important source of revenue to the state budget due to the popularity of trophy hunting on the species of animals listed in the *Red Book*, which is paid at very high price.

For instance, in 2011, the fee for the hunting of Pamir argali (*Ovis ammon polii*, Figure 1-6) was 55,000 somoni (US$ 8,250). Hunting was limited to 65 Pamir argali during the season and brought the total income of about 3.6 million somoni (US$ 540,000). In 2015, the annual limit was set at 85 goals. The annual limit for the markhor (Figure 1-7) in 2015 was limited to seven animals and the single fee was 213,500 somoni (about US$ 34,000).
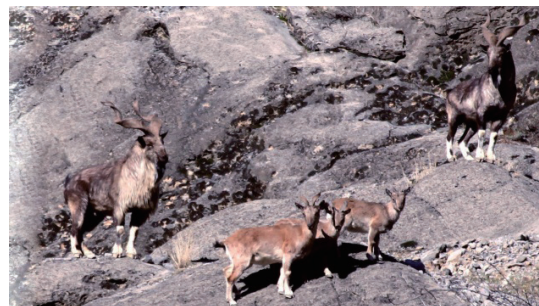

Figure 1-6 Pamir argali

Figure 1-7 Markhor (*Capro falcaneri*)

Income from payments for hunting is distributed as follows:
- State budget: 15%;
- National Stabilization Fund of economic development: 5%;
- The Committee for Environmental Protection: 20%;
- Territorial bodies of Environment Protection Committee: 60%.

The *Law "On hunting and hunting economy"* (2014) establishes the principle of distribution. A payment for a hunting permit, however, has not been implemented due to the need to adopt appropriate implementing regulations. The law provides the following distribution of income:
- 40% is transferred to the special account of settlements, governments and villages in areas where hunting is carried out. The funds are used to finance the measures for socio-economic development, environmental protection and efficient use of game animals in the economy;
- 20% is transferred to the special fund of protected areas (only if the hunting is carried out on or near the protected areas);
- 40% is transferred to a special account of the authorized state body in the field of hunting (Forestry Agency) to finance work related to sustainable control over the populations of game animals.

The Forest Code (2011) contains provisions concerning the use of economic instruments for forest management. To date, they include fees for timber harvesting (industrial roundwood), as well as fuelwood. However, the volumes of timber are very small; Tajikistan does not have the forest industry, and the main share of wood used mainly for construction purposes is imported.

In accordance with *the Forest Code of 1993*, commercial timber harvesting was banned. Only logging for the purpose of maintenance of forests and improvement of its condition was allowed (intermediate felling and sanitary felling), and all the wood harvested in this way is used as a fuel, mainly for heating and cooking by rural population.

The Forest Code (2011) provides that the user fees are established taking into account the "useful properties of forests, quality and accessibility of forest resources and market prices for forest products. "There is also a provision concerning the use of financial incentives to increase the forest cover of the state forest land by afforestation and transfer of land formerly used in agriculture to forest land fund.

1.12 Internal and external factors affecting forests and forestry

In 2015, the annual budget of the Forestry Agency was 15.52 million somoni (US$ 2.52 million), 70% of which was intended for the payment of staff salaries including the staff of more than 40 forestry authorities. The remaining small amount of funds for investment activities was inadequate for the proper maintenance of the SFF and management of flora and fauna.

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Forestry authorities fundamentally depend on the income from commercial activities for the implementation of their daily activities. Forestry Development Program for 2006-2015 (*Government Resolution No. 396 of 2005*) experienced a significant shortage of funds, only 30% of the estimated financial requirements were financed from the state budget.

Means of living and livelihood of the vast majority of the rural population are largely dependent on the use of various resources, biodiversity and the continued provision of related ecosystem services. In the absence of proper legal regulation at the national level, effective monitoring and sustainable management of customary use of natural resources (e.g. firewood, grazing, hunting, fishing and trapping of wild animals for sale abroad, the collection of wild medicinal plants, forest fruits and berries) can easily turn into factors of negative impacts on biodiversity and natural resources.

Proper evaluation of the load level changes on ecosystems and species diversity after 2010 is not possible due to insufficient data.

1.12.1 Deforestation and timber stockpiling

Today, the greatest concern is likely caused by ever-increasing negative impact on the forest and non-forest ecosystems as a result of unsustainable practices of large-scale cattle grazing. The consequence of this effect is not only continued and accelerated processes of deforestation, destruction of forest and non-forest plant communities and the loss of habitat of various species of wild flora and fauna, but also the strengthening processes of soil erosion and desertification.

Particularly degradation of winter pasture reduces their regeneration potential, productivity and carrying capacity, as a consequence, reducing the profitability of livestock. It is expected that, as a result of logging and intensive grazing, area of juniper forests reduces by about 2%-3% per year. As a result of intensive grazing in the pistachio sparse forests, their natural regeneration is already impossible. Uncontrolled grazing in forest areas and illegal logging in just a few hours reduce to zero of the beneficial effect of reforestation and afforestation programs, which have been carried out over several years.

According to information from various sources, another factor affecting the forest ecosystem is the illegal felling of trees for fuelwood and harvesting of fuelwood, the scale of which over the last 10 years has decreased due to the increased availability of other energy sources, such as coal for domestic heating.

This favorable change also would be of utmost importance for reducing the volume of harvesting small shrubs Teresken (Ceratoidespapposa) in the eastern part of Tajikistan, which is used for fuel and fodder purposes. According to the reports, an intensive collection of Teresken in conjunction with large-scale cattle grazing led to the extinction of this species in some areas of the Pamir mountain range.

Total timber stocks in 2013 were estimated at almost 6 million m³ (5.988 million m³), which exceeds the figure (5.1 million m³) given in the Statistical Yearbook for 2014. Most of the rural population (70% or approximately 5-6 million inhabitants) still uses wood as the main and the most affordable type of fuel. Thus, the volume of stocks of timber must be assessed in comparison with the annual demand for fuelwood. Taking into account local climatic conditions (notably in mountainous areas), quality of thermal insulation of houses, as well as the efficiency of heating and cooking methods used currently in Tajikistan, the average annual demand for fuelwood according to some sources is about 3-4 m³ per person. Consequently, the total stock of standing timber in all forests in Tajikistan would not be enough to satisfy domestic demand for wood for one year.

The main sources of firewood are private domestic gardens, particularly those that cover large areas and provide an opportunity for local residents to plant more of woody vegetations, in order to meet their fuelwood needs without any additional costs. Another frequently used source of firewood harvested free of charge are forest shelter belts on irrigated agricultural lands, protection zones of saxaul or tree vegetation strips along roadsides, fields and borders on the banks of watercourses in the mountain gorges. In addition, due to the fact that most of the agricultural land in Tajikistan is much more suitable for livestock than crop production in some regions, the dried dung is more commonly used fuel than wood, which is much less available in mountain areas, for example, Pamir. Some villages are provided with coal for heating purposes; the increasing number of settlements in the highlands that access to electricity also reduces the dependence on firewood.

Planting of fruit trees is widely promoted, including programs aimed at the development of horticulture and viticulture in areas of dry farming, where land degradation has occurred. Local communities and individual farmers prefer to plant and cultivate fruit trees rather than the forest. As a result, the demand for planting fruit trees on the market is significantly higher than typical forest species. The obvious reason is that the fruit trees begin to bear fruit and make a profit immediately, within a few years after planting, while some species of forest trees growing in Tajikistan, especially in harsh mountainous terrain, achieve optimal economic maturity for timber harvesting at the age of 100-200 years. Another challenge for forestry is the fact that the planning of plantations of fruit trees can successfully compete with the reforestation for the available land and financial resources.

Needless to say that the orchards and forests are very different ecosystems and perform a variety of ecological functions. Gardens could never be compared with the forests in terms of volume and quality of fuelwood and timber for construction and industrial processing. The strategic question, of course, is to determine the desired optimum ratio between the arable lands dedicated to the cultivation of orchards and the lands allocated for forest cultivation.

The relatively small amount of fuelwood comes from state-owned forests; it is either sold directly to the public forest institutions (forestry enterprises) or is harvested by final
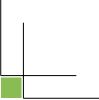
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consumer in accordance with the principle of the Joint Forest Management (JFM). Because of the importance of ecological functions performed by forests and their small number, all forests in Tajikistan are classified as protective forests. The amount of wood that can be purchased by the forestry enterprises is unable to meet the demand. As a result, illegal harvesting of firewood and illegal logging remain widespread.

Due to the lack of statistical data on forest monitoring, volumes of illegal harvesting of wood are not available. According to available information, illegal logging significantly reduced by as much as 90% over the past 10 years, mainly due to the increasing availability of other energy sources. Nevertheless, the establishment of plantations for the cultivation of energy wood on the areas less favorable for grazing in the vicinity of villages can further reduce the negative effects of the continued strong pressure on forest resources.

Other traditional methods of harvesting non-timber forest products (e.g. grass mowing at unclosed canopy of willow or poplar stands and preparation of hay used to feed livestock, gathering of wild forest fruit, berries and nuts, honey production) have relatively less impact on forest ecosystems. According to information from various sources, collection of medicinal plants such as wild (over 60 species), as well as growth in a special forest land (about 22 species) generates income in the amount of 2.5-5.6 million somoni per year. However, over-harvesting in the absence of effective control can lead to the extinction of valuable species (as has already happened in at least two rare species of plants listed in the *Red Book*).

1.12.2 Other factors of influence

Other factors of anthropogenic pressure on biodiversity and the ecosystem are not connected with the withdrawal of biodiversity, including the conversion of natural ecosystems into agricultural land (as in the case of a natural park "Sari Khosor" in 2003), fragmentation, degradation or destruction of habitats and landscapes in the implementation of infrastructure investment projects, creation of barriers to the migration of species (hydroelectric dams have fish ladders), illegal construction of settlements within the boundaries of protected areas (as in the case of the state nature reserve "Romit" in the 1990s), as well as introduction of invasive alien species. Aquatic and semi-aquatic ecosystems are being affected as a result of wastewater discharge. Climate change affects almost all the existing ecosystems in Tajikistan. Most likely, in the near future, these factors will increase.

Chapter 2   Contribution of forests to economic development

2.1   Economic and environmental significance of forests and woodlands

2.2   Financing and investment in forests and forestry

2.3   Forests, livelihoods and poverty

2.1 Economic and environmental significance of forests and woodlands

The contribution of forestry into the national policy is determined by the following essential and constantly operating factors, which should be considered during the development of national programs for economic and social development:

- Uniqueness of forests, their species diversity and invaluable genetic fund, the most important representatives of wild fruit species, scientific and practical interest to breeding rare species of animals and plants included into the *International Red Book*;
- Ecological importance of forests and their environmental role, which are manifested through their anti-erosion, soil conservation, and water control functions;
- Possibility of obtaining timber, non-timber, food and technical forest products, and various herbal raw materials;
- Availability of the large pasturelands at the territory of the SFF that represent a third of the total pasture area of the economy (both summer and winter pastures);
- Use of the SFF for the development of horticulture, nursery business, beekeeping, animal husbandry, and in particular horse breeding and rain-fed agriculture.

Another important and significant contribution of the forestry to the social policies of the economy is that the territory of the SFF is a habitat for a big number of population deprived of permanent jobs, in particular those who are living in the mountain villages. Livelihood in such remote areas depends on the environmental conditions, in which the people live.

The main sources of income for their inhabitants are private livestock, horticulture, agriculture, and in some cases the beekeeping.

Firewood collection, harvesting of non-timber forest products and use of forestland for haying and grazing as well as for crops growing are of the great importance for maintaining the required level of livelihoods.

Additional sources of income of the population could include seasonal work, and in the best case permanent employment by the forest enterprises for forest planting, sanitary felling at forest plantations and performing other forestry-related activities.

2.1.1 Economic benefits

The possibilities of obtaining higher yields of agricultural products that can be used for own consumption or for sale on the market include:

- It is able to produce a variety of food products and vegetable oils, wood, building timber and medicinal plants;
- Improved agroforestry reclamation will produce more food and non-timber forest products per unit area than in the cultivation of crops or only just in forest plantations;

- Efficiency of the labor of the farmer or the tenant would be more effective;
- Financial indicators of farmers and tenants of activity would be higher;
- Growing more crops on the same site will reduce the risk of economic losses from a possible crop failure of any individual cultures.

2.1.2 Environmental benefits

- Presence of tree or shrub plantations in the area will help prevent erosion and improve soil fertility;
- Root systems of trees and shrubs contribute to the transfer from the deeper layers of soil nutrients that are not available to the root systems of grasses and crops in the more superficial layers of the soil;
- It is possible to cultivate nitrogen and enrich the soil of trees and shrubs (acacia, white and yellow, and others Legumes). The soil nitrogen will then be available for use of cultivated crops;
- The hydrological state of soils will be improved due to the acquisition of the soil and foliage shrubs;
- Presence of trees and shrubs in the area will form a more favorable microclimate for arable crops;
- Enriching species diversity of herbaceous plants and the resulting increase in biomass in the hayfields;
- Reducing the risk of breeding foci of pests and fungal diseases in cultivated area;
- Reducing opportunities for the breeding and development of weeds at a farmers or concession areas.

2.2 Financing and investment in forests and forestry

The annual costs of forest management activities on the forest recovery funded from the state budget over the past three years was on average 1.6 million TJS, or only 6.2% of the forestry sector needs.

The funds provided from the state budget are also insufficient for operation and maintenance, repairing and modernization of the existing logistics base.

Financing of the forestry sector is also partly carried out by the forest enterprises. Their incomes are derived mainly from the sale of forest products and the provision of ecosystem services. Analysis on the income generation sources for 2012-2013 has shown that the forest farms received less than 55% of their income from the forestry activities.

Given the low productivity and current pricing for forest products, profitability of forest enterprises is at very low level. In terms of the funded budget and extra budgetary funds as well as incomes received for 2012-2013 biennium, the average profitability of forestry

is below 50%. However, considering capacities of the current forest resources and revenue opportunities, profitability could be increased by at least 60%-80%.

One of the main constraints for increasing the revenue of forest enterprises is the current pricing mechanism, which inter alia discourages forest enterprises in increasing forestry production. Currently, prices for forest products are set up by the Forestry Agency for the next two years, and do not correspond to the current market prices.

It should be noted that mechanism of monitoring expenditures from the state budget and own funding done by the state forestry enterprises is also missing.

Involvement of private sector into forestry development is almost very limited. The world practice shows that the amount of private sector investment in forestry in developing countries is seven times greater than the funds invested by donors in the forest sector in the framework of official development assistance. One of the main reasons is the lack of available information and analysis about the potential sectors for domestic and foreign investors.

The forestry sector is also funded by donors within the framework of particular targeted programs. Based on the corresponding programs implemented during 2015-2017, the annual contribution of donors to the forest sector of Tajikistan is 2 million Euro.

Forests of the Republic of Tajikistan in Soviet times belong to the first group of forests and perform exceptionally protective function from the detriment of economy. The *Forest Code* (2011) introduces a multifunctional forest management, i.e. the integrated use of all the functional features of the forest and the introduction of commercial forestry.

The term "commercial forestry" refers to the forest management aimed at profit and based on investments. Principles of commercial forestry are built on the equal rights of the public and private sectors.

The commercial part of forest sector is the nursery economy that includes production of high-quality forest planting materials, creation of industrial plantations for the production of timber, nuts and fruit harvesting and processing of forest products. Particularly promising activities are production of firewood, timber for construction and handicraft products, cultivation of Ferula, pistachios, walnuts and almonds, and wild fruits for drying.

Existed in the Soviet period, plants for processing Tajik forest products, such as pharmacological plant in the Uzbek SSR, cannery in Vahdat, a mini-workshop for the production of sea buckthorn oil in GBAO, have ceased to function. In this regard, some forest products remained unclaimed. Currently, a number of enterprises specialized in procurement and processing of forest products is up to 25. This is above all due to the insufficient and poor quality of primary production of forest products.

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Profitability of the state forest enterprises is extremely low (less than 50%). Employees are not sufficiently skilled for the business planning, market analysis and meeting demand for forestry products. A proactive search for potential buyers is not undertaken. There is a need in conducting the research of international markets for some types of forest products and certifying their quality in accordance with the international standards and requirements.

Attractiveness of forestry in terms of investments from local and foreign investors, including state forest enterprises and forestry itself, has its own characteristics inherent in this industry. For example, investing into forest sector requires a longer payback period. Limitations related to the terms of land use reflected in the *Land Code* hinder the flow of investments as well. The current statute and status of forest enterprises do not provide opportunities for undertaking commercial activities. Participation of local and foreign investors in development of forestry sector is virtually nonexistent. One of the key reasons is lack of available information about the corresponding potential and opportunities. During the last 2 years, the only 2.4 million somoni allocated from the state budget has been invested into establishing 200 ha of poplar plantations. Forest enterprises themselves invested nothing from their own funds into strengthening forest production capacities. If the trend of low investments will be continued and without involving private sector of the economy and foreign investors, incensement of profitability of forestry would not be possible.

Due to the low annual growth of most types of forests and scarce forest areas in Tajikistan, in general, international mechanisms such as the *Kyoto Protocol of the UN Framework Convention on Climate Change* are difficult to apply in the economy to attract investment.

The commercial forestry could not become a priority in the forestry sector without strengthening and increasing overall production capacity. At the same time, increase of forestry profitability and forest product supply to the population would not be possible until the commercial forestry is in place.

2.3 Forests, livelihoods and poverty

Over 70% of the population of Tajikistan reside on the boundary of forest lands and are dependent on the forest resources. Some people travel abroad in search of work to earn money (about 1 million).

People living nearby the forests legally and/or illegally use firewood, building materials, food and medicinal plants, fruits and berries, wild animals and fish, hay, etc.

In the recent years, up to 10,000 people were involved in the seasonal work within the forestry system.

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Chapter 3   Forestry policy and legislation

3.1   Short-term and long-term planning for forestry development

3.2   The history and future of forestry development

Tajikistan's legal acts system includes the most high-level act the *Constitution*; laws adopted in a national referendum; international treaties part of which Tajikistan is; constitutional laws; codes and laws; joint resolution of both houses of parliament, the MajlisiMilli (National Assembly) and the MajlisiNamoyandagon (House of Representatives); resolutions of the MajlisiMilli and the MajlisiNamoyandagon; presidential decrees; government resolutions; resolutions of ministries, state committees and other state bodies and acts of local representative and executive bodies.

The *Forest Code (2011)* replaced the *Forest Code (1993)*. It regulates the organization of forestry, monitoring and accounting of the state forest, afforestation and reforestation and licensing documents for forest management, and also provides the establishment of the state inspection of forest protection. Compared with the *Forest Code (1993)* which allows the wood harvest only when carrying out sanitary and similar cuttings, The *Forest Code (2011)* contains provisions on timber harvesting and fuelwood. The *Forest Code (1993)* applies the division of forests into groups, but the economy's forests have been allocated only to the first group. The *Forest Code (2011)* does not apply the division of forests into groups. Instead, it provides five categories of protection depending on the functions of forests (water protection forests, protective forests, hygiene and recreational forests, forests of the SPNAs, kernel production and fruit tree plantations forests); however, it does not stipulate control modes of all these categories of forests.

The adopted *2011 Law "On Specially-protected Natural Areas"* replaced the *1996 Law "On Specially-protected Natural Territories and Objects"*. The 2011 Law adds a new category, the state zoological parks into the categories of protected areas and describes in more detail mode all categories of protected areas, which include the state natural reserves; state parks; nature reserves; state zoological parks; state monuments of nature; ecological and ethnographic areas; dendrology parksand botanical gardens; natural resorts, therapeutic and recreational areas. The Act describes the principles of strategic planning for the protection and use of the SPNAs, which should be carried out within the framework of concepts, strategies and programs for socio-economic development and on the basis of state environmental programs. The Law includes the notion of security (buffer) zones and ecological corridors, although it makes no mention of the national ecological network. The Law contains a chapter on the SPNAs of international importance, in particular, the areas included in the World Network of Biosphere Reserves, Wetlands of International Importance and interstate natural parks and reserves.

The *2014 Law "On hunting and hunting economy"* comprehensively regulates the hunting management, and was adopted in order to facilitate trophy hunting. Types of game animals are divided into limited species and non-limited species. Limited species include species of game animals that are threatened with extinction and listed in the *Red Book*. In

pursuance of the Law, several regulations, including the new regulations on the hunting, will be adopted. At the same time, the *2011 Law "On Environmental Protection"* and current regulations on hunting and hunting economy (*Government Resolution No. 324 1997*) in a direct form prohibit the hunting of all species of animals listed in the *Red Book*. The amendments to the *1999 Law "On Tourism"* adopted in 2012 supplemented the types of tourism in Tajikistan, the concept of "international hunting" or hunting with the participation of foreign nationals.

A complete revision of the *Forest Code (2011), Law "On aquaculture, fishing and fish resources of protection" (2013),* and the *Law "On Hunting and Hunting Economy" (2014)* in Tajikistan was performed. New legislation has actualized the mechanisms for the use and protection of biological resources through the introduction of such forms of regulation as the allocation of hunting areas on the basis of auctions. The new laws are not always accompanied by the adoption of by-laws resulting in no fully-applied new legislation in practice.

State policy is aimed at forest conservation and sustainable development of forestry, which includes the effective and efficient use of land and forest resources in the present, difficult period of transition to market relations in the economy and the transfer of national economy to new conditions of its development.

From the first years of independence of Tajikistan, government policy was aimed at developing new legislation that would give the opportunity to the sustainable development of forestry in the new political and economic conditions, as well as the basic program documents defining the strategy for economic development.

In accordance with Article 13 of the *Constitution*, "The land, its subsoil, water, air, flora and fauna and other natural resources are the exclusive property of the state and the state guarantees their effective use in the interests of the people."

State Environment Programme for 2009-2019: The State Environment Programme for 2009-2019 (*Government Resolution No. 123 of 2009*), followed by the Action Plan (*Government Resolution No. 602 of 2009*), is a key strategic document in the field of environmental protection. The Environmental Protection Committee reports annually on the implementation of the Programme; such reports reflect only some of the measures of the Action Plan.

Strategic documents on specific environmental issues: There are a number of strategic documents covering specific aspects of environmental protection, including the National Strategy and Action Plan on Conservation and Sustainable Use of Biodiversity (*Government Resolution No. 392, 2003*), the State Program on development of specially-protected natural territories for 2005-2015 (*Government Resolution No. 79, 2005*), Program on improvement of provision of clean drinking water in the 2008-2020 years (*Government Resolution No. 514,*

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2006) and the National Concept for the rehabilitation of tailings of processing of uranium ores in the 2014-2024 years (*Government Resolution No. 505, 2014*).

Forest fund of the economy, consisting of land, forests, bodies of water and other natural wealth, is state property, and is transferred to the permanent use of forestry enterprises for their intended purpose for the development of forestry.

In state legislation, there is no right of private land ownership.

Permission is granted to rent land on a contractual basis for a long term (10-20 years and more) and even on the conditions for life inheritable possession with the right of transmission to one of members living and working with family members or members of labor economy (leased collective).

In the forestry sector in recent years, it has become a widely practiced form of land rent, which in the first years of its implementation has proved positive. It instills confidence in the irreversibility of the tenants to the state land reform. In addition, tenant income is primarily determined by the results of his own work, and depends largely on himself.

Along with the individual, family and team contract is also carried out, when part of the harvest, according to the contract, remains with the lessee.

Lease relations are governed by a special *Law "On lease" of the Republic of Tajikistan*, adopted by the Government of Tajikistan on 04.11.1995.

And the "*Law on the assessment of the land*" was adopted by the Government of Tajikistan on 12.05.2001, which established the legal basis of land valuation. State cadastral valuation of land is aimed to determine the cadastral value of land for various purposes.

Land valuation is carried out to establish the normative price of land for the purpose of objective taxation and rents. Thus, the basis for determining land tax is the land-cadastral documentation of the land user (Table 3-1).

Table 3-1 Land-cadastral documentation

Laws and resolutions of the Government of the Republic of Tajikistan	Year of adoption
The *Law on Environmental Protection*	2011
Forest Code	2011
The *Law on the protection and use of plant world*	
The *Law on the animal world*	2008
The *Law on Protected Areas*	2011

(Continued)

Laws and resolutions of the Government of the Republic of Tajikistan	Year of adoption
The *Law on hunting and hunting economy*	2014
Code of Administrative Offences	2008
The *Criminal Code (on the part of the plant and animal world)*	2008
Fees for calculation of the size of penalties for the damage caused to forestry enterprises by organizations and citizens in the forests of the Republic of Tajikistan; approved by the Government of the Republic of Tajikistan	2014
The *State Environmental Development Program of the Republic of Tajikistan until 2019;* approved by the Government of the Republic of Tajikistan.	2009
Regulations on hunting and hunting economy; approved by Resolution of the Government of Tajikistan	2015
Regulations on the State Forest Protection; approved by Resolution of the Government of the Republic of Tajikistan	1999
Resolution of the Government of the Republic of Tajikistan "On the definition of the authorized state body in the field of forestry"	2014
Resolution of the Government of the Republic of Tajikistan "On Approval of the Forestry Agency under the Government of the Republic of Tajikistan"	2014
Resolution of the Government of the Republic of Tajikistan "On the extension of further functioning of nature reserves"	2015
The *Republic of Tajikistan Government Resolution "On the list of state inspectors, who have the right to wear service weapons"*	2015

3.1 Short-term and long-term planning for forestry development

In accordance with the Program on national economy development of the Republic of Tajikistan, the Forestry Development Program for 2006-2015 was developed and approved by the Government of the Republic of Tajikistan, based on which the annual forest management plans were developed as well.

Based on the results of the implementation of the Programme, a detailed report was developed and presented by the Government of the Republic of Tajikistan.

Unfortunately, the planned targets for afforestation and some other important activities were not achieved and implemented respectively.

To implement the long-term forestry development, the Forestry Strategy for the period 2016-2030 along with the development program on the key indicators set up for 2016-2020 were

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developed.

3.1.1 The main objectives stipulated by the Strategy are:

- Conservation of forest biodiversity, restoring and conserving forests, and increasing their size and productivity;
- Improvement of quality and quantity of ecosystem services delivered in the context of climate change;
- Promoting economic development by involving entrepreneurs into forestry sector and improving the efficiency of forest management;
- Improving welfare of local population through their participation in forest management and providing them with forest products based on sustainable use of forests.

3.1.2 Indicators of achieving the mentioned objectives are:

- Planting of 10,000 ha of new forests;
- Doubling the productivity of forests;
- Doubling the profitability of state forests;
- Increasing the number of registered entrepreneurs involved in the forestry sector from 25 to 100;
- Increasing the number of households (from the current 565 to 5,000 households) involved in the forestry sector within the framework of joint management of forestry contracts.

The Strategy defines the following priorities for the forest sector of the Republic of Tajikistan:

(i) Institutional, legal and financial reform.
- Improving the management system and strengthening capacities of forest sector institutions;
- Improving the legal framework and strengthening the right of forest use;
- Establishing a system of sustainably funding the forestry sector.

(ii) Preserving and increasing forest covered area and forest productivity.
- Commercial forestry;
- Involvement of local communities in forest management with applying the JFM approach;
- Reforestation and afforestation, anti-erosion, recreational activities and management of the strictly protected forests.

(iii) Forestry development basis.
- Development of seed and nursery sub-sector;
- Conducting registration, monitoring and forest management;
- Capacity building of commercial forestry employees;
- Science and innovation in forestry.

3.2 The history and future of forestry development

In Tajikistan, Alexander Lehmann was one of the first botanists who researched the Zarafshan mountains in the middle of the 19th century, and had published the results of his research in 1852. During 1869-1871, the extensive and comprehensive geographical research of the Turkestan scientific expedition from the Moscow University was conducted under the guidance of A.P. Fedchenko, during which the botanical researches were mainly undertaken by Olga Fedchenko.

During 1882-1884, in the territory of the modern Tajikistan (in its central part and Shugnan), the great floristic research was done by A.E. Regel, who, in his writings, provided a detailed description of the tree and shrub vegetation area. He identified a huge variety of wild fruit species, and noted their importance for establishment of centers of species formation and identifying the origin and formation of crop plants.

In the 90s of the 19th century, a great contribution to the studies on plants available in Tajikistan was made by V.L. Komarov, S.I. Korzhinskii and V.I. Lipsky.

In the early 20th century, the significant contributions to the studies on vegetation of the Central Asia, and in particular Tajikistan, were provided by B.A. Fedchenko. He divided the mountain forests in Tajikistan into xerophytic and mesophytic kinds, and elaborated the links in Pamir-Alai and Western Tien Shan forests, and noted the vast formation of species of apple and other fruit trees. An invaluable contribution to the studies on vegetation, and especially on dendroflora, was made by M.G. Popov, who developed the innovative concept of the origin of flora in Central Asia.

According to his research, this flora is part of the ancient Mediterranean flora, which arose in the second half of the Tertiary period. Due to xerophilization, forest vegetation is concentrated mainly on the gills, representing introzonal phenomenon.

Further studies on tree vegetation are related to Pamir and Tajik complex expedition organized in the economy, and establishment of the base under the Academy of Sciences of the former USSR.

Complex expeditions with participation of P.N. Bogushevsky, A.V. Gursky, M.G. Popov, V.G. Speranskii etc. and under the guidance of N.I. Vavilov produced a lot of researches, in particular on wild nut and fruit species in Tajikistan.

Initiated by N.I. Vavilov in the early 30s of the 20th century, the Scientific Research Institute specialized in the dry subtropics in Tajikistan was established, which unfortunately did not last long. However, Vakhsh and Faizabad zonal experimental stations were survived, and are currently available but in a very poor condition.

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In 1935, the Varzob mountain botanical station, initially led by F.L. Zapryagaev, then by V.I. Zapryagaeva was established and conducted many studies on dendroflora of the area, and on further development of horticultural areas in the forestry in Tajikistan. In particular, many conducted studies were focused on trees and shrubs under the guidance of P.N. Ovchinnikov, the former Director of the Institute of Botany of the Academy of Sciences of Tajikistan.

This resulted in the remarkable organization of the Institute of Botany at the Academy of Sciences of Tajikistan under his leadership, and with his direct participation the numerous valuable monographs on the vegetation of Tajikistan, including the *Flora of the Tajik SSR* in ten volumes were prepared and published.

During the same years, high mountainous Botanical Garden in the Pamirs in the city of Khorog was established by A.V.Gurskiy based on which the scientific foundation for afforestation has been developed in the conditions of the Western Pamirs.

In 1930, the four forestries were already existed in Tajikistan, of which two were located at the territory of the present Sughd region but two others in the Khatlon region.

Their main activities were aimed at the protection of forests, logging and harvesting of nuts, pistachios, dried fruits, medicinal raw materials and industrial raw materials. The volume of timber in the 30s of the 20th century was more than 65,000 m^3 per year. In some regions, harvested timbers were rafted on the river.

In 1932, the forest enterprises for the first time began to engage in reforestation, planting of the forest and then the landing.

Until 1947, the forestry was functioned as the General Directorate of Forestry under the Ministry of Agriculture of the Tajik SSR, and then the Ministry of Forestry of the Tajik SSR was organized at over 2 million ha allocated from the SFF.

The Tajik Forest Experiment Station was organized under the Academy of Sciences of the Tajik SSR, which was then subordinated to the Central Asian Research Institute of Forestry (in Tashkent, Uzbekistan) in 1965.

During these years, new forest enterprises were organized to actively conduct research and development, and guidelines and manuals for creating forest-gardens were issued. Within a short period, new forest plantations and forest-gardens over an area of 1,000 ha were laid, and the required number of forest nurseries were organized.

The Tajik Forest Experiment Station was organized under the Academy of Sciences of the Tajik SSR, which was then subordinated to the Central Asian Research Institute of Forestry (in Tashkent, Uzbekistan) in 1965.

In 1953, forestry was transferred to the Ministry of Agriculture of Tajikistan as the Main Forest Management Department, and pastures located in the almost entire SFF had been given for the long-term use to the agricultural livestock enterprises.

This hampered the development of forestry. The State Forestry Committee was established in 1966, and transformed into the Forestry Production Association of the Tajik SSR in 1988 that was merged then with the Ministry of the Environmental Protection of the Republic of Tajikistan in 2004, and transformed later into the State Committee for Nature Protection and Forestry of the Republic of Tajikistan, which in turn was merged with the Ministry of Agriculture in late 2006, and re-established as the Committee for Environmental Protection under the Government of the Republic of Tajikistan in early 2008.

The independence of forestry under the State Committee on Forestry promoted its development as an independent sector. During 1966-1988, the national forestry system comprised over 30 timber enterprises, 2 nature reserves, 5 forest reclamation stations, 5 permanent base nurseries, 2 biological laboratories for combating forest pests, 1 forest seed control station, and some self-supporting units such as the department "Zagotlesplodosbyt" that was leading work pieces on non-wood forest products, and the "Office of Hunting and Hunting Economy".

In 1964, the Department of Forestry under of the Dushanbe Polytechnic Institute aimed at training of forestry professionals was established and operated until 2006. During the same period, forestry science was fruitfully developed on the basis of the Tajik Forest Experimental Stations, using the botanical field in the Institute of Botany and applying the wildlife biology and biological methods on controlling pests of forest and fruit trees developed by the Institute of Zoology and Parasitology of the Academy of Sciences of the Republic of Tajikistan. Much work has been done on the development of nature reserves, and in particularly on establishing new reserves, sanctuaries and Tajik National Park by the Division of Nature Protection of the Academy of Sciences of the Republic of Tajikistan.

In the recent years, the junior movement on engaging of young people in the processes of development of forestry has been initiated. During 2010-201, two young foresters (Farhodzhon Hurramzoda and Jamoliddin Madibron Ikromzoda) became the winners and prizewinners of the International Junior Forest Contest held in Moscow, Russia.

During these years, forest enterprises and nature reserves implemented several forest management planning activities, developed the master plan for development of forestry, General Development Scheme for Hunting in Tajikistan, targeted Comprehensive Program on reserve "Tigrovaya Balka", and developed the required legislative documentation and scientific advice on almost all aspects of the forestry economics.

Forest plantations and plantations of nuts (walnut, pistachio and almond) were established

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at the tens of thousands of ha. In 1988, thematic workshops on forestry development and walnut cultivation were systematically carried out at the national, regional and whole Soviet Union levels.

Saxauls were planted on the fixed mobile sand on the south of the economy on an area of 20,000 ha. This valuable species like pecan was introduced into the culture and its industrial plantation is preserved on an area of 40 ha in Kabadien forestry.

The particular attention was paid to the development of nature reserves. The first nature reserve "Tigrovaya Balka" (1938) with an area of about 50,000 ha; Dashti Jum reserve (1959) with an area of 19,700 ha, "Zorkul" reserve in the Eastern Pamirs (2002), "Ramit" reserve (1982) with an area of 16,100 ha were established. Moreover, 13 nature reserves were established in almost all natural zones of the economy in the late 60's and early 70's that are functional up to now.

The Tajik National Park (1991) and two nature parks: Shirkent (1994) and Sari Khosor (2002) were established under the Ministry of Environmental Protection of the Republic of Tajikistan.

Forestry was developed in conjunction with agriculture. During the years from 1967 to 1990, with the help of forest reclamation station, more than 5,000 ha of shelter belts on the lands of agricultural enterprises were founded. At the same time, more than 100,000 ha of agricultural fields have been protected from the hot winds and 10%-15% was guaranteed increase in the yield of agricultural crops, especially cotton.

The territory of the SFF mainly falls on the mountainous part (90%), and forests in their species composition are quite diverse. Dendroflora forest vegetation consists of 268 species, of which 32 species are included in the *Red Book* of the Republic of Tajikistan.

Tajikistan is not rich in forests. As such, small forestlands form forest intermittent that bands the mountain slopes at an altitude of 500 (700) to 3,200 (3,700) m, forming a sparse plantings everywhere, typical of all mountain drylands. Forests merge only in the river valleys where there is a constant source of irrigation. Sparse stands of trees are at such great distances from each other that they do not close the crown, causing the development of this magnificent shrubs and high grass.

Very severe fragmentation in the distribution of forests and sparse forests, receiving almost universal landscape value, was served by some botanists for grounds to deny forests existence in the Southern mountains of the Central Asia, and they offered to call these spaces Pamir-Altai parks, groves, woodland, desert forests, savannas and easy accumulation of trees, thereby emphasizing their "non-forest" nature. However, natural sparse tree plantations (regardless of the degree of human influence on them), typical of the mountain areas of Tajikistan, are by nature forest, and interaction between all of the components is very strong,

especially in the rhizosphere.

Studies have shown that in dry sparse forests where environmental determinant of planting structure acts moisture, tree species have signs of transition from tree to bush. They are low-growing, multistemmed with a deep and broad crown and shortened barrel.

The lower boundary of the forest in Tajikistan is at an altitude of about 500 (700) m, which in Southern Tajikistan corresponds to fragmented growth of pistachio (Pistaciavera). Most parts of lower boundary rises to 1,200-1,500 m, and even up to 2,200 m, which is a consequence of the massive destruction of forests in the past, mainly in the period of origin of mining in Central Asia. Upper limit of a forest is located at an altitude of 3,200-3,400 m and even 3,700 m (and some shrubs can be observed in the Pamirs at an altitude of 4,800 m).

Here clumps forests of juniper (Juniperus spp.), Birch (Betula spp.) and willow (Salix spp.) A kind of "ecological niches" on the background of non-forest areas is occupied by prickly herbalists or cryophilic wastelands. All growing trees and shrubs here do not show signs of expansion, their seed multiplication is suppressed, they are short and flattened on the soil surface.

The first work on afforestation was noted in 1882. The massive afforestation in the forest enterprises of the economy started in 1947. There were no obstacles for afforestation, because until 1966 the SFF lands were not given to the long-term use and were assigned to the collective and state farms. Currently, most of the SFF is still used for summer and winter pastures, and conducting tree-planting and agroforestry work in them is difficult.

Severe climatic and soil conditions, the remoteness and the conditions for the establishment of forest plantations require mechanization. However, poor roads, scattered plots, lack of mechanization and weak material and technical base reduce the quality and efficiency of operations. Agricultural authorities are using the lands of the SFF, but any measures to improve forest cover, forest plantations productivity and improve pasture quality were not taken.

Systematic uncontrolled livestock grazing for about 30 years has led to widespread erosion.

In 1969, the protective afforestation in the economy was initiated and carried out in the two following directions:
● Afforestation of mountain slopes, ravines, gullies and other uncomfortable (junk) collective lands and state farms;
● Establishing forest shelterbelts at the irrigated lands.

Since 1988, establishing forest shelterbelts was no longer carried out but much attention was paid to establishing pastures and protective forest plantations of saxaul. In Sughd and

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Khatlon regions, such work is carried out each year in an area of 500 ha. These crops not only improve the grass stand on the sandy pasture and sand, but also serve as good fodder for sheep and goats.

Walnut and pistachio plantations were established like forest plantations with the purpose of soil and water conservation and not for the valuable nut products. Such plantations cannot serve as the basis for nut production for which the need of the national economy is very high.

In 1970s and 1980s, there was a tendency for transferring walnut to intensive industrial basis in the economy. However, its development was hampered firstly, because of the lack of material and technical base, and secondly, the lack of funds to finance work on laying the plantations.

Despite these obstacles, foresters have laid 1,200 ha of plantations of pistachio nuts (Pistaciavera) and walnut (Juglansregia) in recent years. In addition, since 1964, 3 to 12 million pieces of cuttings of poplar (Populus) were laid, and planting other tree species both for commercial timber and protecting hillsides from erosion along roads was carried out.

Until 1992, the annual reforestation was carried out over an area of 4,500 ha. Starting from 1993, these areas were reduced to 3,000-3,500 ha per year, which is due to lack of funding.

Preservation of forest cultures laid down during 1960-1982 is 72%, during 1982-1994 68%, and during 1994-2004 78%. Low preservation of plantations is due to the fact that most of them are in heavy soil and climatic conditions and in addition, with a deficit of funds for the establishment of forest plantations.

From 1992 to 1997, the situation in the forestry sector gained a critical situation. Import of coal and timber from other Republics discontinued. A single power supply system on the post-Soviet space was destroyed, which led to intensive exploitation of forests.

Forest for the majority of rural and regional population has become the only source of fuel, and in the mountainous areas of the business as a source of timber, which led to the destruction of centuries-old trees. According to statistics, the total forest area has not decreased, but studies have shown that reduced rate of forest density, i.e., they have become more sparse.

The amount of forest stocks decreased. Sustainable forest management system is weakened and completely ceased to operate in some areas. Since early 1997, the situation in the field of forest management was gradually returning to normal.

3.2.1 Future development and forestry reforms

The institutional system of the forestry sector follows the principle of separation of functions.

The Agency implements the state policy in the forestry sector. State forest enterprises, nurseries and to a limited extent, the SPNAs perform the economic function. There are also other forest owners who do not conduct forest management activities, such as the State Committee for National Security of the Republic of Tajikistan and the private farms. State Forestry Inspectorate performs control functions. Support functions of the development of the forest sector are carried out through public institutions or private organizations that provide services, such as Research Institute of Forest.

3.2.2 Forestry Agency under the Government

Forestry Agency under the Government was established in 2013 (Regulation approved by the *Government Resolution No. 132 of 2014*) is responsible for the state policy in the field of forests, forestry, hunting and game management, flora and fauna, specially-protected natural territories, and also carries out the economic functions and state control in these areas. The structure of the Forestry Agency includes the State Forestry and Hunting Inspectorate; State Enterprise "Scientific Research Institute of Forestry"; 41 state institutions of forestry, leading forestry activities on the territory of the SFF; five nurseries, with the status of unitary enterprises, and state institutions of the SPNAs.

In accordance with the Regulation of the Agency of Forestry, State Forestry and Hunting Inspectorate imposes state control, i.e., conducting legal compliance audits in relation to forest and hunting resources, and the issuance of permits for the use of hunting and forest resources. At the end of 2015, the State Forestry and Hunting Inspectorate has not functioned; Regulations of the Inspection has not been approved yet.

Under the supervision of state forest institutions (forestry enterprises) are thirteen protected areas, as it was before the creation of the Forestry Agency, when the forestry official bodies were subordinated to public institutions of forestry and hunting under the Committee for Environmental Protection.

National parks and reserves were, until 2013, under the jurisdiction of the state institution of the SPNAs under the Committee for Environmental Protection, and currently under the jurisdiction of the state institution of the SPNAs as part of the Forestry Agency.

The newly established Agency for Forestry and Committee for Environmental Protection has no high level of cooperation. This, for example, indicates a delay in the adoption of by-laws to the *Law "On hunting and hunting economy"* (2014) and the implementation of certain provisions of the law (for example, the creation of an interdepartmental commission to establish catch limits of game animals), which requires cooperation between the two bodies.

Moreover, as the authorized state body in the area of forestry, the struggle for power is manifested in the adoption of a number of government regulations, appointing one or the other body "special authorized state body" on a particular issue (e.g. *Government Resolution*

No. 435 of 2014 defines the Forestry Agency, hunting and specially-protected natural areas; *Government Resolution No. 523 2014* defines the Environment Committee as the specially authorized state body on protection, use and reproduction of flora; *Government Decree No. 65 2015* defines the Committee for Environmental Protection as a special authorized state body on protection and use of species of flora and fauna listed in the *Red Book*). There is no clarity regarding the division of responsibilities of the bodies for the protection of flora and fauna species, not listed in the *Red Book*, on the territory of the forest fund.

After 1991, the number of forest farms increased from 24 to 42. The areas and staff units currently range from 4,500 ha to 108,000 ha, and between 10 and 82 people respectively. Currently, out of 42 forest enterprises, only 7 farms have the documents confirming the right for land use (certificate); certificate issuance process is hampered by lack of funding and assignment of the SFF to agricultural organizations.

In certain forestries, old materials of forest management were not preserved and the newly created forest management (since 1991) had no forest inventory materials, which complicates planning and sustainable management of forests. Despite the reforms undertaken by the centralization of politics in the forestry sector, the regional forestry enterprises have retained management and supervisory functions.

Some forest lands have historically been assigned to dehkan farms and individuals on the basis of lease contracts or certificates for the right to use the land, but due to the lack of control over their forests, vegetation and soil were degraded.

A strong influence of the local executive bodies of the government on forest management is noted, despite the fact that forestry does not belong to the sphere of their competence, such as the proposal of candidates for the post of forestry directors, as well as decisions on the transfer of state forest lands to other users.

The early forestries fire-chemical stations had been engaged in forest protection from pests and diseases as well as the extinguishing of forest fires, and had ceased to operate or almost all had been eliminated. Stations of biological protection of forests also had been eliminated. In the absence of a timely implementation of measures to protect forests from pests and diseases in the required quantities, almost universally forest plantations are infected by pests and diseases. There is no organization dedicated to forest management.

To address the existing problems, it is necessary to:
- Strengthen political functions of the Forestry Agency under the Government of the Republic of Tajikistan, complete the centralization process of coordination of the forestry sector and limit the influence of the local executive bodies of state authority in forestry;
- Strengthen the forest inspection and establish the effective control in the forest sector;
- Monitor the implementation of the Strategy of Forestry Development of the Republic of

Tajikistan for the period till 2030;

- Strengthen the economic functions of forest enterprises and transfer of forest, under the authority of the other owners, not leading forestry activities in forest management specialized organizations;
- Create new ones, improve existing structures, provide services to the forest sector and create favorable conditions for their work.

Chapter 4   Best practices for sustainable forest management

The strategy for the development of forestry in the Republic of Tajikistan for the period 2016-2030 envisages a number of activities aimed at preserving and increasing the area of forests and increasing their productivity through introduction of the JFM, development of commercial forestry, search for new innovative approaches and development of advanced forestry technologies.

The JFM envisages the involvement of the most active part of local population living in the area of forestry activities through joint participation with public institutions in sustainable forest management. The existing legislative and regulatory framework of Tajikistan allows the implementation of the JFM. Adopted by the Parliament of the economy and approved by the *Decree of the President of the Republic of Tajikistan # No.761* dated August 2, 2011, *Forest Code* contains the following articles relevant to the JFM.

The JFM was developed and implemented to involve the local population not only in the sustainable use of forest resources but in preservation, restoration and cultivation of forests through a lease agreement for 20 years concluded between the forest authorities and community, or an individual residing in the area of forestry activities. The jointly agreed management plans regulate the use of forests and activities aimed at the conservation and restoration of forests. The corresponding roles, responsibilities, rights and obligations of the parties are clearly defined by the contract, which guarantees the preservation of the state forest resources, and for the local residents a legitimate source of income related to the wood.

(i) The JFM has been being implemented in the Republic of Tajikistan in the floodplain forests of the Gorno-Badakhshan autonomous region since 2006, and in the pistachio forests, in Farhor and Dangara forestries, as well as in the deciduous forest zone of Khovaling forestry and in the area of juniper forests of Penjikent forestry since 2013.

(ii) Currently, there are about 600 JFMs signed the contracts, thus covering over 2,000 ha of forests. Analysis of the activities for the implementation of the JFM in pilot areas shows a positive result of its implementation.

(iii) Scientific Forest Research Institute, which is in the system of the Forestry Agency of the Republic of Tajikistan, conducts research in the following areas:
● Development of modern methods of cultivation and planting material of juniper (Juniperus) Zeravshanica and development of technology of juniper forests;
● Selection of nuts species, such as pistachio, walnut and wild rose, which provides selection in natural stands of trees, elite (the best forms of) high-yield high-quality fruit trees resistant to pests and diseases;
● Monitoring wildlife, especially rare species in nature reserves "the TigrovayaBalka" and "Romit", holding a controlling registration of the number of animals, conducting assessment

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of the environment, developing recommendations for rehabilitation populations of rare species of animals, and improving the places of animal habitats by conducting biotechnical recommendations;

- The study of biology of the main pests of forest and fruit trees and development of recommendations to address them.

4.1 Soil and water conservation

4.1.1 Soil resources

Based on the regime observations of soil formation processes, a new vision of genesis and structure of the vertical zonations of soils was formulated, and the most modern classification of soils in Tajikistan was designed that included the following bioclimatic soils: sierozem; mountain brown; alpine meadow-steppe; mountain steppe; alpine desert steppe; alpine desert; nival belt.

(i) Gray-brown desert soils are formed in the most arid part of serozem belt, where annual precipitation does not exceed 100-150 mm and similar areas of temperature conditions spread light gray soils. Gray-brown soil type has a typical gray-brown, carbonate, gray-brown sand and gray-brown rock. All of them are little humus, with less than 1% carbonate and 11% $CaCO_3$, with alkaline soil reaction.

The main types of serozem belts are gray desert, gray-meadow, saliniferous, meadow marsh, and irrigated gray soils that are subdivided into the bioclimatic sub-types. These types of soils are very different from each other in humus content in gray soils: light 1-1.5; typical 1.2-2.0; and dark 1.5-3%. The group composition of humus soil above subtypes attitude Cha: SFK increased from 0.40 to 0.80. The humus content in the hydromorphic soils increases to 3%-5% H_2O, pH is 7.5-8.5, the absorption capacity of 10-15 meq per 100 g soil.

The virgin gray soils are wetted with precipitation only in the winter-spring period. In this case, the depth of wetting of light gray soils is 60%-70%, and in some years, 180-130 cm. The upper layer of soil below 0-50 cm (up to 18% during the spring) remains humid. The lower layer of soil below 50-70 cm remains dry throughout the year.

In the dark gray soils, soaking occurs up to 2 m and more. By particle size distribution of medium-loamy virgin gray soils, the bulk of these soils constitute a fraction of the size of 0.05 to 0.001 mm, up to 80%-85%. The duty cycle reaches 52%-56%, carbonates range from 2% to 20%. The humus content in the first period of development as compared to virgin soils decreases.

This is due to the fact that microbiological processes for the entire growing season are intensive because of irrigation, while in the virgin lands they flow more actively only in spring and late autumn periods. However, with long-term irrigation (30 years or more), so-called

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"irrigation" or old irrigation (Rozanov 1951), the content of humus in the meter layer of the soil of cotton fields becomes richer than that in the newly-irrigated and non-irrigated areas.

As a result, long-term irrigation sediments are deposited, with turbidity of 5-7 g in 1 liter of water, whose capacity reaches 1 to 4.6 m, depending on the period of development and relief and forming a cup-shaped relief of various shapes. According to the number and location of irrigated soils, carbonates are close to the typical gray soils. They are more evenly distributed as a result of the annual deposits of fresh irrigation deposits. As a result of the sharp differences between these soils on irrigating, they have been allocated in a separate taxonomic unit: type of irrigated soils and sediments formed in the irrigation.

(ii) Belt of the brown mountain soils covers the foothills and slopes of mountain ranges within 800-2800 m. The amount of rainfall varies from 200-250 mm in the light soils of the Western Pamirs, up to 1,500 mm in the mountain brown leached soils in the vicinity of KhodjaObiGarm. The average annual temperature is 8-9℃ . The sum of active temperatures above 10℃ is from 1,000 to 4,300.

Mountain brown calcareous soils develop at altitudes of 800-1,800 m below the big herb semi savannah vegetation and xerophytic shrubs. The humus horizon has a capacity of 30-35 cm; humus content of 3%-5%; leached or carbonate soil does not exceed 1.2%.

Mountain brown typical soils formed under the canopy of deciduous forests, walnut, mapl and big herb semi savanna vegetation. They are common in the mountain ranges of Central Tajikistan within altitudes of 1,800-2,400 m. The typical profile of well-defined brown soil differentiates genetic horizons.

Humus layer is, up to 40 cm, contains from 5% to 10% humus. This is followed by a transition nutty horizon. The amount of humus is sharply reduced 2%, and in connection with the processes of argillization observed weighting granulometry. Carbonates are leached to a depth of 80-120 cm.

Mountain brown leached soils are common in humid areas of Central Tajikistan, such as on the southern slopes of Hissar ridge in Karategin and Darwaz. The humus content is 10%-15%. pH of water is 6.5-7.5, the absorption capacity of 35-40 meq per 100 g soil, from the action of HCl boils at a depth of up to 140 cm. Group composition of humus in mountain brown soils is characterized by fulvate-humate and humate. Cha ratio: CFK increases from mountain brown carbonate (0.80-0.90), to typical soil (1.0) and then to leached soils (1.0-1.5).

Mountain light brown soils are common mainly in the Northern Tajikistan: in Kurama, Turkestan and Zeravshan ranges. Further, they are formed in the Alai Range and the Western Pamirs, within 1600 - 2400 m above the sea level. They develop under the sparse juniper and Artemisia-bluegrass-tipchak grass vegetation.

The normal profile of the mountain light brown soils is characterized by the following features: humus horizon of 25-35 cm contains 1%-6% of humus. This horizon carbonates little or they are washed down to a depth of 30-40 cm; nutty transitional horizon is weak.

Mountain juniper forest soils are common in the northern slopes of Tajikistan and Kurama ranges at altitudes of 2,400-2,700 m above the sea level. They are under the canopy of juniper and moss. The top 10 cm layer is semi peat. Below it there is a loose powdery horizon. The amount of humus in semi peat layer reaches 17%. Its main type is fulvate. Same amount of it in next horizon is reduced to 5%, and soil solution makes slightly acid reaction.

(iii) High mountain meadow-steppe zone covers high mountain areas of Central Tajikistan and Western Pamirs (3,000-4,000 m). Precipitation is respectively 494 mm (Anzob pass) and 469 mm (Yol). The sum of active temperatures above 10℃ is less than 90℃ . There are common types of high mountain meadow-steppe, high mountain meadow, high mountain saz soils in the field of groundwater seepage.

The humus horizon of these soils has up to 4%-10% of humus, and fulvate type humus has high mobility. The transitional horizon is characterized by clearly pronounced nutty structure. It meets silica powdering, which increases from top to bottom and gives a whitish color. Carbonates are leached throughout the profile. pH of water is 6.20-8.3. The amount of absorbed cations is 20-40 meq. per 100 g soil.

(iv) High mountain steppe zone covers high mountain steppe soils, which were formed under the cover of fescue-feather grass vegetation. They are located above the high mountain meadow-steppe soils, which are mainly prevalent in the Northern Tajikistan (3,000-4,500 m) and the western Pamirs (3,300-4,700 m). Humus horizon of 30-40 cm has a brownish color and contains 2%-4% of humus fulvate type. Effervescence is observed at a depth of 50-100 cm. On the western Pamirs, these soils are highlighted in a separate type of mountainous soils.

It should be noted that in this zone in high humidity areas found saz high mountain meadow-marsh soils, associated with shallow groundwater.

(v) High mountain desert-steppe zone covers high mountain desert steppe and irrigated high mountain desert steppe. It has calcareous and leached subtypes. These soils are common in the West, and partly in the Eastern Pamirs, at altitudes of 3,200-4,700 m above the sea level. The soil cover is formed under mixed grass and spiny desert steppes. Soils are highly stony, fine earth on the granulometric composition from light to heavy clay loam. The humus content in the upper horizon is 1.20-2.15% of the fulvate type, pH of water is 6.5-7.6.

(vi) High desert zone is typical for the Eastern Pamirs, where it falls 50-70 mm of precipitation per year. The extreme minimum temperature there is down to -63℃, while the maximum

temperature is up to 33℃: The zone covers widely different genetic types of soils at the height of 3,500-4,800 m in altitude data.

Soils of the Eastern Pamirs have features like hydromorphic, paleo hydromorphic and automorphic soil series. They are distinguished by a light particle size distribution of the soil profile, low absorption capacity, alkaline (pH of water is 8.9), high carbonate (10-20 $CaCO_3$), the presence of stone, varying degrees of soil salinity sulfate-sodium type, low (0.3%-0.8%) content type fulvate humus 3-5% automorphic and hydromorphic humus. In addition to the above-mentioned types of soil, there are high mountain meadow, meadowmarsh, takyr, saline soil types with their division into a number of subtypes.

Under the conditions of cultivation of high desert land (irrigation, grassing and others). There is some increase in the content of humus and nitrogen in the meadow and peat soils. Their number is 3-18 and 0.28%-0.99% respectively. Here, at a low humus content of soil, peat is high fertilizing value.

Thus, the opportunities for significant expansion and deepening of ecological and genetic studies of the diversity of soils in Tajikistan, their composition, physical, chemical, and biological properties and their role in improving soil fertility in different bioclimatic zones of the economy have been identified.

Along with the general trends of soil-forming process, the specific features of the formation and development of soil are identified, depending on the placement of the mountain ranges, slope exposure, and other factors.

Historically developed areas of agricultural production in some regions of the economy do not always correspond to the current level of development of the industry, resulting in not fully using the potential of natural features. Therefore, the implementation of measures for rational use of soil is now one of the most important tasks. To address this problem, zonal farming systems were developed, which are based on the natural and economic conditions in relation to the use of multistructure soil. To improve soil fertility, biologization agriculture and landscape, along with reclamation, chemicalization and other method, are carried out.

4.1.2 Water resources

Tajikistan is rich in freshwater resources: its water availability is estimated as 981.5 km^3/year. Over 1,000 glaciers with the length of more than 1.5 km, and snowfields of the total area of approx 8,500 km^2 or 5.6% of the economy's territory are registered. Water resources are concentrated in glaciers and snowfields in the range of about 576 km^3. The length of the 16 glaciers is over 16 km. In 2014, the volume of the largest glacier, Fedchenko glacier, was 93.6 km^3, and the volume of the second largest glacier GrumGrzhimailo 22.5 km^3.

In Tajikistan, there are 1,300 natural lakes, a total water surface area of which is 705 km^2. In

these lakes contain a total of 46.3 km^3, of which about 20 km^3 falls on freshwater supplies. Lake Sarez, which currently contains 17 billion m^3 of water, was formed in 1911 by a landslide caused by the earthquake (Figure 4-1). The largest reservoirs are Kairakkum (3,410 million m^3) and Nurek (10,500 million m^3).

Figure 4-1 Lake Sarez

Total renewable annual flow of 947 rivers and seasonal streams flowing through the territory of Tajikistan is about 64 km^3, of which about 1.1 km^3 falls on the basin Syrdarya and about 62.9 km^3 Amu Darya basin. Total renewable annual flow of all rivers flowing through the territory of Tajikistan is about 80 km^3, of which 29.5 km^3 or 36.77% is suitable for drinking purposes (Table 4-1). There are also sources of mineral and thermal waters. Renewable groundwater resources amount to 18.7 km^3/year, of which the approved maintenance reserves are 6 km^3.

Table 4-1 Quality of surface drinking water resources

Name	Average multi-annual runoff		Drinking water quality	
	km^3	%	km^3	%
Pyanj river (including Kizilsu river)	33,369	41.6	33,669	51.4
Kafirnigan river	5,191	6.5	5,191	8.0
Surxondaryo river	1,015	1.3	1,015	1.6
Vakhsh river	18.90	23.6	18.90	29.1
Zeravshan river	5,139	6.4	5,139	7.9
Syrdarya river	15,978	19.9	15,978	1.0
Isfara river	0.46	0.6	0.46	0.7
Basin of Katasay, reservoirs and small rivers of Turkestan Range	0.147	0.2	0.147	0.2

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Based on the indicators of only annual surface runoff and population in 2014, the annual water supply per capita is 7,661 m^3 / year.

From the hydrographic point of view, the territory of Tajikistan is divided into five major river basins: the Syr Darya, Panj, Vakhsh, Zeravshan and Kafirnigan. At a more aggregate level, these pools are part of the basins of the two major rivers of the Central Asia: the Amu Darya and Syr Darya (Table 4-2).

Table 4-2 Major rivers

Name	The length of the watercourse / km
Amudarya - Pyanj	921
Zeravshan	781
Bartang – Murgab - Aksu	558
Vakhsh	524
Kafernigan	387
Gund	313
Kizilsu (Alay)	262
Kizilsu (south)	262
Obihingon	196
Yakhsu	150
Sirdarya	2137[①]

Largest reservoirs, largest lakes, major glaciers of Tajikistan are shown in Table 4-3 to Table 4-5.

Table 4-3 Largest reservoirs

Name	Surface area / km^2	Volume million / m^3
Kairakkum	520.0	3,410
Nurek	106.0	10,500
Muminabad	3.4	30
Selbur	2.3	20

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① Flows 195km through the territory of the economy.

Table 4-4 Largest lakes

Name	Surface area / km^2	Name	Surface area / km^2
Karakul	380.0	Chakankul	9.2
Sarez	86.5	Turumtakul	8.9
Zorkul	38.9	Sasikul	8.92
Yashilkul	35.6	Rangkul	7.78
Shorkul	16.29	Iskanderkul	3.4

Table 4-5 Major glaciers

Name	Area / km^2	Volume / m^3	River Basin
Fedchenko	156.0	93.6	Muksu river
Garmo	114.6	-	Obihingou river
Vitkovski	50.2	6.88	Muksu river
AS USSR	48.1	5.24	Muksu river
Nalivkin	45.2	8.59	Muksu river
Bivachiy	37.1	8.05	Muksu river
Grum-Grzhimaylo	142.9	22.5	Tanimas river
Oktaybrskiy	32.0	-	Karakul river
Geographical society	64.4	10.54	Vanj river

4.2 Desertification control

Desertification control is a global problem, so that each economy can make its contribution to this effort, taking into account the specific characteristics of each region. Historically developed areas of agricultural production in Tajikistan do not always correspond to the current level of development of the economy. As a result, there are no opportunities to fully utilize natural potential (Figure 4-2).

Natural factors can create conditions for the emergence of erosion and cause its development, but they do not always serve the cause of manifestation of land degradation, and often create conditions for the formation of desertification.

The main reason due to intensive erosion processes is improper human activities. Origin of non-irrigated human-induced erosion can be attributed to the beginning of agriculture which has arisen in the primitive society. With the development of society and the improvement of the instruments of production of dynamic processes of development, the maximum score will be achieved at the moment.

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Figure 4-2 Desertification

The main reasons for the intensive development of land degradation in rainfed agriculture are development of steep slopes, bottom and slopes of negative forms of relief, small rivers catchment areas, neglect of anti-erosion measures and others (Figure 4-3).

Figure 4-3 Land degradation

The consequences of desertification will be the impoverishment and even the total destruction of the vegetation cover, thereby expanding the areas covered with sand, increasing the area of waterlogged and saline lands and worsening the health of people. Ultimately, the reduction of fertile lands and the vegetations will lead to environmental degradation, which would entail a deterioration of the socio-economic situation.

The regularity of desertification occurs continuously and, in most cases, is irreversible. The process of desertification especially has an impact on land cover. The violation of its composition and condition will reduce the number of wild animals, birds and insects. The balance between flora and fauna is disrupted since desertification disturbs habitat of a species and the biological capacity of the territory can not withstand environmental pressures. In this regard, one species becomes extinct, distorts competition with the other, or migrates to other areas, which possibly destroys another kind of population.

In order to maintain normal living standards in the existing environmental conditions, it needs to create an extensive research program to develop an appropriately physical, legal and administrative infrastructure, the development of various sectors of the economy, including the main achievements, first of all, the afforestation program, which aims to prevent desertification.

It is necessary and appropriate according to the UN desertification control for the management of natural resources affected by drought and salinization of agricultural production landscapes in the Central Asia Convention. The following links should be highlighted:
- Policy and strategy development management in arid and semi-arid regions;
- Policy for forestry development;
- Ecosystems and communities, restoration of biological diversity;
- Increasing the capacity and awareness of population, goals and objectives of the BWC;
- Preservation and management of natural resources;
- Updating the National Action Plan on Combating Desertification in connection with the requirements and objectives set in the Regional Plan for Environmental Action and subregional action programs on combating desertification.
- Strengthening the activities of nongovernmental organizations to support implementation of the UNCCD through their membership in the international network (association of NGOs to combat desertification).
- Establishment and approval of the status of the Centre on Combating Desertification, as the national authority responsible for implementing the NAP.
- Strengthening the connection of the CCD with other conventions such as biodiversity and climate change.

Analysis of economic development of the Republic of Tajikistan in recent years shows that the result of the governmental measures for the implementation of structural reforms in the economy and the acceleration of economic reforms has made significant growth in a number of economic indicators, which has a positive effect on the implementation of the National Action Programme on Combating Desertification.

In order to overcome the process of desertification in the economy and according to the context of *the UN Convention on Combating Desertification*, the Republic of Tajikistan adopted on December 30, 2001, *No. 598 Government Resolution "On approval of the National Action Programme (NAP) on Combating Desertification.* "This program is the basic document of the economy on combating desertification:
- Approved Poverty Reduction Strategy Paper (PRSP).
- In order to ensure rational use of natural resources of the economy, the maintenance of an optimal state of land pastures, forests, water resources, air, status of biological balance, protection of rare and endangered species of flora and fauna, improvement of public health, the Government adopted the State Environment Programme for 2009-2019 years.

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For the purpose of conservation and sustainable use of land and the suspension of land degradation and desertification, the state government adopted a resolution in 1997, *No. 294 "On state control over land use and protection in the Republic of Tajikistan"*.

The main areas of activities to improve the condition of land resources, reduce risk of soil degradation and enhance desertification prevention effects are:
- Establishment of requirements for pasture rotation, and grazing of public, private and farm animals;
- Defining the requirements and criteria for steep-slope areas, and prohibiting their illegal and unreasonable use;
- Introduction of soil and water saving irrigation techniques;
- Restoration of drainage networks;
- Protection, restoration and expansion of the forest area;
- Improvement of mountain pastures and planting of shrubs vegetation;
- Ensuring access of the rural population, particularly in mountain regions, to alternative (renewable) energy sources;
- Organization of monitoring of desertification;
- Development of recommendations and guidelines according to sustainable land management;
- Increasing the role of local populations and communities in combating land degradation and desertification.

Given that desertification affects the whole complex of the major environmental issues: climate change, deforestation, loss of biodiversity, and degradation of water resources, the development of the National Environmental Action Plan (NEAP) which combines an integrated approach is very important.

It is also necessary to improve legislation on this issue.

Currently, large areas of semidesert-desert ecosystems are expropriated for the cultivation of agricultural products and the territory and conducted intensive grazing.

Here there is a high degree of fragmentation due to development of motor roads. Land degradation processes upset the balance of ecosystems.

Middle mountain ecosystems are used for rainfed crops. This often leads to soil erosion and is accompanied by clearing additional land. It is much influenced by deforestation, grazing, collection of medicinal plants and the development of the mining industry. More than 40 different mines, quarries and mining industries are located in this area, with no measures taken for land reclamation.

The ecosystems of reservoirs, as a result of seasonal fluctuations in water level, especially in

water reservoirs, are being affected by shoreline erosion, such as in the Nurek reservoir area. The degradation of these ecosystems occurs due to the regulation of river flow and water pollution.

In recent years, there were negative trends in the high mountain ecosystems under the influence of intensive cattle grazing and uprooting shrubs.

There is poaching of rare wildlife species: argali, snow leopard, ibex, and other.

In the nival zone and at the foot of the highest peaks in the field of mountaineering and tourist bivouacs, thousands of tons of waste, pieces of machinery and equipment are left. This significantly reduces the recreational value and attractiveness of these ecosystems. In addition, more and more impacts on the nival ecosystem have global warming, so the area tends to decrease.

Impact on the historic landscape increases constantly. Many of the monuments of history, archeology and ethnography were significantly affected and are now more in need of protection. It concerns the Stone Age cave paintings in the Pamirs, traces of ancient metallurgists in Shirkent and Adrasman, ancient settlement Penjikent, Hissar and other objects.

Tajikistan has ratified a number of international conventions, including *the UN Convention on Biological Diversity*, *the UN Convention on Combating Desertification*, *the Ramsar Convention on Wetlands*, *and the Convention on the Conservation of Migratory Species of Wild Animals*. All this is a good prerequisite for the harmonization of the protection of ecosystems in Tajikistan and the entire Central Asian region.

Institutionally, in protection of ecosystems, the State Committee for Nature Protection and Forestry, the State Committee for Land Management, local authorities, the administration of reserves, game reserves, historical, natural and national parks are engaged.

4.3 Pasture control

About 500,000 ha of the state forest lands are currently used as pastures. The SFF lands are assigned for long-term use in accordance with the decision of the Government of Tajikistan for the agricultural enterprises for 10 years. Some pastures for individuals are assigned by forestry authorities under contracts for up to 20 years. The use of pastures is monitored by authorities on nature protection and forestry in accordance with the *Law of the Republic of Tajikistan "On pastures" (2013)*.

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4.4 Forest fires and diseases prevention

Many forest areas, especially in southern forests, are characterized by a high grade of burning, especially in the summer the hottest season of the year. The forests with the highest fire risk are pistachio, almond and riparian forests, including the territory of the old reserve "TigrovajaBalka", located along the Vakhsh River in the southern border.

The key root cause of forest fires is the anthropogenic factor.

Due to weak technical fire fighting equipment and lack of even the simplest means of fire extinguishing means, in some years, the damage from forest fires was significant, although the number of forest fires as a rule is small.

The main materials for the forest fires are mainly grassroots, dry grass and litter. Fires rarely acquire the character of crown fires and, as a rule, they cause enormous damage to forest plantations.

In addition to large forest fires causing damage by illegal logging of the part of the population (Figure 4-4), the number of forest fires exceeded 2,000 cases (Table 4-6).

Figure 4-4 Illegal logging

Table 4-6 Violations in the forests sector

Years	Detected violations	Recovered damages / thousand somoni
2013	2024	364.0
2014	2025	389.0
2015	2019	324.0

It should be noted that, for the period 2013-2015, 2,965 persons were imposed an administrative fine in the amount of 379,989 somoni.

Diseases prevention measures are shown in Table 4-7.

Table 4-7 Forests pests and diseases prevention

Measures	1991	2000	2010	2012	2013	2014	2015
Chemical, mechanical and biological control measures / thousand ha	8.7	7.8	7.3	7.4	8.7	8.0	8.0
Biological methods / thousand ha	1.2	0.03	0.03	-	-	-	-

4.5 Biodiversity conservation

Forestry of Tajikistan is an important component of the natural resource potential of the economy, and holds a special place in solving the problem of prevention of desertification and conservation of biodiversity in the context of global climate change on our planet. The Republic of Tajikistan applies to sparsely forested economies of the Central Asia. Only 3% of Tajikistan's territory is covered by forest plantations.

Forests in Tajikistan operate mainly water protection, erosion control, bank protection, hygiene and health functions. Dendroflora of the economy is represented by 268 species of trees and shrubs. Most rich in species are xerophilous forests, among which there are 89 species. Second place in species richness is small-leaved forests which there are 57 species. Deciduous forests are also characterized by a rich diversity of species, where 45 species of dendroflora are concentrated. In all florocoenotypes, the number of shrubs is much more than that of trees (Figure 4-5, Figure 4-6).

Figure 4-5 Herb

Figure 4-6 Trees and shurbs

4.5.1 Vegetations

Complex, diverse natural conditions of Tajikistan create the extremely rich vegetations in composition and structure. Within the economy, the most typical types of vegetations are as follows (Figure 4-7, Figure 4-8).

(i) Broad-leaved forests. Formation of heat-loving broad-leaved trees and shrubs (walnut,

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Turkestan maple, sycamore exochorda, rose, shadberry, etc.), characteristic of the midlands of Central Tajikistan, a total area of 140,000 ha.

Figure 4-7 Forest degradation

Figure 4-8 Forest tending

(ii) Tugai forests. Formation of thermophilic and hygrophilous woody plants (birch, tamarisk, poplar, Elaeagnus), usually in combination with halophytic, grass-boggy and krupnotravnymi groups, a total area of 70,000 ha; found in the flood plains of the South and parts of northern Tajikistan.

(iii) Small-leaved forests. Formations holodnostoykih mesophilic trees and shrubs (birch, poplar, willow, sea buckthorn), found along the mountain rivers and streams (Zeravshan, Badakhshan and partially Central Tajikistan), a total area of about 840,000 ha.

(iv) Juniper (Figure 4-9). Plantations of evergreen conifer from the genus of juniper, divided into three subtypes.

Figure 4-9 Juniper forests

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- Thermophilic juniper forests (juniper Zeravshan and hemispherical), found mainly in the Northern and Central Tajikistan;
- Cryophilic juniper: plantations of tall species (juniper Turkestan found mainly in Northern Tajikistan (the Turkestan Range);
- Juniper elfin wood (juniper Turkestan), found in the northern and eastern Tajikistan, a total area of juniper of 400,000 ha, and together with steppe and meadow clearings, up to 650,000 ha.

(v) Shiblyak. Submitted by woodland from xerophilous dwarf trees and shrubs (pistachio, almonds Bukhara, Chelon, Cercis, grenades and other), distributed mostly in the South, South-East and Central Tajikistan, at least in the North and East, wedging in Badakhshan, a total area of 650,000 ha.

(vi) Leaf cushions. Communities of perennial cryophytic squat dense thorny shrubs (acantholimons, Oxytropis and other), widespread in the highlands, a total area of 1,100,000 ha.

(vii) Semi desert shrub. Trees and shrubs of white saxaul, buckwheat and cherkez al., found in southern and northern Tajikistan, a total area of 705,000 ha.

(viii) Polu shrub desert. Communities of xerophytic dwarf semishrubs (Polynyas, Eurotia, saksaulchika, ayanii and other), found in northern Tajikistan, the Pamir and somewhat less in the southern part of the economy, a total area of 3 ha.

(ix) Barbed prickly cushions and herbalists. Shrub, coarse-grass and thorny xerophytic plants (sainfoin, ehidny, astragalus, acantholimons, arenaria), found throughout Tajikistan in the subalpine and alpine zones, a total area of 660,000 ha.

(x) Steppes. Communities of perennial herbaceous and partly semi-shrub shrub species Microtherm and xerophytes, with a predominance of dense-turf grasses (fescue, ovsets steppe feather grass and meadow grass); particularly common herbs including wormwood and cuckooflower, which is found everywhere in the highlands; a total area of 420,000 ha.

(xi) Semi savanna (Figure 4-10). Communities of perennial and annual grasses (ephemeral type of development), a total area of 770,000 ha; divided into the following subtypes:
- Low-grass savanna semi. small ephemeral and ephemeroids (Poabulbosa, thick sedge, vulva, bonfires and other).
- Tall-grass semi-Savannah. ephemeroid formation cereals (barley bulbous, wheatgrass piliferous and other).
- Large herbal semi savannas. grassy major categories, mainly are Umbelliferae (Yugan, Ferula) and Asteraceae (nard).

Figure 4-10 Semi saranna

(xii) Meadows. Communities of herbaceous of perennial mesophytes (Renger, foxtail, cocksfoot, fire hulless, Thoron, ligulyarii and other), found in the valleys of the rivers and in the subalpine zone, a total area of 770,000 ha. There are little forests in Tajikistan, but they are rich in composition (168 trees and shrubs) and located on an altitude of 3,500 m above the sea level.

Broad-leaved, thermophilic and hygrophilous forests are widespread in Hissar and Darvoz areas and up to an altitude of 2,200 m above the sea level. In the lower band of the belt, at a height of 1,800-2,000 m above the sea level, walnut prevails, which grows with the Turkestan maple, apple, plum and Tajik poplar, and is sometimes accompanied by various shrubs.

At the upper limit of deciduous forests and mesophilic shrubs, common cold-resistant and hygrophilous small-leaved birch and poplar-willow forests are associated with groundwater yields and river valleys. Large stands of birch are found in the upper reaches of the river, Obihingou on Garmo river, in the valleys of the rivers of Badakhshan. In the hot lowlands of the desert zone in floodplains, common riparian forest consists mainly of poplars and tamarisks. These plantations are usually combined with thickets of original savannah groupings of major cereals, eriontusa and wild sugar cane (2-5 m high).

Shiblyak forms peculiar xerophytic woodlands, and in many places, only single trees of pistachio, Bukhara almond, hackberry, figs, Paliurusspinachristi and other are found. The most valuable tracts of pistachio are located in the Southern Tajikistan, with a total area of 200,000 ha.

Natural thickets of willow, pomegranate and Cercis are currently the best preserved in the

western and southern slopes of Darvaz ridge in the form of small lenses or groups. The most common type of tree vegetation is juniper, frequently with steppes and landscape forming forests.

In the Southern Tajikistan, plantations of pistachio are replaced by black juniper. In the Eastern Tajikistan, juniper can be met much less frequently, although it can be traced to Badakhshan. In accordance with National Action Program on Combating Desertification in Tajikistan, Xerophytic sand and desert forests are developed on ancient ridge-hilly sands in northern and southern Tajikistan. They consist of Haloxylon trees (black and white ones), Salsola, Calligonum and sand acacia.

In spring, here vegetate ephemera and inflated sedge, and in the summer, sandy feather grass and hare barley. However, the dominant features of the landscape of Tajikistan determine not wood, but subshrub, that is, shrub and herbaceous vegetation (50%-60% of the total area of the economy).

Desert vegetation is composed of gnarled subshrub wormwood and saltworts. In Northern Tajikistan, they occupy vast areas of the trail to the SyrdaryaKurama ridge. Small arrays of them are found in the southern Tajikistan and Badakhshan. The basis of their vegetation forms is semi-shrubs: Teresken wormwood and pink floral Lehman yezosruce Tibetan, pillow shaped Acantholimon, etc. There grasslands desert is characterized by utmost sparseness and gives a very low yield of edible forage (from 0.5 to 3 centners per hectare).

4.5.2 Animal world

In Tajikistan, fauna is rich in species composition, having a relationship with the fauna of the Central Asia (Tibet, the Himalayas and other), on the other hand, with fauna of deserts and steppes of the Central Asia. The fauna of the Pamir has much in common with that of the Himalayas and Tibet, and fauna of the mountains of the Northern and Central Tajikistan, being a younger age, tends to that of Turan lowland.

In Tajikistan currently inhabits 49 species of fish, 2 species of amphibians, 47 species of reptiles, and 82 species of mammals (Figure 4-11 to Figure 4-16). The number of invertebrate species is up to 12,000, of which the share of insects accounts for more than 10,000. There are representatives of protozoa, coelenterates, molluscs, worms, crustaceans, arachnids and numerous species of insects.

Tajikistan is considered the center of origin of many species of beetles, Hemiptera, Lepidoptera, sucking insects and other systematic groups, with various species of insects. The most typical fish of the major rivers of Tajikistan are considered trout, Marinka Turkestan catfish, carp, barbel, catfish and weed species of minnow, gambusia, bistryanka and numerous species of loaches.

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Figure 4-11 Capra cibirica

Figure 4-12 Capra falconeri

Figure 4-13 Grus leucogeranus

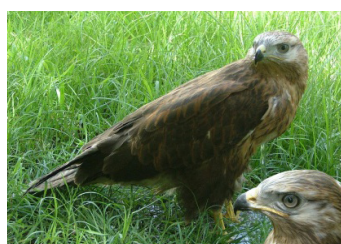**Figure 4-14   Falco poregrinus**
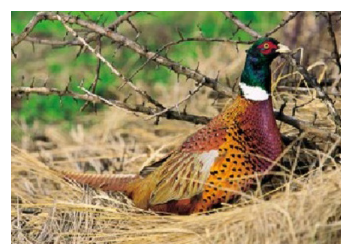

Figure 4-15 Alectoris kakelik

Figure 4-16 Phasianus tajikistanica

The development of new land and the construction of hydroelectric power plants made change in the species composition of aquatic animals. The drying-up of the Aral Sea has led to the fact that in recent years fish migration route has completely stopped. Certain fish like the type completely stopped migration, along with this and other types of commercial fish species, are threatened with extinction.

The sturgeons in the rivers Syrdarya and Amudarya and their biggest tributaries have 2 ancient forms, Amur and Syrdarya pseudoscaphirhynchus having an extremely important evolutionary significance. For lakes and rivers of the Pamirs, distinctive and sometimes quite numerous species is considered lzheosman. Overall, out of 49 commercial fish species in the economy, 21 species have commercial value, and the rest do not.

Amphibians in Tajikistan are represented by green toad and marsh frog. In Tajikistan, there are 44 species of reptiles, including 15 species of snakes, 1 species of turtle and 28 species of lizards. Reptiles are widespread in the sandy and clay deserts, especially numerous in the lower reaches of rivers (Kafrnigan,Vakhsh and Panj), and the valleys of the rivers (Zeravshan and Syrdarya). After mastering virgin and fallow land, nearly all kinds of habitats dramatically reduced; for the most part, it has an insular character. In general, in recent years, the number of reptiles drastically reduced.

Birds of Tajikistan are at the special place. There are 380 species of birds with 36 subspecies and forms: non migratory (82), nesting (150), transiting (108), wintering (80) and vagrants (21). Birds spread much wider than the reptiles and take all natural and landscaped areas of the economy.

By the nature of stay, these species and subspecies are classified: non migratory, nesting, migratory, wintering and vagrants.

Resident birds make up 21.5% of the total of avifauna of Tajikistan, and are typical mountain species like the bearded vulture, golden eagle, griffon vulture, Himalayan snow cock, juniper grosbeak, and for the lowlands of characteristic blue-gray doves, turtledoves, small mayna, blackbirds, sparrows and other.

Migrating - Nesting birds make up 39% of the total number of species of avifauna. Since the end of February, nesting birds migrate from semi-desert to high mountains. This group includes such birds as ducks, geese, teals, stone curlew, plovers, prey Peregrine, hawk, tyuvik, pigeons, Oriental Turtle Dove, etc. Birds of Tajikistan make up 30% of the total number of species of avifauna.

Spring migration starts in the second half of February. In March, promotion of birds from the south-west to north-east activates. In April, the migration reaches its peak. In May, the flight is declining. Migratory birds include such species as ducks, teals, storks, herons, eagles, swallows, warblers, flycatchers and orioles.

Autumn migration begins in August. In November, the bulk of migratory birds flit through Tajikistan and, at the same time, low flight of wintering birds fauna of the economy is formed.

Wintering birds include more than 20% of the total number of species of avifauna of the economy. These include dives, teal, wigeon, Sabine gray, goose, bean goose, falcon, great ulit, coot, seagull, and many others.

Stray birds make up slightly more than 5% of avifauna of the economy. The composition of this group is unstable and depends on many factors. This group includes: egret, scoter, white-fronted goose, Altai merlin and some other species.

There are 35 species. This fauna is divided into groups as follows: insectivores (8 species), bats (19 species), lagomorphs (3 species), rodents (29 species), predatory (22 species), and ungulates (7 species). In Tajikistan, distribution is received in all natural and man-made landscapes. In the lowlands, in the flood plain riparian forests, semi-deserts and sandy areas are populated by representatives of insectivores, bats, rodents, predators and cloven-hoofed animals. Characteristic animals are shrews, jackal, fox, hyena, steppe cat, polecat, mole voles, hares and many others. The foothill area of low mountain of the economy inhabits foxes, wolves, stone marten, leopard, mouflon and rare markhor. The zones of broad-leaved and juniper forests are populated by lynx, bears, rodents of the dormouse, wood mouse and Turkestan rat, and rocky slopes are home to Siberian ibex.

In the high mountainous zone, ecologically-adapted species of mammals such as goats on rocky slopes and snow leopards rise. Wild mammal fauna of the Pamirs in its topography has different ecological features from all the rest of Tajikistan. High altitude (3,500 to 7,000 m above the sea level), difficult terrain, flat slopes, slow flowing rivers, the abundance of warm springs, very cold winter (the temperature reaches -6℃), and short summers contribute to the development of representatives of birds and mammals. In the Pamirs, amphibians and reptiles are absent. Mammals living here include pikas and hares, argali, Siberian ibex and others. The most dangerous enemies of argali and ibex are snow leopards and wolves (Figure 4-17 to Figure 4-20). These two predators during the winter hunt a significant amount of ungulates, mostly sick and old animals, so they heal the populations of argali and ibex.

Figure 4-17 Panthera

Figure 4-18 Capra cibirica

Figure 4-19 Ovis marco polo

Figure 4-20 Gazella

The fauna of Tajikistan is a very valuable natural resource of the economy. In the case of rational caring, it can serve as a source of revenues and profits for years to come.

Improving the condition of forests and restoration of degraded lands, and preserving the natural balance largely depend on the improvement of the vegetation world of the forests first. In order to solve the existing problems, it is advisable to perform the following activities:

- Conducting preservation of biodiversity, strengthening the protection of the forests and fauna, and ensuring clean environment;
- Returning pastures of the forest fund of agricultural enterprises state forestry and receiving a certificate of land use rights;
- Organizing and streamlining the structure of the forest, land and forest mapping;
- Organizing planting of rare species of nuts, pistachios, almonds and other wild plants to form their plantations using new breeding achievements;
- Organizing and restoring windbreaks, orchards and plantations for the purpose of protection of land from erosion and, in turn, providing the population with work places, fruits and building materials, as well as increasing the fertility of pastures;
- Organizing protection strips along highways and farmlands;
- Increasing industry funding for a tree-planting work gradually, protecting forests against fire and insect pests, and increasing the salary workers in the sector;
- Providing the industry with the main technical means and work equipment;
- Training personnel for forestry in the economy and abroad;
- Streamlining the organization of hunting in the hunting territory and carrying out biotechnical activities for the conservation and protection of wild animals and birds;
- Organizing crop area of medicinal plants (ferule, rhubarb, St. John's wort, licorice, etc.) and medicinal plants to provide the population with ecologically pure medicines;
- Organizing mountain tourism and international hunting, taking into account the preservation of the ecological situation and the natural balance of forest for the purpose of foreign exchange earnings for the improvement of the biotech sector and the environmental situation;
- Organizing afforestation zones and forestry enterprises on the SFF lands and agricultural lands, which have forests;
- Controlling the SFF lands, dekhkan (individual) farms, associations, cooperatives, organizations and enterprises of the competent state regulatory bodies for the purpose of biodiversity conservation and protection of flora and fauna, wild plants and trees, harvesting of medicinal plants, wood, accounting of wild animals to determine the mandatory payment to the budget;
- Cooperating with foreign organizations to develop and implement investment programs to improve the environmental conditions of forest;
- Organizing schools of young foresters to improve the new generation of knowledge and ecological education.

Although in recent years, there has been the loss of biodiversity by individual rare species of mammals, reptiles, birds and others, Tajikistan has a rich gene pool of wild nature. Representatives of fauna, wildlife, especially mountain and floodplain forests are the main habitat for the animals. On the territory of forest enterprises and specially-protected natural areas, there are more than 3/4 of all available fauna.

Four state nature reserves, one national park, two natural parks, three natural-recreation zones (recreation and tourism), more than 20 therapeutic natural areas, and 13 state nature

reserves of national importance have the status of specially-protected natural areas of the Republic of Tajikistan (Figure 4-21, Table 4-8).
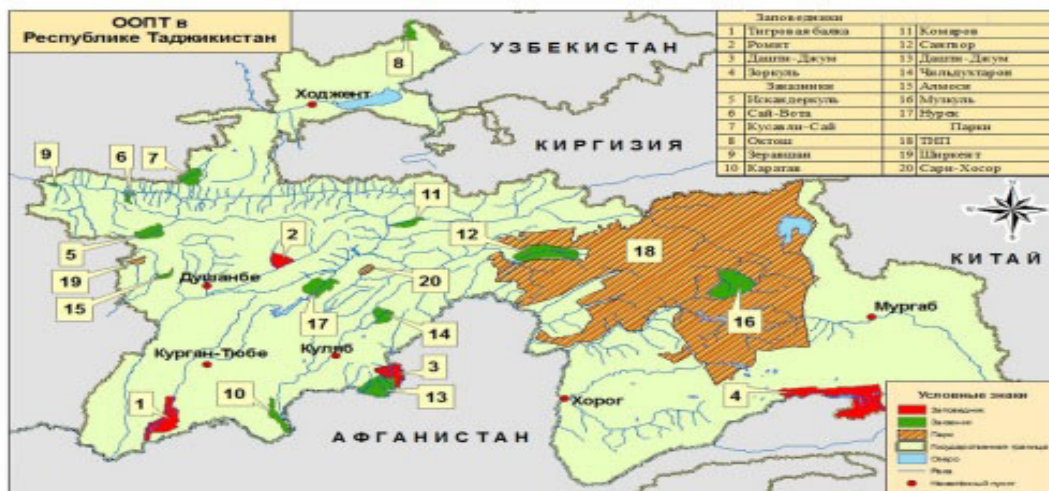
Source: Tajikistan Forestry Bureau.

Figure 4-21 Map of the state natural reserves of the Republic of Tajikistan

Table 4-8 State natural reserves of the Republic of Tajikistan

Name of the reserves	Year of establishment	Area / thousand ha	Goals and objectives
TigrovajaBalka	1938	49.8	Preservation of tugai forest complexes and rare animals: the Bukhara deer, goitered gazelle, urial, striped hyena, jungle cat, monitor lizard, cobra, lebetina viper, pheasant and wintering areas for migratory birds
Romit	1959	16.1	Preservation of mountainforest natural complexes and rare species of animals: bear, lynx, snow leopard, otter, porcupine, ular, reptiles, birds, trout; plants: halmon, onion, etc.
DashtiJum	1983	19.7	Preservation of mountainforest natural complexes and rare species of animals: bear, snow leopard, mountain sheep (urial), screw-horned goat (morhur)
Zorkul	2000	87.7	Preservation of Indian mountain goose colony, argali, ibex and snow leopard

The total area of the protected areas is 3.1 million ha (22% of the economy's territory), of which 2.6 million ha belong to the National Park, 173,400 ha 4 reserves (Table 4-9), 313,260 ha 13 sanctuaries and 6,800 ha 2 nature parks.

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Table 4-9 The number of protected species in nature reserves

Name of the reserves	Animals	Birds	Plants
TigrovajaBalka	28	214	480
Romit	31	150	1100
DashtiJum	13	35	900
Zorkul	16	12	200

4.6 Rehabilitation of degraded forests

The main function of the forests is ensuring stability of natural ecosystems due to water protection, climate regulation, soil conservation properties of forests.

The sharp increase in the number of natural disasters in Tajikistan in recent years (floods, landslides, etc.) related to the degradation of forest resources and the reduction of forest areas. With the land reform and organization of dehkan farms on the fixed lands of the SFF, many fertile areas of forest were transferred to the dehkan farms, which subsequently occurred degradation. At the same time, the preservation, restoration and cultivation of antierosion, recreation and specially-protected forests, together with appropriate financial support of these activities, are the tasks of the Government of Tajikistan.

Plans in terms of afforestation and reforestation taken in recent years include land area of about 2,000 ha. However, in fact, these volumes are not achieved and the rate of forest degradation outstrips the pace of recovery of the forest. In recent decades, forest restoration and improvement of their quality indicators have been carried out in insufficient quantities. Due to the problems with planting material produced by forest plantations, as a rule, survival rate was low (Figure 4-22).

Figure 4-22 Rehabilitation of degraded forests

Due to the lack of timely funding and carrying out measures to protect forests from pests and diseases in the required quantities, pests and diseases infect forest plantations almost everywhere. In general, mechanical control measures are carried out as the cheapest, without sprayers and pollinators, as well as pesticides. The biological method of pest management as the most environmentally friendly method does not apply.

Most of the forests in the Republic of Tajikistan are degraded due to livestock grazing, and activities to promote the natural regeneration of forests have been discontinued and are not being carried out.

The deterioration of providing the population with electricity, natural gas, coal and other energy sources after the collapse of the Union has sharply increased the scale of illegal logging of forests, especially in the mountains. Because this dilutes the mountain forests, their area drastically reduced. Cuttings are even exposed to fruit crops: pistachio, almond, sea buckthorn and other valuable species.

As a result of uncontrolled destruction of slope, forests are expanding the scale of desertification of the mountains. Currently, about 90% of the economy's hillsides are lifeless mountain deserts.

Such phenomenon is the same dangerous as scaling up of soil erosion. Wind erosion now covers 24% of all the agricultural lands, water erosion 41%, and irrigation 26% of all the irrigated lands.

There are currently more than 50,000 landslides, of which 1,200 ones are threatening settlements, roads, etc. Growing scale of the loss of humus, the most valuable part of the agri-business land, determines their fertility. Annual soil erosion is 87 million tons, with humus losses reaching 11-13 million tons per year.

As a result of deforestation from intensifying erosion in the mountains, expression of mudflows, landslides and other natural phenomena, creating emergencies and natural disasters is activated.

Maximum manifestations emergency situations fell on the period after 1997 to the present.

Although the Government of the Republic of Tajikistan has done a lot for recovery and sustainable development of forestry, due to lack of logistical base and lack of funding, environmental issues become more urgent and intensity of their danger every year is constantly increasing (Figure 4-23).

Figure 4-23 Reforestation

4.7 Comprehensive utilization of forest resources and non-timber forest products

All forests of Tajikistan are classified as protective forests that are of importantly and urgently environmental, economic and social importance, since the majority of them are located in the mountain belt, perform primarily protective, anti-erosion, soil and water-regulating function, and at the same time, serve as a source of timber, industrial raw materials and food products, including the pistachio nuts favored by population.

There are no industrial forests in Tajikistan, so the final felling is not conducted in them, only sanitary and tending cuttings of forests are made to obtain firewood, and therefore timber industry in the forestry sector is not available.

During the Soviet Union in the 70-80s of the 20th century, timber consumption of Tajikistan according to the statistical data of the year 1978 was in the amount of 347,400 m^3, including 307,200 m^3 business timber (sawlogs 131,000 m^3, pit-prop 74,100 m^3 and constructional timber 72,000 m^3) and 40,200 m^3 firewood.

In recent years, the flow of timber wood from the Russian Federation went through commercial channels in small amounts, approximately several tens of thousands of cubic meters per year, and was used to meet the construction needs.

In the recent years, depletion of forest resources and decrease of their protective functions

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have significantly reduced the volume of wood harvested in Tajikistan, and, in fact, forestry enterprises harvested only 6,000 to 7,000 m^3 of wood per year from sanitary felling, which met the less than 5% of need of the economy in the fuel feedstock. Timber, as a rule, is not harvested.

At the same time, significant reduction of the volume of natural gas, coal, fuel oil and other fuels supplied to the economy was the main cause of mass illegal felling of the forest, which leads to the depletion and forest degradation and soil enhancement processes, erosion and deforestation and causes nationwide concern and anxiety.

Due to their natural characteristics, namely the presence of a large number of nuts and wild fruit species (walnut, pistachio, almond, apricot, mulberry, apple, plum, cherry, hawthorn, pomegranate, persimmon, etc.) in composition, forests in Tajikistan have historically served the local population to provide foods, timber products, firewood, building materials, as well as a place for haying, grazing, placement of bee apiaries etc.

4.8 National commitment to tree planting

From the first days of independence and the adoption of the *Basic Law of the Republic of Tajikistan Constitution of the Republic of Tajikistan*, one of the main debts was landscaping, restoration and afforestation. Tajikistan is one of the most sparsely republics in the Central Asia. Forest cover in Tajikistan is about 3%.

Wherefore the Republic of Tajikistan ratified the UN convention to combat desertification, biodiversity, climate change, protection of the ozone layer, and others.

In addition, the Government of Tajikistan adopted a number of state documents on the development of forestry and the National Strategy and Action Plan for the conservation of biodiversity. At present, the strategy for forestry development until 2030 was developed and is under approval.

Chapter 5   Forestry education and research

5.1 Training program for forest staff

Currently, about 4,000 people are employed in the forestry of the Republic of Tajikistan on a permanent basis but up to 10,000 people are hired for seasonal work.

In the recent years, a tendency for increase of the average age of forestry workers is observed, and over a third of all employees are aged 45-55 years but pre-retired group of employees aged 55 to 63 years ranges 20%. The younger working-age population are not interested in working in the forestry sector due to low wages, inadequate working conditions and poor material and technical basis, e.g. poor or obsolete PCs and other technical equipment, administrative facilities and premises that hinder the high-quality implementation of forestry activities. Moreover, there is a gender imbalance in the sector as male employee rate is amounted to 92%.

Currently, a third of forestry employees have the secondary or incomplete secondary education background but the number of employees with the specialized secondary and higher education background are not sufficient to meet the demand on the forestry experts.

The only training program focused on forestry is offered by the Horticulture and Agricultural Biotechnology Department in the Tajik Agrarian University, in which up to 25 students are enrolled and over 20 forestry engineers are graduated from the University annually. The number of those graduated in 1998 was 236 people but only 5% of them are working in the forestry sector.

In general, there is very low interest among the young people in the forestry-related occupations as well as poor quality of training of trainers specialized in forest sciences. The training course targeted at foresters that was developed and approved by the Ministry of Education and Science of the Republic of Tajikistan is considered for 9 weeks to accomplish and develop the basic skills to perform forester's duties but it is not sufficient.

Many of the current employees of the Forestry Agency have graduated from the Lvov, Voronezh, Moscow, St. Petersburg and other Forest Academy available during the Soviet times. After the independence of the Republic of Tajikistan, studying in those universities was renewed in 2009 only. There are 4 graduates of this academy in the economy but none of them came back to work in the forest sector. 9 students continue their education.

Regular permutation with the high flowability of key personnel (20%) significantly complicates ensuring the smooth operation of forestry sector organizations.

Workforce planning and organization of the personnel reserve locally do not exist, there is no

database of potential employees. Heads of forestry enterprises do not see prospects for the development of the organization and, consequently, future staffing needs.

Very low wages in the forestry sector are worth noting. For example, wages of forester from the state budget are 75% of the subsistence minimum in the Republic of Tajikistan. In the practice of forestry enterprises, the means of self-supporting activity is also a system of motivation of employees, which is a surcharge of approximately 20%-25% of salary.

The required training courses to improve the managerial and business skills for forest managers are not available that is the challenge as the SFF covers 12% of the territory of the Republic of Tajikistan.

To improve the situation, it is necessary to:
● Provide decent social and living conditions of employment;
● Train forestry workers;
● Create a personnel reserve.

5.2 Technical capacity of forestry authorities

● The availability of legal acts;
● The presence of forestry workers;
● The availability of fixed state forest lands;
● The availability of forest infrastructure;
● The ratification of the UN Convention in the field of environmental protection.

5.3 Fact sheet on capacity building in the forestry sector

The sustainable management and use of forests for the benefit of the state, society and future generations is possible only in case a system of sustainable financing of the forestry sector is established. Currently, forestry sector is financed from the state budget, as well as from the special (non-budget) funds generated from the forestry activities undertaken by forestries in the economy.

While the planning budget allocations for the forest sector in Tajikistan are used in estimate-budget approach. Estimates for the establishment of forest crops and plantations are based on the standards of settlement and routing, approved in 1984. Along with this, there is no modern methodical approach for the compilation of estimates for other types of events, such as forest protection, labor costs norms, etc.

Estimate-budget financing method creates irrational incentives to increase the costs, as savings in the current year will certainly cut down the budgetary expenses in the next year.

Moreover, this method is based on the indicators of regulatory costs, and does not take into account the performance of the funded cost items.

Thus, the problem is non-compliance buck and outcomes forestry production and forest management. To change this method of budgeting, the Concept on forecast development within the legislation of the Republic of Tajikistan up to 2015 that includes activities on updating the methodology of the formation and execution of the budget was approved by the *Decree of the President of Tajikistan # 1021* on 19 February 2011.

Along with this, the formation of budget at all levels of subordination for the next year takes place based on the funding level of the previous year, rather than the actual needs of the sector. As a result, the forest sector chronically lacks funding.

The analysis of forestry funding during 2012-2014 showed that state budget funding in average is sufficient for covering 28% of financial needs of the sector. It should be noted that the share of funding of forest sector in the total state budget expenditures amounted to averaged 0.09% during 2012-2014. However, the growth of funding outpaced the growth of the total state budget expenditure and inflation rate in Tajikistan.

Thus, in 2012 and 2013, the forest funding was increased by 32.9% and 43.1%, and the state budget expenditure was increased by 20.3% and 18.6% respectively. The inflation rate over the same period was 6.4% and 3.7% respectively. It should be noted that the increase in funding was mainly directed to administrative costs.

Despite the increase in funding, share of funds allocated for forestry activities (establishing forest plantations, construction and repair of irrigation systems, pest control, establishing and restoration of fire windbreaks, repair of forest road) in the public sector expenditure was reduced during the last 3 years. Based on 19.3% in 2012, the decrease amounted to 14.2% in 2014. This trend was continued in 2015: the budget approved by the Ministry of Finance was 12.4%.

Currently, the system of Forestry of the Republic of Tajikistan has a Research Institute of Forestry that conducts research in the following areas:
- Development of modern methods of cultivation and planting material of juniper (Juniperus) Zeravshanica and development of technology of juniper forests;
- Selection of nuts species, such as pistachio, walnut and wild rose, which provides selection in natural stands of trees, elite (the best forms of) high-yield high-quality fruit trees resistant to pests and diseases;
- Monitoring wildlife, especially rare species in nature reserves "the TigrovayaBalka" and "Romit", holding a controlling registration of the number of animals, conducting assessment of the environment, developing recommendations for rehabilitation populations of rare species of animals, and improving the places of animal habitats by conducting biotechnical

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recommendations;
- The study of biology of the main pests of forest and fruit trees and development of recommendations to address them.

In addition, the selection work is conducted on the study of identified and selected best sorts of rosehip, walnut and pistachio, resistant to diseases and pests, with high-quality fruits and high stable yield.

So far, the Research Institute of Forestry was transferred to the variety trials and approved standard grade network of three kinds of pistachio and one grade of walnut and rosehip, which were zoned and approved for implementation in their manufactures.

Due to limited funding and lack of material, technical base of the Research Institute of Forestry is unable to expand the scope of work for scientific research. During the last two decades previously laid on the experimental plot "Navobod" collection of the best varieties and forms of nuts (pecans, early appearance of fruit dwarf form of a walnut), sea buckthorn and some other breeds have been lost. The use of biological control in forest protection previously held in the Institute of Biological Station has long ceased to exist.

In Tajikistan, implementation of technology of forest operations of the Soviet era is applied so far. Innovative technologies are not available due to lack of adequate funding and the limited possibilities of studying the best international practices.

To improve the situation, it is necessary to:
- Create necessary conditions for scientific work in the forestry sector;
- Carry out scientific work on priority areas.

5.4 International forestry cooperation

The various non-governmental organizations directly or indirectly involved in the forestry activities (Figure 5-1).

Among the most closely cooperating ones with forestry are the Regional Environmental Centre, which has the status of an international organization, German Agro Action, GIZ, FAO, UNDP, the "Aga Khan" Fund, etc. All these organizations contribute to the implementation of particular programs that directly or indirectly promote forestry development. It is like a program "Fight against poverty", "Sustainable land Pamir and Pamir-Alai" project, "Biodiversity of Hissar Mountains", the GIZ program "Sustainable use of natural resources in Central Asia" and the project CAFT "Climate change adaptation to through sustainable forest management in river catchments of the main rivers of Tajikistan" financed by the German bank KfW. In addition, the NAMA project that will also be implemented in 2017 and is funded by the Government of Germany.

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Figure 5-1 Intrenational cooperation

Although the contributions by the international companies or local communities and the Republican Associations are not so significant; however, these organizations have produced the positive outcomes and impacts, and local population feel grateful to them as they in some extent mitigate shortage of government funding required for forestry development.

Forestry in its activity is inextricably linked with the implementation of the following major international programs:
● National Action Programme to Combat Desertification in Tajikistan;
● Reduction Strategy and Increasing Absorption of Greenhouse Gases till 2015;
● National Strategy and Action Plan on Conservation and Sustainable Use of Biodiversity;
● In-situ / On-farm Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Species) in Central Asia;
● Wetlands of International Importance as Waterfowl Habitat;
● On the Conservation of Migratory Species of Wild Animals;

Local public organizations, such as NGO "Jangalparvar", "TajikLes Service (TLS)" consulting company, NGO "Azal", Support Center for the SPNAs and other organizations, each in its own way, contribute to the implementation of particular programs that directly or indirectly promote the development of forestry. It should be noted that the mechanism for monitoring an expenditure of budget and own resources of state forestry enterprises is also missing.

Participation of the private sector in forestry development in the economy is almost absent. The world practice shows that the amount of private sector investment in forestry in developing countries is seven times greater than the funds invested by donors in the forest sector in the framework of official development assistance. One of the main reasons is the lack of available information and analysis about the potential sectors for domestic and

foreign investors.

The forestry sector is also funded by donors within the framework of specific programs. Taking into account the programs for 2015-2017, the annual contribution of donors in the forest sector of Tajikistan is 2 million Euro.

Based on the foregoing, in order to create a sustainable system of financing, the forest sector needs to improve the process and the method of financing the sector plan from the budget and extrabudgetary funds, taking into account the target forecast indicators based on program-oriented approach.

5.5 Forest research

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- Monitoring wildlife, especially rare species in nature reserves "the TigrovayaBalka" and "Romit", holding a controlling registration of the number of animals, conducting assessment of the environment, developing recommendations for rehabilitation populations of rare species of animals, and improving the places of animal habitats by conducting biotechnical recommendations;
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5.6 Strategic planning for capacity building in forestry

The institutional system of the forestry sector follows the principle of separation of functions. The Agency implements the state policy in the forestry sector. State forest enterprises, nurseries and to a limited extent, the SPNAs perform the economic function. There are also other forest owners who do not conduct forest management activities, such as the State Committee for National Security of the Republic of Tajikistan and the private farms. State Forestry Inspectorate performs control functions. Support functions of the development of the forest sector are carried out through public institutions or private organizations that provide services, such as Research Institute of Forest and consulting company Tajikles Service (TLS) LLC.

Forestry Agency under the Government of the Republic of Tajikistan was established by the *Decree of the President of the Republic of Tajikistan # No. 12* on the improvement of the structure of the executive authorities of the Republic of Tajikistan from November 19, 2013 as a separate state agency. On the basis of the regulation approved by the *Decree of the Government of Tajikistan # No. 132* on February 28, 2014, the Agency is the central body of executive power of the Republic of Tajikistan, responsible for drafting and implementing a unified state policy, regulatory, legal regulation and governance in the forest, forest resources, hunting and game management, flora and fauna, specially-protected natural territories, and coordinating and managing the activities under its system of organizations that carry out managing and controlling functions.

After 1991, the number of forest farms increased from 24 to 42. The areas and staff units currently range from 4,500 ha to 108,000 ha, and between 10 and 82 people respectively. Currently, out of 42 forest enterprises, only 7 farms have the documents confirming the right for land use (certificate); certificate issuance process is hampered by lack of funding and assignment of the SFF to agricultural organizations.

In certain forestry authorities, old materials of forest management were not preserved and the newly created forest management (since 1991) had no forest inventory materials, which complicates planning and sustainable management of forests. Despite the reforms undertaken by the centralization of politics in the forestry sector, the regional forestry enterprises have retained management and supervisory functions.

Some forest lands have historically been assigned to dehkan farms and individuals on the basis of lease contracts or certificates for the right to use the land, but due to the lack of control over their forests, vegetation and soil were degraded.

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A strong influence of the local executive bodies of the government on forest management is noted, despite the fact that forestry does not belong to the sphere of their competence, such as the proposal of candidates for the post of forestry directors, as well as decisions on the transfer of state forest lands to other users.

The early forestries fire-chemical stations had been engaged in forest protection from pests and diseases as well as the extinguishing of forest fires, and had ceased to operate or almost all had been eliminated. Stations of biological protection of forests also had been eliminated. In the absence of a timely implementation of measures to protect forests from pests and diseases in the required quantities, almost universally forest plantations are infected by pests and diseases. There is no organization dedicated to forest management.

To address the existing problems, it is necessary to:
- Strengthen political functions of the Forestry Agency under the Government of the Republic of Tajikistan, complete the centralization process of coordination of the forestry sector and limit the influence of the local executive bodies of state authority in forestry;
- Strengthen the forest inspection and establish the effective control in the forest sector;
- Monitor the implementation of the Strategy of Forestry Development of the Republic of Tajikistan for the period till 2030;
- Strengthen the economic functions of forest enterprises and transfer of forest, under the authority of the other owners, not leading forestry activities in forest management specialized organizations;
- Create new ones, improve existing structures, provide services to the forest sector and create favorable conditions for their work.

Chapter 6　Forestry projects and initiatives

6.1　Projects and initiatives

6.2　Development of seed and nursery economy

6.3　Involvement of the local population in forest management using Joint Forest Management (JFM) approach

6.1 Projects and initiatives

Projects and initiatives including the implementation of projects and its socio-economic impact on forest management.

6.2 Development of seed and nursery economy

Seed and nursery economy: The development of seed and nursery economy is a basis for commercial forestry, afforestation and reforestation, anti-erosion, recreation activities, and maintaining the specially protected forests (Figure 6-1).

Figure 6-1 Nursery

The forestry sector has the five basic nursery farms covering about 400 ha and establishing a system. Almost all state forest enterprises have small forest nurseries with the total area of approx 41 ha. In total, forestry sector cultivates over 3 million pieces of planting material per year, about 30 kinds of plants, most of which are fruit trees. However, forest species are grown in insufficient quantities and do not meet the needs of forest enterprises.

A number of the SPNAs like natural park "Sari Khosor", "Shirkent" and "the Tigrovaya Balka" reserve are focused on in-situ (inside natural habitats) conservation of genetic forest resources, but some endemic species are not covered by the specially-protected status (birch, Vavilov almonds, spiny almond, poplar, Asiatic poplar, wild persimmon, wild pomegranate, pear, apple, etc.), or it is not known where else they grow. For ex-situ (outside the natural habitats) conservation are botanic gardens in Dushanbe, Kulyab and Khorog.

Seeds for growing planting material are collected all over the place, excluding qualitative characteristics, as there are no permanent seed bases and warehouses for storing seeds.

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Seeds are usually sown without checking their quality, as there is no State Forest Seed Control Station.

There are no regulations on forest seed production and proper quality control of cultivation of planting material. We have low human resource capacity in the field of nursery economy.

To improve the situation, it is planned to:
● Establish the basis for effective management of seed and nursery economy;
● Improve the quality and increase the volume of produced seeds and seedlings.

Forest management planning is a system of measures for the registration, evaluation and forest management planning, aimed at improving the efficiency of forest management and use of forest resources. Implementation of forest management in state forestries and the SPNAs in the Republic of Tajikistan will determine the quantitative and qualitative assessment of the availability and status of forest resources and biodiversity of the economy. Obtaining reliable data on forest areas, their entirety, stocks of standing timber, and their sanitary condition allows to plan the work on forest management and reforestation.

The last forest management in the Republic of Tajikistan was conducted in 1990-1991 by All-Union Association Forest Inventory Enterprise "Lesproekt". Thus, over the past 20 years, it has not carried out any work on the management, although the greatest changes in the quantitative and qualitative assessment of the state of forests took place in those years.

There is no private forest management organization to carry out forest management activities in Tajikistan. Either that structure should be set up by the Forestry Agency with state funding of forest management, or a private company under the state order must perform operation.

There is no system for forest monitoring at the moment, which in addition to qualitative and quantitative indicators of the forest includes biodiversity, people's needs, vulnerability to climate change.

There is no methodology for inventory and forest management adapted to the types of forests in Tajikistan.

Most forest enterprises hitherto do not have documents certifying the right of land use, which creates certain difficulties in the planning of work in the territory of the SFF, and often leads to conflicts with neighboring land users and temporary users of rangelands.

To improve the situation, it is planned to:
● Lay the foundation for inventory, forest management and monitoring;
● Conduct inventory, forest management and monitoring of all the forests of the Republic of Tajikistan;
● Improve the regulatory framework and strengthen law enforcement.

With adoption of the *Forest Code of the Republic of Tajikistan* in 2011, reforms in the field of legal regulation of forest relations began, which were aimed at the implementation of an efficient market system of forests and adaptation of forest relations.

The *Forest Code* does not regulate the whole or insufficiently other important relationship in the field of forest relations, in particular the legal status of the category of forest, about use of forest resources, the issuance of permits, the issues of charging for different kinds of forest management and spending of these funds. Controversy exists in the *Forest Code* and the *Land Code* and provisions on the Forestry Agency and the Committee for Environmental Protection.

The weak institutional framework in respect of matters of forest protection and monitoring compliance with the legislation of the Republic of Tajikistan was one of the reasons for the low warning and suppression of forest offenses. Despite the fact that the *Forest Code* (2011) at the legislative level provides the establishment of the State Forestry Inspectorate and its position in 2015, the State Forestry Inspectorate has still not been staffed and equipped.

Insufficient financial and material support of foresters and inspectors, poor knowledge of the forest, administrative, criminal and procedural legislation do not allow to effectively suppress and prevent forest violations and bring the perpetrators to justice.

The powers of other supervisory and regulatory authorities, including the environmental police, environmental protection, quarantine and fire in terms of their supervision and monitoring of forest offenses, are also duplicated and are not differentiated in legislation.

The system of incentives for forestry workers in the identification of offenders under departmental documents is not fully developed or implemented. In 2013, forestry considered 2,970 cases of forest offences. 25% of the total amount of damage was not reimbursed. These figures do not reveal the real extent of the offenses committed and the damage caused for forestry.

There is a low legal literacy of the local population in the field of forest relations and the role of ecological safety of the economy's forests. Insufficient conducted informational seminars for the public about the available form of legal norms in the area of the forest.

Repeatedly exceeding population's needs for forest products, compared with the production capacity of the forest, in particular, due to the limited energy supply and the high cost of other energy resources, pushes to the offenses.

Interactions between regulatory and supervisory authorities in struggle against organized illegal harvesting of forest products are not sufficient. There is no mechanism of certification of origin and other appropriate documentation for forest products, which make it possible to trace the origin, collection, sale and export of products.

Ensuring sustainable development of forest ecosystems and biodiversity, the prevention of offenses in this area requires the establishment of a perfect legal framework and well-established system to counter violations, as well as to improve the practice of normative legal acts. Detection, prevention and suppression of illegal activities in the forestry sector require the creation of a clear and established system of organizational, legal and other measures to prevent forest offenses.

To improve the legal framework and strengthen the law enforcement, it is necessary to:
- Improve legal framework by making changes and additions to the *Forest Code* and other normative legal acts;
- Harmonize specification of powers of regulatory bodies, development and implementation of incentive mechanisms;
- Raise awareness of natural and legal forest users on issues of legal forest relations.

6.3 Involvement of the local population in forest management using Joint Forest Management (JFM) approach

Currently, in the foothill and mountain areas of the economy, the main forests are home to about 70% of the population, which in some way are forest products or are involved in different types of forest. Therefore, forests play an important role in rural development and welfare of the population in these areas.

At this stage, the involvement of local communities in forest activities is usually conducted as part of seasonal, annual and long-term contracts for the use of forest resources. The local population does not participate fully in the forest management and consequently, it does not have interest in sustainable forest management as the main principle of the conservation of forests and biodiversity.

The JFM was developed and implemented to involve the local population not only in the sustainable use of forest resources but in preservation, restoration and cultivation of forests through a lease agreement for 20 years concluded between the forest authorities and community, or an individual residing in the area of forestry activities. The jointly agreed management plans regulate the use of forests and activities aimed at the conservation and restoration of forests. The corresponding roles, responsibilities, rights and obligations of the parties are clearly defined by the contract, which guarantees the preservation of the state forest resources, and for the local residents a legitimate source of income related to the wood.

It should be noted that the JFM, as well as all the work in the forests of the Republic of Tajikistan, is aimed at cultivation of native species of trees and restoration of the natural bush that will provide environmental sustainability and enhance adaptive capacity to climate change and biodiversity conservation.

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In 2006, the JFM approach was tested in Tajikistan in the floodplain forests in Gorno-Badakhshan Autonomous Oblast (GBAO). Since 2013, it is being tested in the pistachio forests located in Farkhor and Dangara state forest enterprises, in Khovaling deciduous state forest enterprise forest zone and in the area of juniper forests belonging to Pendzhekent state forest enterprise.

Currently, 565 contracts for the JFM have been signed, covering over 7,000 ha of forest. Analysis of the activities implemented in the pilot areas shows some positive results.

For the widespread implementation of this approach, there is a corresponding legal basis. Application of the JFM approach is based on the provisions of the *Forest Code of the Republic of Tajikistan*. Moreover, a draft regulation of the JFM in Tajikistan is developed. It is envisaged that the guidelines for the implementation of the JFM approach to forest enterprises will be developed.

However, for widespreading the implementation of the JFM approach, there are numbers of barriers, such as lack of awareness of forest enterprises, local people and local executive authorities of the JFM approach and its benefits. The predominance of consumer, attitudes of the local population to forests and forest resources, on the one hand, and the interest of forest enterprises in only their own development, on the other hand, are the reasons for the low level of confidence of the parties. Only with long-term assistance from international organizations and NGOs can it become possible to build a relationship of trust between the parties and to achieve the goals for restoration of forest resources for mutual benefit.

Proceeding from the aforesaid, in order to involve the local population in forest management using the JFM approach, it is necessary to:
● Improve a basis for the widespread implementation of the JFM approach;
● Conduct widespread use of the JFM approach and gradual replacement of seasonal contracts for the JFM approach.

Chapter 7 International forestry cooperation mechanisms

Forestry in its activity is inextricably linked with the implementation of the following major international programs (Figure 7-1):

● National Action Programme to Combat Desertification in Tajikistan;

● Reduction Strategy and Increasing Absorption of Greenhouse Gases till 2015;

● National Strategy and Action Plan on Conservation and Sustainable Use of Biodiversity;

● In-situ / On-farm Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Species) in Central Asia;

● Wetlands of International Importance as Waterfowl Habitat;

● On the Conservation of Migratory Species of Wild Animals;

● Self-assessment of the Environment of the Republic of Tajikistan.

Figure 7-1　Internation forestry cooperation

Achievements of forestry in the period of independence:

● 13,000.0 ha of forests for improvement of pastures and protection of land from erosion were laid;

● 200.0 ha of poplar plantations for timber construction were laid;

● 834.0 ha of floodplain forests in the Nurek reservoir were laid;

● "State Forestry and Hunting Inspectorate" was organized;

● "Tajik National Park" was included in the UNESCO World Heritage List in 2013;

● State reserve "Ramit" was given the status of the local biosphere reserve;

● Natural-historical park "Shirkent" was created (2004);

● Natural park "Sari Khosor" was created (2004);

● The management plans for "specially-protected natural areas" in the period 2013-2018 were developed and approved;

● With the support of international organizations (GIZ, the German government), more than

1,000 ha of forests were laid;
- The book "*Forest Genetic Resources of Tajikistan*" (2012) was published.

Chapter 8 Challenges and opportunities for forestry development

Tajikistan is a Republic with a traditionally high percentage of population growth. The problem of employment of the population, with a high birth rate, especially in rural areas, along with poverty, will continue to be relevant.

In this connection, there will be a natural need for people to learn new areas to increase the arable land in the mountains. It will also increase the need to provide the population with fuel, primarily fuelwood, and the wood for construction. In addition, the following need will also increase:

- The need for construction of new hydro power plants and providing the population with energy sources.
- The need to develop coal deposits and to price and purchase coal available to the public.
- The need to improve the legislative framework in the field of environmental protection and forestry in particular.

Tajikistan, as a mountainous economy, has insufficient arable-suitable land (less than 7% of the territory). And despite the fact that the economy is primarily dependent on the agricultural sector, and hence the presence and condition of soil, forest lands and their area are steadily declining.

The problem of land degradation is of particular relevance. The reduced area of arable land and plantations almost completely cut shelter belts on the lands of rural-economic enterprises, which previously were about 5,000 ha forests thinning. About 50,000 ha per year of arable land are subjected to varying degrees of desertification processes.

Soil degradation leads to a decrease in food products, deterioration of living standards and even the cause of migration in some regions of the economy.

Unjustified plowing through the destruction of trees and shrubs in a dissected relief activates the development of desertification processes.

Intensive development of soil erosion contributes to the development of rural - economic use of hillsides with a slope greater than 150 m.

The impact of negative effects of climate warming and soil erosion due to anthropogenic factors increases natural disasters, which can lead the economy into unforeseen natural disasters and even to environmental catastrophes.

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Acknowledgements

This book builds on the main research results from the project *"Study on Current Status, International Cooperation, Development Strategy of Forestry and Best Practices of Forest Management in Greater Central Asia (2016-R22)"*, which is funded by the Department of Science and Technology (DST) of State Forest Administration of China (SFA). We are deeply grateful to all colleagues from the DST for their technical and managerial guidance throughout the project implementation phase.

We are also highly grateful to the scholars and officials from the forest authorities of Kazakhstan, Tajikistan, Uzbekistan, Turkmenistan, Kyrgyzstan and Mongolia for their important inputs in compiling the main contents of this book.

Our great thanks also go to a number of consultants who peer-reviewed this book and offered their thoughtful insights for areas of improvement.

In particular, we would like to express our warm appreciation to all other colleagues from APFNet for their valuable suggestions in this process, especially Dr. Zhai Hongbo, who contributed greatly to development of the project concept and framework.