

Forest Rehabilitation in Kyrgyzstan

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1. General Information

1.1 Geographic Information

The territory of the Kyrgyz Republic is 19.99 million ha (4.3% are forests, 4.4% - water surface, 54.0% - agricultural lands and 37.3% - other lands). Almost 95% of the territory is mountainous at more than 1500 m asl. The average elevation is 2,750 m asl with the highest point at 7,439 m and the lowest one at 401 m. Fifty eight percent (58%) of all human settlements in the country are located within the elevation of 1,000-2,000 m (35% of the total population) while 5% live above 2,000 m asl.

Nearly 90% of the total territory of Kyrgyzstan lies at altitudes of 1,500 m asl and higher (Abdymomunov 2001a) and more than 40% above 3,000 m asl (von Maydell, 1983).

The Kyrgyz Republic is bordered by the Republic of Kazakhstan, the People's Republic of China, the Republic of Tajikistan and the Uzbek Republic. Located at the intersection of three large soil-climatic zones (i.e. Eurasia-Turanian, Western-Asian and Central Asian), Kyrgyzstan's climate shows a variety of climates.

The Kyrgyz Republic is located at the junction of two mountain systems (the Tien Shan and the Pamir). The highest points of the Republic in the Tien Shan Mountains are Victory Peak (Pobedy) (7,439 m) and Khan-Tengri (6,995 m). The lowest lying area is a transboundary crossing of the Naryn River at 480 m asl. The average elevation of the territory of the Republic is 2,630 m asl. About 93% of its territory lies at an elevation higher than 1,000 m; 85% lies higher than 1,500 m and about 42% is higher than 3,000 m asl. The variety of climatic and natural conditions and the mountainous landscapes of Kyrgyzstan can be classified into four climatic zones as follows:

- The valley-sub mountain zone (from 900 to 1,200 m) is characterized by hot summers, and snow-less and mild winters with significant lack of precipitation. The total cumulative positive temperatures for this zone are ranging from 3,600 to 4,900°C.
- The mountain zone (from 900 – 1,200 to 2,000 – 2,200 m) has a typical temperate climate with warm and relatively sufficiently damp summers, and temperate, cold

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stable and snowy winters. The total accumulated positive temperatures for this zone are in the range between 2,700 and 4,000°C.

- The high-mountain zone (from 2,000 – 2,200 to 3,000 – 3,500 m) has cool summers and cold winters without much snow. Temperature in July is about 11 - 16°C. Extended winters last from November to March. In January, the temperature is 8-10°C below zero, and the other cold months of the year have temperatures of minus 3-7°C. In the upper part of this zone a frost-free period is reduced to three to four months and even less. The frost free period can be reduced to zero if we move higher up, i.e. there is also some frost during the warmest summer days here. The total accumulated positive temperatures in this zone are 600 – 2,600°C.
- The nival belt zone (from 3,500 m and higher) has severe and very cold climate. This is a belt of snowfields, rocks and glaciers, as well as a belt of moisture accumulation. Even in the lowest parts of this zone the average July temperatures do not exceed 4-7°C, while January temperatures go down to 19-22°C below zero. The total accumulated positive temperatures for this zone range between 600 and 800°C.

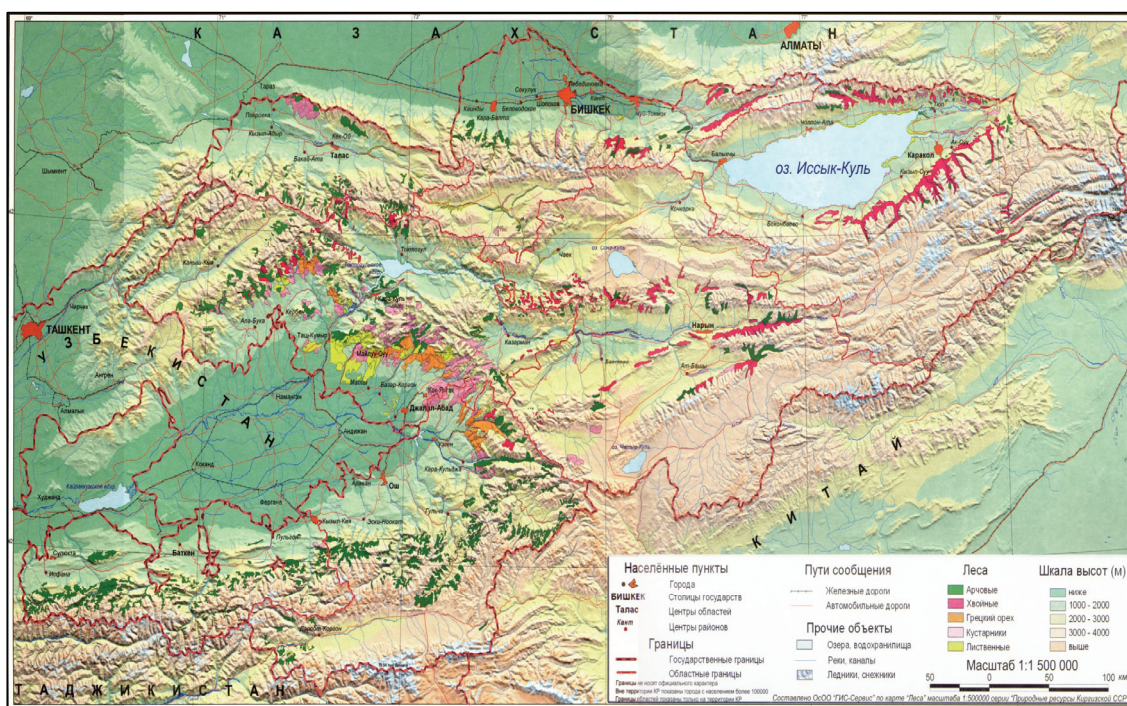
Only 20% of the territory of the Republic can be classified as an area for comfortable habitation. The majority of the population lives here and its economic activities takes place in this area. About 50% of the territory is classified as uninhabitable. Only mining enterprises run their activity here on a permanent basis, while other economic activities are only of seasonal type.

The averaged readings of the total annual precipitation in all climatic regions are quite similar: northwestern region - 456 mm, northeastern region – 421 mm and southwestern region – 521 mm. The higher readings in the southwestern climatic region reflect the higher moisture transfer by western air streams. Low annual precipitation in the inner Tien-Shan area (294 mm) is explained by the location of the region within the wind shadow of the northwestern moisture-laden air flows (UNDP, Bishkek, 2009).

Being a mountainous country, climatic conditions in Kyrgyzstan are significantly influencing the living conditions and daily activities of people. Kyrgyzstan occupies the main part of the Tien Shan mountain and, according to its height marks (average height of ridge line of many mountain ranges is 3.4-5 km and more), takes the fifth place among the highest mountainous ranges in the world, connecting to the Himalayas, Karakorum, Hindukush and Pamir mountain ranges (National Academy of Sciences of Kyrgyz Republic, Bishkek, 2007).

The Kyrgyz Republic is of special interest for the whole Central Asian region because most of the region's water resources originating in this country concentrate in its glaciers, lakes, rivers and underground reservoirs. In 2000, the total glacier volume was estimated at 417.5 km³. There are 1,923 lakes with a total water surface of 6,836 km². The largest ones are Issyk-Kul (6,236 km²), Son-Kul (278 km²), and Chatyr-Kul (171 km²). The longest rivers are Naryn (535 km), Chatkal (205 km) and Chu (221 km). The water of the Issyk-Kul Lake is salty and cannot be used for human consumption.

There are about 5,000 rivers in the Kyrgyz Republic, related to eight hydrological basins. The hydrological basins belong to the rivers Syr-Darya, Amu-Darya, Chui, Talas, Ili (Kar-Kyra), Tarim and two closed lakes – Issyk-Kul and Chatyr-Kul. All basins except for the last two are transboundary basins. The long-term average annual river flow from the territory of the Republic is about 48.6 km³, as estimated in the year 2000 (UNDP, Bishkek, 2009).



Cartography: GIS-Service Bishkek 2003; Grundlage: Natürliche Ressourcen der Kirg. SSR: Wälder (1:500.000)

Figure 1: Forest map of the Kyrgyz Republic

1.2 Demography

Kyrgyz people are one of the most ancient people of Central Asia. The first record of Kyrgyz people was found in Chinese chronicles more than 2,000 years ago. Since then, the Kyrgyz State has experienced rises and downturns, multiply wars and interminable years of starvation, disease and drought. The history also includes large-scale escape of people from cruel invaders and long-time migrations in search for a better lot, and other events that considerably influenced the life and size of the population.

Nevertheless, the first records of the more or less precise number of Kyrgyz people are contained in the results of the Russian's population census of 1987, for the first time recognizing Kyrgyz people as an ethnic group (for a long time in Russian history, the "Kyrgyz ethnic group" was mistakenly related to Kazakh people). The number of people in the country has almost doubled over the past century. Certainly, many geopolitical events that happened over 100 years have influenced - to a greater or lesser extent - the size of this nation.

It is commonly known that after the transition from a nomadic to a settled life style the number of Kyrgyz people started sharply to increase. Before that transition almost half out of 10 born infants did not survive. A strong social policy during the Soviet period played some positive role in the increase of population. At that time, infant mortality rates decreased considerably.

The Kyrgyz Republic has a population of 5.2 million people (as at 1 January 2006). The urban population makes 35% while 63% out of this number are able-aged people (men aged 16 to 59, women aged 16 to 54). The rural population makes 65% with 55% of this number are able-aged people. In 2005, the natural increase of population made 11.7 people per 1,000 people in urban areas, and in rural areas it was 15.5 people. There are more than 90 ethnic groups living in the Kyrgyz Republic. In the beginning of 2006, there were 68.4%

ethnic Kyrgyz people, 14.3% - Uzbeks, and 9.5% - Russians. The amount of Hui (Dungans, or Chinese Muslims), Uighur and Tajik ethnic groups was about 1% each. Other ethnic groups were represented with less than 5%. The average annual increase of the resident population of the Republic was 0.94% during the period 2001 – 2006 (UNDP, Bishkek, 2009).

Kyrgyz and Uzbek are Turkic ethnic groups, Sunni Muslim and speak related Turkic tongues. Traditionally, the Kyrgyz lived as nomadic herdsman and horsemen, while the Uzbek have a sedentary tradition. The vast majority of Uzbek in Kyrgyzstan live in the lower parts of the fertile Fergana valley in the south of the country.

Due to topographic conditions the majority of the population is concentrated in the south of the country. More than half the population lives in the densely populated Fergana Valley. The ethnic composition of the population has changed considerably over the past decades. The emigration of Russians and other Slavic nationalities began in the late 1980s (Heleniak 1997), and increased dramatically in the early 1990s at the height of the economic crisis to reach its peak in 1993 (UN, 2003a, p. 40).

1.3 Natural Resources

Land and water resources are the most significant natural resources in Kyrgyzstan. However, benefiting from these resources depends on the prevailing climatic conditions which are not everywhere favorable. There are 0.247 ha of plough land per capita in the Kyrgyz Republic, of which 0.167 ha are irrigable lands. Because of the complex mountain topography and interaction of many natural factors there is great diversity in soil formations.

The quality of soil differs from grey-brown desert type to chernozem-forest type in spruce forests. Foothill valleys and inter-mountain valleys are areas of permanent residence and economical activity; the soil here belongs primarily to various types of grey soils and grey-brown desert type soils of the mountain-valley classification. Here, the humus content of the soil ranges from 0.8 to 2.5%. Only the eastern area of the Issyk-Kul Valley has mountain-valley type of light-brown soils with a humus content of 2.6 to 3.4% and dark-brown soils with a humus content up to 6%.

The socio-economic transformation processes are, of course, intimately connected with changing land-use systems and often environmental degradation. In different economic times, it is easy for environmental issues to be seen as a “frill” and to be relegated to a future agenda. The generally adverse state of the natural environment in the former Soviet Union, largely resulting from outmoded, inefficient, and polluting industrial enterprises, military activities, as well as from waste and inefficient use of natural resources, has been well known for over two decades (cf. Pryde 1995; Stadelbauer, 1996, 1998).

The adoption of subsistence strategies for sustaining livelihoods in the newly independent states such as Kyrgyzstan suggests that the pressure on locally available natural resources might be reduced and that the adopted model might ease the competition for access to environmental wealth and the threat on biodiversity conservation. Large areas of agriculture lands are currently inadequately managed and therefore less productive. According to the results of a land inventory, 8,000 ha of irrigated tillage have been out of use for the last five years.

1.4 Water Resources

Water resources of the Kyrgyz Republic are used for irrigation, industrial and residential water supply, and for power generation. The water resources are accumulated in glaciers, lakes, rivers and as underground water.

The territory of the Kyrgyz Republic is part of a closed cut off basin in Central Asia. Having considerable water reserves made up of more than 50 km³/year of surface river flow, 13 km³ of fresh underground water, and 700 km³ in glaciers the Kyrgyz Republic uses only 12 to 17% of the surface flow for its needs (National Academy of Sciences of the Kyrgyz Republic, 2007).

In the year 2000, the total glacier volume has been estimated at 417.5 km³. According to data of mathematic-cartographic modelling performed in the middle of the 1970s the glaciers lost about 15% of their volume by the end of the century.

The Tien Shan Mountains have wide and levelled intermountain troughs located at 3,000 m asl and higher, showing typical glacier-accumulative relief. The permafrost zone starts at this altitude; the relief here has thermokarst features. Tien Shan Mountains have 1,677 small, high altitude lakes at elevations above 3,000 m.

There are 1932 lakes with a total area of water surface of 6,836 km² on the territory of the Kyrgyz Republic. The largest are Issuk-Kul Lake (mirror area is 6,236 km²), Son-Kul (mirror area is 275 km²) and Chatur-Kul (mirror area is 175 km²). Currently, 24 reservoirs with common displacement of 24 km³ are operated in the Kyrgyz Republic. There are 200 basins of decade and seasonal regulation with a total volume of 105 million m³ of water. The reservoirs are subdivided into mountain, sub-mountain and flat categories, depending on their location.

The mountainous topography has formed well developed river networks. There are more than 3,000 rivers in the Kyrgyz Republic, relating to eight hydro geological basins and belonging to the rivers Syr-Darya, Amu-Darya, Chui, Talas, Ili (Kar-Kyra), Tarim and two closed lakes – Issyk-Kul and Chatyr-Kul.

The total long-term average annual river flow from the territory of the Kyrgyz Republic has equalled 48.6 km³ for many years. The average annual river flow has increased by 2.9 km³ (6.4 %). The mean percentage of river flow during the vegetation period is 74% and 26% during fall-winter and early spring seasons. About 20–25% of the river flow is used for domestic water consumption while the rest of the river flow goes to the territories of the neighbouring states: Uzbekistan, Kazakhstan, Tajikistan and China.

Potential fresh water underground reserves of the Kyrgyz Republic are estimated at 13 km³. These underground reserves are located in intermountain troughs, the most economically developed areas of the country.

Useful ground water resources under the commercial recovery classification make 16 million m³ a day or more than 5 km³ a year. The total ground water withdrawal for consumption makes up about 5% of the resources.

1.5 Hydropower Resources

Water is a strategic resource for the Kyrgyz Republic, a source for food and power generation. The Republic possesses huge resources of surface waters as outlined above.

Due to changes in the surface water flow a short-term increase in capacity by 5 -10% can be expected by 2020 – 2025. During this period and in accordance with the State program on “The Main Areas for Prospective Development of Power Energy in the Kyrgyz Republic till 2025” it is planned to add another 2,660 to 3,660 MW to the existing power generating capacity.

Providing inhabitants living in remote mountainous areas located far away from basic energy sources such as hydro power plants and thermal energy is a major problem today. The Institute of Water and Hydro Power of the National Academy of Sciences of the Kyrgyz Republic therefore proposes to consider the use of local hydro power resources and to create the technical means for improving the living conditions of the mountain populations.

Under the National Energy Program, it is planned to restore 39 small power stations that have existed before and also to build new ones. As of 2008, there were more than 10 micro-hydro power stations operational in the Kyrgyz Republic (UNDP, Bishkek, 2009, National Academy of Sciences of Kyrgyz Republic, Bishkek, 2007).

1.6 Forest Resources

As of January 2003, the total area of the State forest was 3.32 million ha, of which 0.865 million ha or 4.32% was forested land (State Forest Service Fund, 2003). The total forest growing stock is estimated at 28.84 million m³. There are four types of forests: spruce forests the dominant species of which is *Picea schrenkiana*; walnut-fruit forests (*Juglans regia*, *Malus* and *Prunus* sp.); juniper (Artcha) forests (*Juniperus* sp.) growing up to 3,200 m under extremely dry conditions; and shrubs and riverside forests mainly made up of various species of willows, *Salix* sp.. juniper forests cover the largest area – 172,300 ha, followed by spruce forests, which cover 116,500 ha. In the north of Kyrgyzstan, forests are mainly composed of spruce, poplar and willow trees, while in the south of the country, where the climate is drier and protected from northern winds, forests are composed of a mix of walnut, maple, apple, cherry, plum, crataegus and almond trees.

The general average annual increment in 2003 was 0.44 million m³ with 64.9 m³ of standing stock per ha of forested land. In age composition, mature and over mature stands prevail, (44.2% of forests area). The share of under-storey trees is 9.9%. Because of government forestation efforts from 1999 through 2003, the creation of new forests reserve areas, and the transformation of former agricultural lands into state forests has brought the total area of State forest reserves to 259,700 ha. This is augmented by 262,100 ha of national nature parks. In total, 16,400 ha were reforested between 1998 and 2003.

Vertical stratification and a variety of climatic zones have caused significant diversity of tree species in the forest reserves, on one hand, and a low percentage of forest lands in the country on the other hand. Different combinations of species create a wide diversity of forest ecosystems: juniper and spruce at high altitude, walnut-fruit at middle altitude and flood-plain types at foothills. The long-term objective for the State Agency of Environmental Protection and Forestry is to increase the forest cover up to 6% by 2025 - 2030, which means expanding the forest areas by 289,000 ha compared to the forest cover in 2003.

1.7 Socio-Economic Situation

The break-up of the Soviet Union, with the subsequent political and economic transition has resulted in an economic crisis across the former Soviet block. Since 1991, economic, social and political reforms have taken place in the Kyrgyz Republic.

Highest priority in the state's policy is given to social development and more than half of the annual state budget is needed for this area. The main focus is on poverty reduction, effective systems of social security and expanding human capacity. The breakdown of the Soviet Union's integrated economy and the sudden stop of direct and indirect subsidies from the central Soviet budget had dramatic consequences for all sectors of the economy in newly independent Kyrgyzstan. The country embarked early on what is seen as the most ambitious economic reform program among the former Soviet Republics in Central Asia, including price liberalization, privatization, agricultural and land reforms, and an early introduction of its own currency. The country gained considerable support for its determined reform agenda from the international community.

During the first years of independence, from 1991 until 1995, the country experienced drastic reductions in output and income in all sectors of the economy. The industrial sector virtually collapsed and agriculture again became the dominant sector in the early 1990s.

The social and economical development of the Kyrgyz Republic can be broken down into two phases – the first phase covers the years from 1991 to 1995 and the second – from 1996 to 2006. The first phase was a period of significant fall of economic activity, and of industrial activity, in particular. It led to an abrupt decline of GDP in 1995 when GDP made 50.7% of the 1990 level (expressed in prices of 1990). That decline included the fall of industrial production down to 33%, agriculture – to 45%, transport – to 88%, services – to 61% of 1990 GDP. The second phase was a period of GDP growth in real terms (prices of 1990).

After a first macroeconomic stabilization, the country's economy recovered from 1996 until 1998. However, this recovery was mainly based on growth in a few sectors (notably agriculture, gold mining and energy). High budget and balance of payment deficits made the economy extremely vulnerable (World Bank, 2001b, p 11). In late 1998, the country slid into a financial crisis mainly triggered by the Russian ruble crisis, from which it recovered only in 2000 when economic growth resumed. It is estimated that in 2002 the GDP reached about 70% of its level in 1990 (UN, 2003b, p. 11).

By 2005, the GDP achieved 80% of the respective level of 1990. At the same time, the gross industrial product reached 53.9%, construction – 46%, agriculture –103.8% and transport – 130.9%. The services sector made 6.5 times as much compared to 1990. The second phase was a period of economic stabilization (UNDP, Bishkek, 2009).

The economic contribution of the forest sector in monetary terms - equity of forestry (leskhozes) – is about 50.0 million Som (USD 1.2 million), which is approximately 0.05% of the country's GDP (102.8 billion Som or USD 2.5 billion). However, forests and forest resource management play a major role in the protection of watersheds and biodiversity resources within fragile mountainous ecosystems, and this contribution is excluded from the available estimates. Timber exports from Kyrgyz Republic are limited to products of exceptional value (e.g. walnut timber) but the volumes of such products are small as they are extracted as by-products of activities such as sanitary harvesting. However, because of poverty and other social problems, people in the rural areas experience difficulties in covering the increased cost of principal energy sources such as electricity, gas, coal, and firewood.

As a result, people in the remote areas are forced to use illegally harvested firewood. In urban areas, fuel wood is not consumed in large quantities. If gas and central heating are unavailable, the most common alternative is electricity, and thermal energy from coal combustion. The government provides poor families with free-of-charge allocations of coal (World Bank, 2005). Any purposeful changes regarding prosperity of people, conservation of natural resources, ecological safety should be implemented with the participation of the local population. Social mobilization is one of the instruments for involvement of local residents into the process of resources conservation and their proper management.

1.8 Land-use

1.8.1 Agriculture

Today, the agricultural sector plays a key role in Kyrgyzstan's economy. In 2002, it was responsible for more than one third of GDP and employed half of the economically active population. It has to be stressed that within the country there are important regional disparities between economically more dynamic regions, such as the capital Bishkek and its surroundings in the north of the country, and remote rural regions mainly in the south and in the centre of the country. Rural areas have often relapsed into subsistence agriculture and a non-cash economy.

The agriculture sector is an important factor of food security. Between 1990 and 2005, the share of agriculture in the GDP was about 30%. Plant cultivation made up 54.4% of the agriculture input into GDP, and cattle-breeding provided 43.9%. The share of services, forestry and hunting in agriculture input was insignificant.

Furthermore, it is important to note that the informal sector, not included in official statistics, plays an important role in the country. Despite some success of the various reforms, the Kyrgyz economy still faces a number of crucial challenges, including diversifying its economy, reducing the heavy burden of external debt, strengthening governance, expanding exports, increasing investments, developing small and medium businesses and agriculture (UN, 2003a; World Bank, 2003a), particularly in marginalized rural areas.

Agriculture is a business that depends to a large extent on the prevailing climate. Its productivity of plant cultivation depends on annual climatic conditions such as total precipitation and humidity, seasonal distribution of precipitation and moisture levels during the vegetation period. Therefore, agriculture productivity can be negatively affected by drought, hail, strong winds, and other weather phenomena. That is why productivity varies from year to year. At the same time, the dynamic of gross output indicates the tendency of agriculture growth.

Today, about 150,000 ha of irrigated land is affected by salinization and about 140,000 ha is insufficiently drained. The reasons for salinization and swamping are irrational water use for irrigation, reduction of capital investment and lack of technical maintenance and rehabilitation of irrigation and drainage systems. Plastering of solonetzic soil was terminated because of shortage of funds although this technology was once the most efficient approach of rehabilitating agricultural land.

For timely identification of harmful technologies applied in the agriculture sector, their assessment, prevention and elimination, the Government of the Kyrgyz Republic approved the Regulation on Monitoring of Agricultural Land of the Kyrgyz Republic through Resolution №115. The State Register ("Gosregistr") of the Kyrgyz Republic is a governmental body for the monitoring of arable land and pastures, their state and use, regulation of land relations,

land market development, and surveying of agriculture lands including forest shelter-belt areas.

All agricultural lands, regardless of type of property and economic activity, are subjected to close monitoring. Results of systematic observations, surveys, studies, inventory, archive data and other data on qualitative and quantitative information on the status of land are the basis for monitoring. The Government of the Kyrgyz Republic has developed and adopted the State Program on “Land”, which has been implemented in three stages (1998, 1999-2000, 2001-2005). Within this program, the “Gosregistr” carries out soil examination and salt analysis of agricultural lands. This evaluation involves an assessment of the natural soil fertility and other local and site-specific parameters for defining the quality of the agricultural lands. These are key criteria for calculating the land tax levied for land-use and market promotion in rural areas. As an outcome of this work, a land cadastre plan for land reclamation works will be introduced and recommendations for proper land management options be elaborated, thus protecting land from negative impacts.

1.8.2 Industry

The period between 1990 and 1995 displayed not only a significant reduction of industry input into the GDP of the Kyrgyz Republic, but also drastic restructuring of the industrial production. Before 1990, the main part of the industrial production was represented by machinery construction, production of electrical equipment and electronics, while the production of the light and processing industry played only an auxiliary role.

The economy stabilized after 1995, when the top position in the production of industry products was taken by the light and processing industry. After having put the newly established Kumtor gold-mining processing complex into operation, the contribution of the metallurgical industry to the national economy increased significantly.

The current state of industrial production can be described as unstable due to low product diversification. Three quarters of the industrial output are produced by the following industries – metallurgy (mainly gold production), electrical power, natural gas, food items, beverages and tobacco production. Advanced technology products of machinery, electrical equipment and electronics make less than 5% of the gross industrial production. There has not been any noticeable development trend in the industrial production of the Kyrgyz Republic within the recent five years.

The power generating industry in the industrial sector has experienced only minor alterations. The production basis of the power sector consists of 17 power stations. This number includes 15 hydro-power stations of 2.95 million kW of installed capacity, two heat and power plants of 0.73 million kW and more than 70 thousand km power lines of 0.4-500 KV. Power consumption is at a level of 1,351 kWh per capita (UNDP, Bishkek, 2009).

1.8.3 Tourism

Landlocked, sparsely populated and mountainous, there is a great potential for the development of nature based tourism in the Kyrgyz Republic. Furthermore, several sites of the Kyrgyz Republic have adequate facilities for visitors, as they served as resort and spa facilities in the Soviet times for visitors from other USSR Republics. With the UN designation of 2002 as the “Year of Mountains” and Kyrgyzstan’s participation in the Mountain Forum Council, the country is well situated to expand tourism, especially since nature based tourism is the fastest growing sector of international tourism. To this end, the Government has made tourism development an economic priority and is working towards creating favorable conditions for the expansion of tourism. There are some other programs on tourism

development in the Kyrgyz Republic related to the regions, projects, and studies, such as the proposals on comprehensive tourism development in the Issyk-Kul Region designed by the Aga-Khan Development Foundation.

Due to the involvement of private entrepreneurs in tourism, some promotional activities have been carried out in Kyrgyzstan. Existing initiatives on voluntary participation of the tourism sector and NGOs are directed towards development of sustainable tourism and biodiversity conservation. However, main obstacle to successful introduction is a lack of a supporting policy and legal framework complementing the voluntary promotional efforts.

The Government of the Kyrgyz Republic adopted a marketing strategy towards 2010 on sustainable development of the tourism industry called "Hospitable Kyrgyzstan". The master plan aims to develop a marketing strategy for tourism products at foreign markets and improve the image of Kyrgyzstan as a friendly tourist destination (UNPD, Bishkek, 2005).

According to the Centre of Economic Research of the National Academy of Sciences of the Kyrgyz Republic (2007), mountain tourism is one of the successful projects supported by international organizations. The development of international tourism in the country is fast progressing as there is growing interest in adventurous tourism shown by the market's main clients, support by the WTO through the global tour called "Silk Way", cooperation among tourism operators and the public sector, and unique traditions and attributes of the nomadic way of life of the Kyrgyz people. All this will allow to develop mountain tourism and to attract investments that favorably influence the economic efficiency of the tourism industry.

1.8.4 Protected Areas

An important activity in the conservation of biological diversity is the creation of a network of specially protected nature territories. Specially protected nature territories are specific areas, waters (defined areas of water) including nature complexes or separate objects of nature for which the special regime of protection and use shall be established. In the Kyrgyz Republic, the Law on Protected Areas was adopted. It entered into force in May 1994. The Law on Specially Protected Nature Territories defines six types of protected areas: reserves, national nature parks, botanical, zoological, geological and natural areas of public health significance (Table 1). Many of these areas fall into one of three main types of protected areas identified in the international classification system of the World Conservation Union (IUCN), Strict Nature Reserves (Category Ia), National Parks (Category II), and Wildlife/Habitat Reserves (Category IV) (IUCN, 1994).

During the Soviet time, botanical and dendrological gardens had been established for very specific purposes. Some of these areas may be important for the conservation of flora and fauna, but most of them are small and may contain a number of exotic plants for aesthetic reason. Thus, more than half of the designated protected areas in the Kyrgyz Republic do not confirm to IUCN guidelines (1994), but are nonetheless important for the cultural and historical integrity of the country (Heinen *et al.*, 2001).

The system of protected areas of different categories is a basis for biodiversity conservation. In the first place, it should ensure the protection of natural complexes in general, and rare species in particular. In the Kyrgyz Republic, 84 diversity hotspots were included into the protected area network. The establishment of a network of specially protected nature territories was started in 1948 by the creation of the first protected area of Issyk-Kul (total area 19,086 ha) and in 1959 by the creation of the biosphere reserve Sary-Chelek (total area 23,868 ha).

Today, the specially protected nature territories include nine state reserves with a total area of 1,048,512 ha, representing 5.2% of the total territory of the country, as well as one

biosphere territory (4,314,400 ha) including all territories of Issyk-Kul Oblast (UNDP, Bishkek, 2008).

Today's policy is not to increase the number of protected areas but to establish a unified "Environmental Network", main components of which are not withdrawn from the nature management, but combine functions of nature protection and economic development.

Today, the WWF has developed an ecological network of the Central Asian states which helps reconcile nature conservation and economic development. This is achieved by supporting environmental corridors and by creating valuable areas with sustainable alternative land-use and nature management within productive landscapes beyond existing systems of protected areas. In the framework of the project implementation, an approach has been proposed, which included the setting up of environmental corridors between the protected areas along with development of specific environmentally sustainable forms of land-use. To define such areas, a comprehensive analysis of biological diversity and the social-economic situation was conducted (UNDP, Bishkek, 2005).

State reserves shall be created with the purpose of protection and research on the genetics of animals and plants, typical and unique ecological systems and landscapes, the creation of conditions for undisturbed natural processes, and developing the scientific basis for the protection of nature. The following tasks shall be carried out in State reserves:

- Conservation of complex natural ecosystems;
- Conservation and rehabilitation up to an ecologically stable level in terms of number of rare animals and plants, and species of animals and plants under the threat of disappearance, support to maintaining biological diversity;
- Conducting scientific investigations and monitoring of all aspects of the biosphere, preparation of scientifically sound recommendations on improvement of the protection and use of natural ecosystems;
- Assistance in the education of scientific researchers and specialists in the sphere of nature protection and reserve management; and
- Dissemination of ecological knowledge.

Biosphere territories are model regions of sustainable land-use in which - together with the inhabitants living and working there – the concepts of conservation, maintenance and development are being developed and put into action. They can be distinguished from other protected areas by the fact that the people living in the cultural landscapes and their use practices are explicitly part of the biosphere reserve concept. In order to meet nature conservation needs as well as to integrate the use function of the area, four different zones – corresponding to the impact of human activity - are designated in a biosphere territory: core zone; buffer zone; transition area and rehabilitation zone.

In 1998, the entire Issyk-Kul Region has been declared biosphere territory. The total area of the biosphere territory is 4,314,400 ha. In September 2001, the Biosphere Territory "Issyk-Kul" was officially recognized by the UNESCO and has been included into the list of the World Network of Biosphere Reserves.

National nature parks shall be created for the protection of nature complexes which have special ecological, historical-cultural and aesthetic importance, and shall be intended for the use in nature-preservative, recreational, educational, scientific purposes by nature conservation and recreational institutions. The following basic tasks shall be assigned to the national nature parks:

- Protection of standard and unique nature complexes and nature objects;
- Conservation of cultural and nature heritage (archeological, historical, ethnographic and other objects, and also unique landscapes); and
- Ecological education and public awareness.

Within the GEF-UNEP-WWF Project “Creation of the ECONET for the long-term biodiversity conservation within the eco-regions of Central Asia” an environmental network scheme has been developed, which includes the protected area of different categories guaranteeing conservation of the main natural ecosystems and extension of the protected area size to 10% of the total territory of the country. At the moment, the Pamir-Alay transboundary protected territory (Kyrgyz Republic – Tajikistan) is being created. In order to reserve territories of the Kyrgyz Republic having international significance, both the Issyk-Kul Reserve and Isyk-Kul Lake Reserve were included into the list of the International Wetland Ramsar Convention.

The walnut-fruit forest areas of Tien Shan Region were presented to UNESCO for nomination as World Nature and Cultural Heritage by initiative of the State Agency of Environmental Protection and Forestry of the Government of the Kyrgyz Republic (order from 12.04.2007, № 82-p).

Also, the State Reserve “Syrmataash” and National Natural Park “Sarkent” were additionally presented to the Government of the Kyrgyz Republic for inclusion into the list of protected areas in the country.

Table 1: Dynamics of area of special protected natural territories

Special protected natural territories	Area change of special protected natural territories (ha)					
	1990	1995	2000	2005	2007	2008
State reserves	164,857	236,937	236,937	354,760	377,760	377,760
National nature parks	11,172	13,458	23,870	25,920	24,200	24,200
Reserves (zakazniki)	288,900	288,900	251,063	291,017	289,448	289,448
Buffer zones of reserves						139,246
Nature monuments	60	60	60	60	60	60
Total area	464,989	539,355	511,870	905,034	909,265	1,048,512
% cover area of country	2.3	2.6	2.5	4.5	4.6	5.2

1.9. Land-use Pattern

The total area of natural pastures is 9.2 million ha and includes spring-autumn pastures (2.8 million ha) winter pastures (2.4 million ha), and natural hayfields (219,000 ha). By economic activity: pure pastures - 14% of total pasture area, stony pastures - 24%, shrubbery pastures - 12%, weeded - 32%, overgrazed - 18%. Most of the pastures are located in mountain areas forming watersheds of the Aral Sea Basin. Their state has impact on water flow regime and desertification processes in Kyrgyzstan as well as in Central Asia, in general.

Pastures of the Fergana Valley were used in a similar way. At present, the livestock which was considerably reduced during 1990-1995 to a more stable level, is pastured the whole year round on the spring-to-autumn pastures. Therefore, pressure on the spring and autumn

pastures has increased by 5-6 times, resulting in pasture degradation. At the same time, outturn and winter pastures are not used efficiently. Small farms are not able to organize their livestock for moving to remote pastures due to economic problems.

Urban forestry is important for forest-based recreation in and around cities. At present, gardening of cities and inhabited localities is a major element of town planning. Annually, approximately 100 species of trees and bushes are planted on streets, boulevards, gardens and parks. Urban forestry is under the jurisdiction of the city administrations with centers of accomplishment and union of parks.

Roads are the main objects of infrastructure of any country (automobile, railways, etc). Road construction in mountain terrain is often very difficult. According to the Ministry of Transport and Communication, in the Kyrgyz Republic, 97% of all transportation is ensured by motor transport. The general extent of motorways in the country is 18,800 km, of which 5,500 are with asphalt or concrete surface. The transport networks of the Kyrgyz Republic have modern types of transport – railway, automobile and aviation.

Although Kyrgyzstan is a mountainous country, the transport sector has the potential to become an important part of the economy, because of the country's location between Europe and Asia. An increase in the transport volume will have positive effects on other economic sectors and overall GDP (National Academy of Sciences of Kyrgyz Republic, 2007).

2. State of Forests

2.1 Forest Cover

In 2005, the forest cover of the Kyrgyz Republic was estimated at 869,300 ha representing 4.5% of the country's total land area (FAO, 2006). Other wooded lands cover another 312,800 ha (FAO, 2006). Planted forests cover approximately 66,000 ha representing 7.6% of the total forest area (FAO, 2006). The remoteness from human settlements and inaccessibility provide opportunities for forest plantations. Lack of adequate forest management of these plantations resulted in largely over-mature forest stands which are increasingly susceptible to pests and diseases.

Forests are the national wealth of the Kyrgyz Republic. They are all property of the State and in spite of their small size, forests play an important role in the development of the economy and improvement of the environment.

In ecological terms, the Kyrgyz Republic is a very rich country. Although the forest area is rather small, it supports rich floral and faunal diversity. The forests can be grouped into four main types (Musuraliev, 1988):

Walnut-fruit-forests

The walnut-fruit forests of Kyrgyzstan are located on the western and southwestern slopes of the Fergana and Chatkal mountain ridges. These forests represent the biggest remaining area of this particular forest type worldwide and are therefore considered to be of global significance for biodiversity conservation. Walnut-fruit forests play an important protective role, as they protect mountain slopes from erosion, regulate drainage systems, and raise the water level in the rivers.

All walnut-fruit forests of the Kyrgyz Republic are formed by one species of *Juglans regia*, although a significant variety of tree species co-exists in these forests, the most valuable of them being *Juglans regia*. Under the term walnut-fruit forests, a range of forest ecosystems dominated by fruit bearing woody species have been subsumed, including walnut (*Juglans regia* L.), apple (*Malus* spp.), hawthorn (*Crataegus* spp.), plumb (*Prunus* spp.), rose species (*Rosa* spp.) almond (*Prunus amygdalus* Stokes), and pistachio (*Pistacia vera* L.). Forest stands of walnut and accompanying species exist in valleys and on hills in altitudes between 800 and 2,400 m asl, whereas pistachio forests and almond stands grow in dryer, lower parts of the hills.

Long-term forest inventory data revealed that the area of walnut-fruit forests significantly decreased in the period from 1932 to 1966 from 44,000 ha to only 25,700 ha, because of excessive timber felling. Today, the total area is stable at about 40,000 ha.

Spruce forests

Spruce forests have important economic and nature protection values. Located on steep slopes of mountain ridges, they prevent and reduce the severity of erosive processes, such as mud and land slides, regulate mountain rivers and improve water infiltration into the soil.

Spruce forests (*Picea schrenkiana* Fisch. et May.) occur in the west, in the centre of the country and at higher locations of the ranges north of the Fergana Valley, mainly at altitudes between 1,700 and 3,000 m asl. Small areas of stands with the endemic Semenov fir (*Abies semenovii* B. Fedtsch.) can be found in the very west of the country. The main species of spruce forests occurring in the Kyrgyz Republic is *Picea schrenkiana*. In the period 1896 to 1929, the total area of spruce forests amounted to 218,500 ha, and in 1956, it had decreased to 113,200 ha or 46.2%. The reason of this reduction in spruce forests can be attributed to industrial felling whereby 5.95 million m³ of wood was cut. From 1993 to 2003, the total area of spruce forests increased. This trend has continued until reaching the size of 124,100 ha today. This increase has taken place basically because of the establishment of artificial forest plantations and in part it has been due to natural regeneration.

Juniper forests

Archa (Juniper) is the local name of tree and bush forms of the junipers growing in the Central Asian region. Juniper forests, establishing on steep slopes of mountains, play important roles in water regulation and water storage in soils, protect the ground from erosion and counteract formations of mud flows. If unchecked, such events would cause disaster and destruction. In addition, these forests improve water infiltration and thus protect the numerous brooks and large rivers such as the two major waterways of Central Asia - the Syr-Darya and Amu-Darya rivers.

Junipers grow under arid conditions or in very high altitudes up to 3,500 m asl either in the very south of the country or dispersed in small stands in other parts of Kyrgyzstan. These forests are typically open stands, formed by tree and crawling forms of juniper. The dynamics of the juniper forest area over the last 10 years shows an increase, because of transfer of lands to the State Forest Fund and natural regeneration.

Flood Plain Forests

In the mountain regions, flood plain forests are located along the Naryn, Chy, Tup, Talas, Sysamur, Djergalan, Yassu rivers, and many other small rivers, where they play a role in the regulation of water supply and protection against soil erosion. The types of the flood plain forests depend on the environmental conditions and species interactions. They are

composed of various species such as *Populus nigra*, *P. diversifolia*, *Salix alba*, *S. cinerea*, *Eleagnus angustifolia*, *Tamarix laxa*, *Hippophae rhamnoides* and *Ulmus* spp.

In 2003, the State Forest Fund estimated that the flood plain forests were composed of 2,100 ha of *Salix* wood, 24,500 ha of *Salix* shrubs, 7,900 ha of *Populus* spp., and 6,300 ha of *Hippophae* spp. Human pressures have significantly decreased the density of wood in the flood plain forests.

Table 2: Previous and current trends in forests and forestry in the country

No.	The State Forest	1993	1998	2003
1	Total area (Under management of the Forest Fund)	2,861,300	3,163,200	3,321,500
2	Area covered with forests	843,000	849,500	864,900

Note:

- In 2005, the forest cover of the Kyrgyz Republic was estimated at 869,300 ha representing 4.5% of the country's total land area (FAO, 2006).
- Other wooded lands cover another 312,800 ha (FAO, 2006). Planted forests cover approximately 66,000 ha representing 7.6% of the total forest area (FAO, 2006).

National Forest Categories	Area (1000 hectares)		
	1993	1998	2003
Natural forests	793.4	794.1	801.5
• Non-exploitable forest zone	238.0	238.2	240.5
• Forest exploitation zone	555.4	555.9	561.0
Planted forests	49.6	55.4	63.4
• Protective planted forests	29.4	35.7	40.1
• Forest fruits producing stands	20.2	19.7	23.3
Total forest area (natural and planted forests)	843.0	849.5	864.9

2.2 History

Before World War II, the country had around twice the amount of forested area compared to today. The main reasons for the reduction have been unsustainable logging, overgrazing, fuel wood collection, and fires.

Forest resources are very important for the Kyrgyz economy and sustainability of mountain ecosystems. Therefore, since 1948 more than 200,000 ha of forests have been planted throughout the Republic in a concentrated effort to conserve, reforest and expand the nation's forested areas (Table in 2.2.1 on dynamics of forest area).

Government reforestation efforts from 1999 to 2003, the creation of new forests reserve areas, and the transformation of former agricultural lands into State forests have increased the total area of State forest reserves to 259,700 ha. This is augmented by 262,100 ha of national nature parks. In total, 16,400 ha have been reforested from 1998 until 2003.

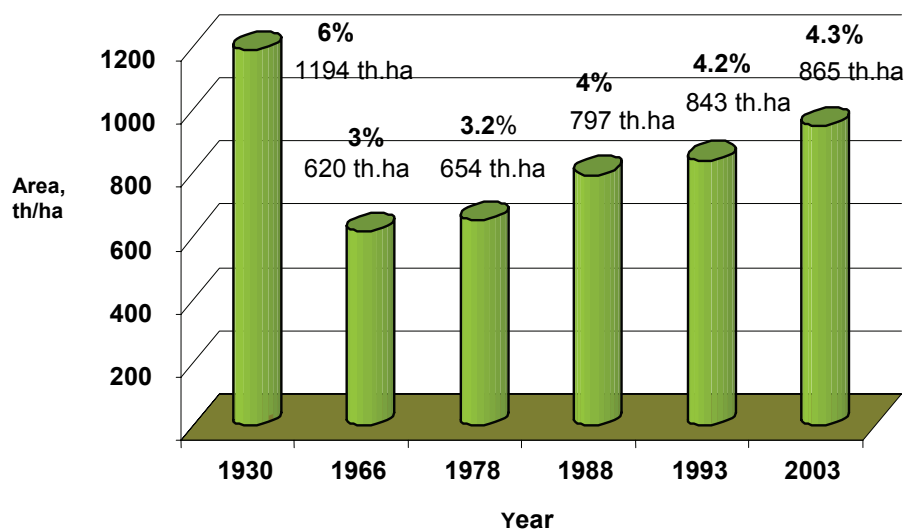


Figure 2: Dynamics of forest cover in Kyrgyzstan from 1930 to 2003

2.3 Forest Biodiversity

The area of the Kyrgyz Republic contains a wealth of biodiversity resources in terms of species, ecosystems and landscapes. Although by land mass a small nation, the country displays a wide variation in elevations and geological formations, leading to a broad range of habitats reflected in a high diversity of species. The ecosystems represented in the country range from high mountains to lowland fertile plains and large fresh water systems.

The ecosystems of the Kyrgyz Republic are of great economic, recreational, aesthetic and functional importance. These ecosystems have a strong spiritual importance for the nation, which has strong traditions regarding the relationship between man and nature.

Biodiversity reproduction capacity depends on the state of natural ecosystems. There are 20 ecosystem classes in Kyrgyzstan including one man-made ecosystem. In general, grass ecosystems are poorer compared to forest ecosystems and they have more endangered species than the forests. Consequences of overgrazing strongly impacted on their ability to maintain a high level of biodiversity on a sustainable basis, in spite of the fact that for 20 years considerable parts have been free of pasturing due to strong reduction in the number of livestock. The most complex coniferous forests among the forest ecosystems are mixed and have less endangered species compared to broad-leaved forests.

Not only do the Central Asian countries share a recent political legacy, watersheds and mountain ranges, but they also share many similar issues and problems regarding nature conservation, environmental protection, rural development and the sustainable use of natural resources.

In Central Asia, a vast and varied region with generally relatively low forest cover, tree species are of great value in defining forest ecosystems and providing resources such as fuelwood, timber, fruits and nuts. In fact, the genetic diversity of fruit and nut trees within the region is of outstanding global significance. The mountains of Central Asia are a recognized

global biodiversity hotspot (Davis *et al.*, 1995), supporting over 300 wild fruit and nut species. These include wild species of apple (four species), almond (8–10 species), cherry (8–10 species), plum (4–5 species), and walnut (one species) as well as many domesticated varieties. The rich diversity of fruit and nut species in the region led the Russian geneticist and plant breeder N.I. Vavilov to propose this area as one of the world's eight centres of crop origin and domestication (Hawkes, 1998).

There are a number of key ecosystems within the Kyrgyz Republic as defined by their rarity, such as walnut-fruit forests. The territory of Kyrgyzstan is characterized by a high level of biodiversity concentration on ecosystem level as well as on species level. Despite its small size, the Kyrgyz Republic is notable for its high concentration of plant and animal species and also good conservation of natural landscapes and ecosystems. Kyrgyzstan possesses 2% of the world's flora and fauna, despite accounting for only 0.03% of its land area. In 2007, the second edition of the Red Data Book of Kyrgyz Republic included 4 fungi species, 83 plant species, one spider species, 17 insect species, 7 fish species, 2 amphibian species, 8 reptile species, 57 bird species, and 23 mammals.

The many wild tree-crop relatives found in these forests are of exceptional commercial importance, yet 11 of these tree species are now critically endangered. Only 30,000 ha of this forest remain, which is less than 5% of its original area. The flora comprises 5,000 species, of which 180 are trees, including many local endemics.

The Kyrgyz Republic ratified the Convention on Biological Diversity in 1996, and in support of its implementation, developed a National Biodiversity Strategy and Action Plan, in which fruit and nut forests are identified as one of two key priorities. The National Biodiversity Strategy and Action Plan note that these forests have declined by 50% in recent decades, as a result of unsustainable land-use practices.

The high diversity of forest types, tree and shrub species points to the significance of Central Asian forests for the conservation of woody biodiversity and to the vital role of forest ecosystems as habitats for flora and fauna to be preserved. A particular feature of forests and woodlands in all parts of Central Asia, is the presence, in some forest types even dominance, of fruit bearing woody species, amongst which also species and relatives of species of eminent commercial interest worldwide, such as apple, pear, pistachio or walnut. The genetic diversity of their wild relatives growing in Central Asian forests is of global importance. The fruit and nut species are wild relatives of domesticated cultivars with exceptional commercial importance. Yet many are now under severe threat of extinction.

These forests are the source of many domesticated fruit and nut trees that are cultivated widely in temperate countries, including apple. The area is referred to as 'Eden' in a recent account (Deakin (2008), 'Wildwood'), reflecting the uniquely high diversity of edible fruit and nut species, together with their extraordinary role in human history and culture, involving dispersal along the Silk Road in antiquity. Many of these species are endangered or vulnerable, particularly wild apricot *Armenica vulgaris* (EN), which is threatened by unsustainable harvesting and over-collection by national and international plant-breeding companies.

Two wild apple species, *Malus niedzwetzkyana* (EN) and *Malus sieversii* (VU) are still found in the fragmented fruit and nut forests of Central Asia and are threatened by habitat degradation, mainly from agricultural development and over-grazing. For walnut, the experts have taken a precautionary approach until further evidence becomes available, because of the global significance of the walnut-fruit forests in Central Asia and their importance as an international genetic resource (Eastwood *et al.*, 2009).

The successful biological conservation of the walnut-fruit forests will require both ecological and biological knowledge of the forest ecosystem and social acceptance and change (Hemery, *et al.*, 1998; Kolov, 1998; McMgranahan, 1998; Musuraliev, 1998; Orozumbekov, 2008).

Table 3: Biodiversity of Kyrgyzstan

Group	World			Kyrgyzstan		
	Number of species in the world	Number of species per 1 thousand km ²	Number of species in country	% of world number of species	Number of species per 1 thousand km ²	Number of species in Red Data List of KR
Ultramicrobe (virus), bacteria, protozoan	5,760	0.011	261	0.05	1.32	4
Inferior plants	73,883	0.145	3,676	4.98	18.57	5 (0.1 %)
Higher plants	248,428	1.666	3,786	1.52	19.12	84 (2.2 %)
Worms	36,200	0.071	1,282	3.54	6.47	0
(<i>Spisula</i>) dipper	50,000	0.098	168	0.34	0.85	0
Arthropods	874,161	5.860	10,242	1.17	51.72	18 (0.2 %)
Fish	19,056	0.041	75	0.39	0.38	7 (9.3 %)
Amphibians	4,184	0.023	4	0.09	0.02	2 (50 %)
Reptiles	6,300	0.047	33	0.52	0.15	8 (24.2 %)
Birds	9,040	0.062	368	4.07	1.86	53 (14.4 %)
Mammals	4,000	0.027	83	2.07	0.44	24 (28.9 %)

Case Study: Community Conservation of the Walnut-Fruit Forests in Kyrgyzstan

Fauna and Flora International (FFI, UK) is working with local partners in Kyrgyzstan to improve the conservation of walnut-fruit forests by promoting the involvement of local communities in forest management.

Threats to forest integrity include: limited natural regeneration because of grazing pressure and hay-making within the forest; illegal cutting of trees and collection of firewood; over-harvesting of fruits and nuts; pests (such as gypsy moth) and disease.

In recent times, local people have had little opportunity to engage in forest management and planning, although they do have access to forest resources through the leasing of forest plots.

These fruit and nut forests are a vital resource for local people, providing fuelwood, food, fodder and grazing for livestock, as well as an important income from the walnut harvest.

The project is initially working in Kara Alma, bringing together community representatives, the local forest service and other stakeholders for open discussions on key issues, resulting in a collaborative conservation management plan for the sustainable use of the forest.

In addition, following a participatory needs assessment, training and essential equipment are being provided to the local forest service to increase their capacity to work with local communities to protect and manage the forest.

Through the provision of small grants and associated training, local people are being supported to adopt environmentally sustainable livelihood options to reduce socio-economic pressures on the forest. These small-scale income generation initiatives have included bee keeping, fruit preservation, and various small workshops.

Liesje Birchenough, Eurasia Programme Manager, Fauna & Flora International

2.4 Ex- and In -Situ Conservation of Endemic Tree Species

One of the main tasks of the countries that joined the Convention on Biological Diversity is the conservation of components of biodiversity in their natural habitat (*in-situ*). For this purpose, it is necessary to expand networks of especially protected natural territories with the new approaches of *in-situ* conservation of biodiversity. For example: creation of biosphere territories, both at national level and as transboundary parks.

Since 1998, in the territory of Kyrgyzstan new methods of *in situ* conservation of biodiversity have been introduced, i.e. creation of biosphere territories. Biosphere territories are model regions of sustainable land-use, in which - together with the inhabitants living and working there - concepts of conservation, maintenance and development are being developed and put into action.

They can be distinguished from other protected areas by the fact that the people living in the cultural landscapes and the use thereof are explicitly part of the biosphere reserve concept. In order to meet the nature conservational needs as well as to integrate the use function of

the area, four different zones – corresponding to the impact of human activity are designated within the biosphere territory: core zone; buffer zone; transition area and rehabilitation zone. The Global Environmental Facility (GEF) Project “*In situ*/on farm agrarian biodiversity conservation (fruit cultures and wild fruit species) in Central Asia” was developed in order to improve partnership among stakeholders and define an optimal and sustainable use of agricultural biodiversity for improved welfare of the rural population.

A review of the status of the region’s botanical gardens, gene bank facilities and ex situ tree collections needs to be undertaken. This should be coupled with a review of the ex situ collections held outside the region. Once the state of these institutions is known, a program of institutional capacity building, possibly with the formation of a regional network of ex situ conservation facilities, should be initiated. Botanical gardens are institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education (Wyse Jackson and Sutherland, 2000). The majority of State conservation agencies and research institutions are severely under-resourced and are unable to conduct baseline surveys, let alone regulate and manage forest resource use. In turn, botanical gardens and germplasm banks lack the staff and basic equipment to maintain globally important ex situ collections of threatened tree species.

Representatives of the 44 threatened tree species not yet conserved in ex situ collections should be established as soon as possible to act as an insurance policy against extinctions in the wild (Eastwood, Lazkov, and Newton 2009). The increasing agricultural lands of the Kyrgyz Republic represent their own contribution to biodiversity, including a variety of races of livestock and cultivated plants. Furthermore, the botanical diversity of the Kyrgyz Republic represents important genetic resources for plant breeding.

As explained earlier in this paper, the walnut-fruits in the southern part of Kyrgyzstan are of global conservation importance and particularly valuable. Their high diversity of fruit- and nut-bearing tree species, including walnut, apple, pistachio, almond, pear, cherries and plums is considered to be one of the main centres of origin for cultivated fruit plants. Thus, this ecosystem represents an extremely valuable “storehouse” of genetic resources.

2.5 Conservation of Wild Apple Populations in Kyrgyzstan

Population of wild apple trees in nut and fruit forests is presented by two forms – *Malus sieversii* and *Malus niedzwetzkyana* with great diversity of forms, including economic value. Fruits of the best forms of the wild apple tree do not yield adequate quality in some regions. The gene pools of wild apple trees can be the basis for formation of winter and drought-resistant eco-types. Unfortunately, presently this unique genetic diversity is under threat of disappearance, caused by the lack of natural seed reproduction, willful economic activity of people, pasture of cattle, lack of protective and regeneration measures. Under such conditions, it is essential to preserve existing diversity in the forests through genetic material in order to derive benefits not only for the sake of natural evolution and provision of consumers, but also for breeders and researchers.

Malus niedzwetzkyana is registered in the Red Book of the Kyrgyz Republic. The amount of apple units and area is being reduced year after year and the plant has almost disappeared. Branches are with dark purple bark. Annual shoots are black. Leaves are close with reddish tint, inversely egg-shaped, elliptical, oblong, and have denticulated margins. Later they become villous only below. Petioles are long, thick and villous. Flowers are purple on thin white felt pedicels. Apples are violet-dark red, with red pulp. Blossoming is in April-May. Trees are with dark purple bark with purple flowers and violet-dark red fruits, spread in Talas, along the Basin of Chatkal River. Many authors think that *Malus niedzwetzkyana* is a form of

Malus sieversii. However, the basis of this taxonomic decision is rather small and suffers from specimen expansion among populations of *Malus sieversii* and also insufficient genetic insurability from the latter. Thus, there is a large variety of intermediates. Further, genetic research is required to clarify whether or not *Malus niedzwetzkyana* is independent of *Malus sieversii*.

Wild stands of apple in Central Asia have received global interest because they represent a reservoir of genetic diversity from which domestic cultivars may be drawn (Miller 2006). The species *Malus sieversii* Lebed is native to Central Asia and has been recognized as a major progenitor of the domesticated apple, *M. x domestica* Borkh. It is likely that, in ancient times, apple seeds and trees were transported from Central Asia into both China to the East and to Europe to the West through the Silk Route (Forsline *et al.*, 2003). Phylogenetic studies show that wild apple (*Malus sieversii*) from Central Asia is quite similar to domesticated apples, and that several other *Malus* species are nearly indistinguishable (Juniper, 2007). Another important Central Asian apple species is *Malus niedzwetskayana* which is considered an endangered species. Because of the potential importance of *M. niedzwetskyana* as a genetic resource, it is paramount to preserve it and other wild apple species from Central Asia.

In Kyrgyzstan, *Malus* species is mainly spread in Chatkal mountain range (Sary-Chelek reserve, gorge rivers- Karasu and Aflatun), and the Fergana mountain range (tracts - Ak-Terek-Gava, Kara-Alma and so on). In Kazakhstan, it can be found in the Syrdaria Karatau mountain range (Berkara gorge), western spurs of Talas mountain range (mountains – Daubaba and Mashat), and Zailiiskii Alatau mountain range. In Uzbekistan, it is present in the Kuraminskii, Ugamskii, and Pskemskii mountain ranges. Outside the former USSR, it has been identified in Western China (Sintszjan). The apple species is registered in different Red Books, such as the Red Book of the USSR (1978), the Red Book of Kazakh SSR (1981), the Red Book of the Kyrgyz SSR, in 1985 as well as in 2007. For long-term conservation purposes, it is necessary to establish a reproduction farm for cultivating and regenerating the existing varieties of apple.

Case Study: Conserving Eden: Participatory Forest Management in the Tien Shan Region - a Project Funded by the Darwin Initiative (2009 – 2012)

This project will comprise the following activities:

Institutional capacity building. Capacity to undertake research is currently limited in Kyrgyzstan, because of a lack of financial and institutional support. This will be addressed through a programme of institutional strengthening, and through a programme of collaborative research, detailed below, involving partners from the UK and Kyrgyzstan.

Training. Training will be provided on forest survey techniques, monitoring and participatory management approaches, both in the UK and in Kyrgyzstan.

Research. A collaborative research programme will be developed focusing on the sustainable management of fruit and nut forests. This will be achieved by a field survey supported by forest simulation modelling, to identify sustainable harvesting thresholds and management recommendations.

Outreach. Results of the research will be used to develop plans for sustainable management of fruit and nut forests; and (ii) to identify implications for policy-makers at both local and national scales, to support the sustainable management of fruit and nut forests.

The project will also provide: a community outreach programme to be developed in the study area, to raise awareness of the need for sustainable land-use practices; a workshop supported by policy briefs to present policy recommendations to relevant stakeholders, including national government agencies and CBD national focal point; an interpretation facility at the national Botanic Gardens, supported by a campaign in the national media, with the aim of raising public awareness of the national and international importance of fruit and nut forests; scientific publications.

The project will be aimed directly at implementing the ecosystem approach, by supporting the development of forest management strategies that promote conservation and sustainable use in an equitable way. The integral role of humans in these ecosystems will be addressed through the development of participatory management approaches.

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2.6 Forest Tenure, Legislation and Policy

The forests of the Kyrgyz Republic are the property of the State and form a unified State Forest Fund (hereinafter SFF). According to the Decree of the Government №315 dated July 3, 1960, the forests have been attributed to the first group, and the Forest Code of 1999 has assigned to them full nature protection status pursuing mainly ecological, sanitary and hygienic functions and other protective purposes with prohibition of industrial wood production.

In the case of pastures outside of forest farms (leshoze), rights of use are granted in the form of leases, for which fees are collected by the village government (Ail Okmot) and shared with the regional (Rayon or Oblast) authorities (Brylski *et al.*, 2001). The leases for pastures are typically annual, but can also be of longer term (ibid). In the case of forests and pastures

within leshozes, the leshoz is responsible for management and can allow access through sub-leases.

Leases within leshozes are also provided for farming plots. Again, the lease period is variable, and there are now a number of different types of leases, and a variety of arrangements apply. For example, in the leshozes with walnut-fruit forests, leases allow people to collect a certain amount of fuel wood, to obtain agricultural plots, to collect hay or to harvest walnuts or fruits for sale. In exchange for access to forest resources, they are usually expected to pay a share of the walnut harvest (40-70%), a set amount of walnuts depending on the size of the family (100-400 kg), payment in cash, or carry out certain tasks for the leshoze, such as collecting seeds or preparing and planting of seedlings. In some cases, in exchange for labour implemented for the leshoze, a person can use forest resources free of charge (Fisher *et al.*, 2004).

Current legislature related to forest preservation and use in the Kyrgyz Republic contains the following components:

The Constitution of Kyrgyz Republic is the highest legal form where values, institutes and norms of constitutional formation and bases of State-legal regulations of qualitative social communications and attitudes of the State to power are officially established. The Code is a law containing all or a general mass of norms regulating a certain area of social relations in detail. In the Kyrgyz Republic, there are five codes including the Forest Code which establish the legal basis of rational use, preservation, defense and reproduction of forests and increase of their ecological and resource potential. In 1993, the first Forest Code was adopted, in 1999, alterations and additions were included and at present it is undergoing revision.

The Law is a legislative act adopted by Chambers of Jogorku Kenesh of the Kyrgyz Republic according to established procedures or by referendum and it regulates the most important issues of public and social activity. Aiming at the improvement of ecological conditions in the Kyrgyz Republic, the government established the National Program "LES" for the period 1995-2000. The focus of this program is on the preservation of forests, wild animals and plants, increase in the forest cover and specially protected territories, greening of cities, roads, channels and other economic objects. The program features the following four sections:

- Goal and tasks of the National Program "LES".
- The basic directions of radical improvement of reproduction and a qualitative condition of forests (forest recover, protective forest growing, forest planting, measures of assistance to natural reforestation, cultivation of planting material, forest-seed economy, forest management planning, etc.)
- Specially protected natural territories of the Kyrgyz Republic and the organization of a new natural reserve and national natural parks.
- Establishing parks in cities and settlements, creating of green space along roads and water ways and lakes, in schools, hospitals and other objects.

The implementation plan of the National Program "LES" for 1995 contains detailed and concrete actions. For example, 185 ha of poplar plantations are to be established, 61 ha of willow plantations, 200 ha of industrial plantations of walnut and 100 ha of industrial plantations of pistachio. Because during plan implementation the principles of central governance of the Soviet Union were still in place, the project received full funding from the State budget. An evaluation of the period 1995 – 2000 revealed satisfactory results.

The new national forest policy completed in 1998, takes into account the extremely important hydrological, soil-protective, water-security functions that also regulate the climate, improve sanitary and hygienic conditions and improve the role and value of forests for the people of Kyrgyzstan and its future generations. In this Decree, it is stipulated that new and more specific national forest policy guidelines be developed, providing the basis for preservation, dynamical augmentation, rational use of forests and steady development of the forestry sector. This concerns also the improvement of the ecological conditions of the environment and protection of the unique natural heritage of Kyrgyzstan for the period 2000-2005. The forest policy includes the following components:

- The Concept which determines the main strategic directions;
- The Forest Code and the environmental legislation which defines the legal frameworks of the forest policy (1999);
- The National Forest Program which defines a complex of activities and measures on implementation of the Concept (2005-2015); and
- The Five-Year Action Plan which provides concrete activities for implementation of the National Forest Program (2006-2010).

Overall, the forest policy is directed towards the sustainable management of forests, improvement of the organization of forestry, involvement of people and local communities in the development of forestry, development of cooperation among private businesses in forestry, and the definition of the role of the State in the forest sector.

Thus, the contemporary national forest policy is aimed at the systematic consideration of the forest problems and ensuring of transition from the use of forest resources to efficient management of forests with the purpose of conservation and augmentation of the national forest wealth.

2.7 Forest Administration and Management

2.7.1 Forest administration

The State Agency of Environmental Protection and Forestry under the Government of the Kyrgyz Republic is in-charge of the management of forests. The agency implements the country's forest policy through the following activities:

- Management and protection of all lands under the forest fund;
- Reproduction of trees and other flora for regenerating various natural ecosystems;
- Development of hunting farm facilities and their use;
- Development of the special protected natural territories and conservation of biodiversity; and
- Protection, reproduction, control of the use of wild animals and their habitat.

The State Agency of Environmental Protection and Forestry includes the Department of Hunting Control, Department of Forest Ecosystem Development which includes the territorial department of development of walnut fruit forest ecosystems in Jalal-Abad regions, 42 territorial *leshozes* (i.e. forest farms, forest hunting farms, forest ranges, forest nurseries, forest protection station), 9 State reserves, 8 national parks, the Biosphere Territory "Issyk-Kul", Department for Forest and Hunting Inventory, the Fund of Nature Protection and Forest Sector Development.

The Department of Hunting Control is a Division of the State Agency of Environmental Protection and Forestry exercising State control in the sphere of hunting management, conservation, hunting resources utilization and reproduction, wild animal habitat conservation, as well as favoring comprehensive development of sportive-amateur hunting and hunting tourism in the Kyrgyz Republic.

The Department of Forest Ecosystem Development is also a division of the State Agency of Environmental Protection and Forestry. The department controls and guides the work in the field of conservation and development of forest ecosystems and the sustainable management of forests in the Territory of the Kyrgyz Republic.

The Department for Forest and Hunting Inventory is a division of the State Agency of Environmental Protection and Forestry and is in-charge of monitoring of forest resources (e.g. forest cover, age class distribution, stocking, density of plantings, etc.), and hunting resources on the lands of the hunting fund. It also provides directives on forest management such as type of plantings for forest plantation establishment, felling operations and implementation of biotechnical control methods, etc.

The Fund of Nature Protection and Forest Sector Development operates under the State Agency of Environmental Protection and Forestry and receives its financial resources from State budgets, local funds for nature protection and the forest development fund. The agency provides funding for nature protection activities including improvement of the condition and facilities for environmental protection, securing of ecological safety, development of new systems for environmental protection and forestry, as well as environmental education and public awareness.

The Territorial Department of Development of Walnut-Fruit Forest Ecosystems in the Jalal-Abad Region is a division of the Department of Forest Ecosystem Development and carries out management functions and coordination of forest sector activities in the area of Jalal-Abad.

The Territorial Forestry Enterprises (Ieshozes) are the main component of the regional forest service and exercise territorial State control within the forest sector. Forestry enterprises are legal bodies with full economic and financial independence.

State Reserves have been created with the purpose of protection and study of genetic resources of animals and plants, typical and unique ecological systems and landscapes, creation of conditions for undisturbed flow of natural processes, working out of scientific grounds of protection of nature and represent the nature-preservative and scientific research institutions. State reserves are structural divisions of the State Agency of Environmental Protection and Forestry and have juridical power with full economic and financial independence.

The State Nature National Parks have been created for the protection of nature complexes which have special ecological, historical-cultural and aesthetic importance. They are nature conservation and recreational institutions also with educational and scientific purposes. The national nature parks operate under the State Agency of Environmental Protection and Forestry and have juridical power with full economic and financial independence,

Biosphere Territories are model regions of sustainable land-use in which - together with the inhabitants living and working there – the concepts of conservation, maintenance and development works are being tested and put into action. They can be distinguished from other protected areas by the fact that the people living in the cultural landscapes and their use practices are explicitly part of the biosphere reserve concept. The Issyk-Kul Region is

recognized by UNESCO as main biosphere territory in the country as already mentioned in Chapter 1.8.4

2.7.2 Forest management

Forest management in Kyrgyzstan is largely based on the Soviet approach, as many concepts and practices that had evolved prior to independence are still followed. The concept of the “State Forest Fund” (Goslesfund – the land managed by State forest authorities) developed under the Soviet Union has not changed (FAO, 2007).

Forests of the Kyrgyz Republic are basically located in the vicinity of rural settlements where more than 60% of the population lives. After disintegration of the USSR, the life of the population has considerably worsened in the countryside. The recession of the economy and its unstable development had largely negative effects at all levels of society, particularly for the poorest population. As a result, more than half of the rural population lives under the poverty line. In order to address this, the State Agency of Environmental Protection and Forestry has developed a number of legal tools directed towards reorganization of forestry and attracting rural people living on the State forest fund territory to forest management. An important component in these efforts is the delegation of forest management to local government, providing more employment in the countryside, better income and food security as well as strengthening weak social groups such as women and very poor people.

Since the 1930s, field-level management of forests has been undertaken by State forest farms (leshozes), with some forests allocated to collective farms (kolhozes) and State farms (sovhozes). In 1943, a forest classification system grouped forests of the former Soviet Union into three categories:

- Group I forests: State forest nurseries, protective forests, (e.g. shelterbelts, and green zones), steppe forests, national parks, State reserves, etc. Location: predominant in the central and southern regions of the Soviet Union. Logging restriction: clear cutting prohibited, restricted felling (e.g. regeneration felling, silvicultural thinning, selective cutting of over-mature trees).
- Group II forests: Forests of sparsely forested areas (forest steppes), forests belonging to collective farms, forests in populated areas, etc. Location: central region of the Soviet Union. Logging restrictions: principally clear cutting, without exceeding the annual growth.
- Group III forests: All other exploitable forests. Location: northern regions of the European part, Taiga zone, Siberia, Far East.

Group I forests were primarily designated for environmental protection and most of forests in Central Asia were placed under this category, especially the forests of the Kyrgyz Republic. This classification resulted in improved protection and increased investments in afforestation. Kyrgyzstan is in the forefront of adopting participatory approaches and introduced Collaborative Forest Management (CFM) in 1998. CFM in the Kyrgyz Republic has its origin in an international seminar on walnut-fruit forests held in Arstanbap-Ata forest farm amidst the walnut-fruit forest in September 1995 (Blaser *et al.*, 1998). However, the area with community involvement remains very limited (FAO, 2007). The need to establish new forest resources management approaches is justified by the real ecological situation and dynamics of socio-economic developments in the country. According to Carter (2003), the basic concept behind Collaborative Forest Management is “a working partnership between the key stakeholders in the management of a given forest, in particular the immediate, local users and the relevant forest authorities.” In CFM, local individuals take responsibility for the management of a forest plot, performing certain forest activities in return for permitted forest

harvests (mainly of walnuts and other fruits) as well as dead wood for fuel (as felling trees for timber is not allowed).

The Forest Code of the Kyrgyz Republic does not completely take into consideration the aspects of the new national forest policy, and thus the existing legislation does not fully meet the requirements of changing national conditions. A State program, entitled "Forest" sets out necessary tasks and activities for the implementation of the concept of forest development but does not take into account possible changes to forest conditions because top-down planning procedures have not allowed for sufficiently flexible regulations. The peculiarities of the forest sector are not always considered by the main normative and legislative documents.

In Kyrgyzstan, the impact of local populations on forests has increased due to economic instability. Moreover, relations between the State Agency of Environmental Protection and forestry staff, local populations, and local authorities are not particularly strong, which sometimes leads to conflicts. Furthermore, coordination between the State Agency and other ministries and organizations needs improvement. Despite the fact that the area of cultivated forest is currently expanding, the safekeeping, tending and monitoring of forests must be also improved.

Today, the centralized forest governance system is not able to assure full sustainability of forest ecosystem development. That is why involvement of local communities in sustainable forest management is the only managerial alternative which will allow conserving forests. However, besides this approach, State forest farms (leshozes) use several other management approaches to involve local population into the forest sector through leasing forest plots for use (KIRFOR, 2009).

Poverty alleviation and environmental sustainability are important development goals for the countries (UNDP, 2003). These goals are found in one of the main strategies of the Kyrgyz Forestry Sector Development as well as in the Collaborative Forest Management Programme (Goslesfond, 2004; Intercooperation (IC), 2007). Even though, these strategies are clearly mentioned at a decision-making level, a contribution of them among different stakeholders and institutions is insufficiently recognized. Due to this reason, the progress of development towards sustainable forest management is limited and will only improve if the contribution of stakeholders to sustain forest resources is recognized.

The recently developed concept of Joint Forest Management (JFM) is defining frames for forest collaboration to introduce integrated management. Regional differences in forests and needs of the local population are considered by providing for flexibility in the participation of local communities in forest management.

3. Forest Degradation

The socio-economic transition processes are intimately connected with changing land-use systems and often forest degradation.

Forest degradation in the Kyrgyz Republic is defined as follows: "Gradual loss of viability and dying off of the forests as a result of deterioration of the ecological condition of the forest environment under influence of anthropogenic or natural factors" (Terminological Glossary, 2002). The creation of a centralized control system resulted in the disempowerment of rural populations - thereby losing valuable knowledge about local forest ecological conditions and applied technologies with exclusion of stakeholders for ensuring sustainability - and in a fundamental change in their style of livelihoods and forest resource use (e.g. the sedentarisation of nomads and expropriation of farmers).

Today, forestry has to accommodate a changing administrative and economic environment. The recent changes have withdrawn the previous centralized institutional support and control without yet developing an alternative system and approach to replace it. Unlike agricultural land, State forest land has not been distributed to private individuals, and officially remains the property and responsibility of the State. Forests in the Kyrgyz Republic form a unified State Forest Fund, which comprises both forested areas and lands which are not covered with forests but intended for forestry purposes. Besides certain specified areas of production, Kyrgyzstan's function in the command economy of the Soviet Union was mainly characterized by the production of meat while utilizing abundantly available natural resources in the form of grazing grounds (Schmidt, 2001).

Obviously, the transition to an independent State was accompanied by several so far inexperienced side-effects:

- The State has to rely mainly on its own resources and expertise in running the State economy and managing the available natural resources.
- Despite a decrease of livestock numbers, the pressure on natural resources intensified. This on first sight paradox observation can only be explained by a growing pressure on natural resources due to an increase of subsistence-oriented survival strategies.
- Lack of experience of farmer-led resource management after 70 years of Soviet rule created a socio-political environment in which control mechanisms, power relations and access rights are not yet defined in a manner which seems to find a consensual balance and to become sustainable.

3.1 Causes of Forest Degradation

The main negative factors affecting on ecological and resource potential of forests in the Kyrgyz Republic are fires, illegal felling, pests and diseases. It is necessary to elaborate the program of international cooperation on forest fires and the foundation of the regional network for Central Asian countries, since all these countries relate to sparsely wooded territories and international technical assistance in infrastructure development and improvement of the material base for fire protection is necessary. The elaboration of the system of control on illegal felling and creation of the system of forest disease monitoring is also needed.

Since 1994, the forest sector of the country has undergone four transformations. As for the Kyrgyz Republic with a low forested territory, such constant reformations negatively affect the sustainable development of the sector. Therefore, close cooperation with interested structures in the country, expansion of international cooperation and further international technical assistance is required for the preservation of an independent status of the forest sector. The First Regional Forest Congress (Bishkek, 2004) positively evaluated forest policy development in Kyrgyzstan and noted that international technical assistance in this further development might be a model for Central Asian countries (State Forest Service, Bishkek, 2004).

Overexploitations in the first half of the century coupled with overharvesting, overgrazing and insufficient silvicultural treatment have shaped the present-day appearance of forests (cf. Scheuber *et al.*, 2000a; Müller & Sorg, 2001). Suffering great damage from human activities in the area, the maintenance of the manifold functions of the forests is seriously threatened and even their existence is at risk, despite decades of efforts into their conservation (Ministry

of Environmental Protection, 1998). Problems presently exerting heavy pressure on these forests can be summarized as follows:

Grazing with cattle, sheep and goat is taking place almost everywhere in the walnut-fruit forests, obviously nearly completely destroying young growth of trees and most shrub vegetation, including walnut, apple, cherry, plum, and other valuable species. According to Musuraliev (1998), forest grazing has already caused extensive degradation in large areas. Although livestock numbers decreased significantly in recent years (Yunusova *et al.*, 2000; Schmidt, 2001), grazing still seems to be the prime cause preventing natural regeneration. Seedlings and saplings are only to be found in places inaccessible to livestock.

Grazing pressure is extraordinarily high in areas close to human settlements and in spring and autumn, when alpine pastures are snow-covered, but the forests can be grazed. As a result, most of the forests have become secondary vegetation, consisting mainly of unpalatable shrub species, with a high percentage of inedible herbs (Sherbinina, 1998).

Hay-making is conducted nearly everywhere by enterprises, peasant farms, local people and even foresters themselves. Since animal husbandry is an important constituent of the newly revived subsistence economy, local people depend on a sufficient hay supply. Hay-making, mainly carried out in the forests, obviously results in the destruction of the natural regeneration of nearly all tree and shrub vegetation (Blaser *et al.*, 1998).

Since collecting of nuts and fruit has an immense and growing economic importance for the households in the region and a harvest is to be expected only every third year, virtually 100% harvesting of nuts takes place, rendering natural regeneration impossible (Blaser *et al.*, 1998; Musuraliev, 1998; Hemery, 1998).

The mountain forests have been exploited for timber, fuel wood, and, in particular, charcoal since ancient times. Whereas coniferous forests were predominantly utilized for construction timber, pistachio wood was the main raw material for charcoal production. Walnut stands were exploited for their valuable burrs, and also for firewood. In recent years, illegal cutting of firewood and illegal felling of trees has increased due to the energy crisis and high fuel prices. Also, uncoordinated commercial timber harvesting increased due to growing demand (Musuraliev, 1998).

After the collapse of the Soviet Union many changes occurred in the forests with impact on local populations and landscapes. Changes in employment resulted in more people becoming dependent on agriculture and harvesting natural resources for their daily needs as well as for providing income. The reduced ability to protect the forests from pests and diseases and overuse due to lack of financial resources has caused considerable negative impact on the local economy. As a particular result of the transition process, a currently unsustainable use of forest resources, widespread forest degradation and biodiversity erosion are to be lamented.

Forest fires occur as unguided (spontaneous) events (burning) in territories of the State Forest Fund, including forest and non forest lands. For the last 10 years, the number of fires changed from 1 up to 42 cases, and the general burnt area from 48 ha to 7,799 ha of forest areas. Illegal felling is defined as cutting of trees without the corresponding sanction or with infringement of its conditions (felling of a greater number of trees, other species, in other places, etc.).

In fact, forest protection is a major priority in the Forestry Development Program in the Kyrgyz Republic. During recent years, there have been many changes in walnut-fruit forests due to anthropogenic disturbances, resulting in significant impacts to this vital resource. Moreover, in recent years, the population has become more dependent on the natural

resources for dietary needs and income, causing an increase in the harvesting of walnut-fruit forests.

In addition, there has been a decrease in the ability to protect these walnut-fruit forests from pests and diseases due to a lack of financial resources. Due to the uniqueness and regional importance of the walnut-fruit forests, there is a need to develop a comprehensive pest management strategy and control of forest pests in the Kyrgyz Republic.

The implementation of policies relating to forest health and protection requires improvement of the forest sector activities in the Kyrgyz Republic. A new central unit should be established to deal with monitoring methodology. Given the information above, the fruit-nut forests of Kyrgyzstan are a unique biological community but are threatened in many ways. Adding to the problems facing these walnut and fruit forests, there has been a sustained outbreak of the gypsy moth (*Lymantria dispar* L.) (Orozumbekov *et al.*, 2003, Orozumbekov *et al.*, 2009) and other alien invasive species in the forests (*Sphaerolecanium prunastri*, *Diaspidiotus perniciosus*, *Pseudococcus Comstocki*, *Hyphantria cunea* and new quarantine species on pine plantations - *Monochamus galloprovincialis*). They are the main focus of forest protection in Kyrgyz Republic.

Defoliation of the walnut-fruit forests has significantly decreased the harvest of cash crops such as pistachio, walnut and apple resulting in major economic losses. Since these forests are also important for watershed protection, such damage also presents significant environmental problems. The species of moth can occur at low population levels in forests for many years without causing significant damage. However, at times, there are significant outbreaks that cause severe defoliation of trees, which can cause massive tree mortality. Frequently, outbreaks coincide with periods when the trees are under stress.

3.2 Gypsy Moth in the Walnut-Fruit Forests (*Lymantria dispar* L.)

The gypsy moth is widely distributed throughout Asia. Across the region, populations utilize a slightly broader range of tree species, and outbreaks are common in many areas. In contrast, relatively little information exists about populations in Central Asia. Therefore, only an introductory description is given here about the occurrence of the moth in a variety of landscapes of Central Asian countries, mostly focusing on damages inflicted on the unique walnut-fruit forests in the Kyrgyz Republic (Orozumbekov *et al.*, 2003). While the biology of the gypsy moth resembles that in many other areas, there are certain aspects that differ in fundamental ways from other regions.

The gypsy moth population is isolated from other Euroasian gypsy moth populations by deserts to the north, spruce forests in Tien-Shan to the northeast and east, and the Caspian Sea to the west. There may be significant reproductive isolation among populations that are geographically separated by high mountains. Little is known about the distribution of the gypsy moth to the south of Central Asia in Pakistan, but it is likely that the population continues its distribution in high mountain valleys ultimately integrating with *Lymantria obfuscata* in India, Pakistan and Afghanistan (Pogue *et al.*, 2007). Through most of the gypsy moth range in Europe, Asia and North America, its primary hosts are *Quercus*, *Populus* and *Larix*. In Central Asia, none of these hosts grow naturally but it is common in other hosts like *Pistacia*, *Malus* and *Juglans*.

In naturally regenerating forests of the Kyrgyz Republic, the gypsy moth attacks pistachio, walnut, apple and hawthorn trees and in planted forests it is known to infest walnut, apple and hawthorn trees. The larvae of this moth are defoliating large areas of the walnut-fruit

forest stands, annually. Since the early 1980s the annual area affected by moth outbreaks has ranged from 10,000 to 52,000 ha (Ashimov, 1989; Orozumbekov, 2003).

In the forests of Kazakhstan gypsy moth outbreaks occur in intervals of 8-10 years, but this does not seem to be the case with gypsy moth outbreaks in walnut-fruit forests of Kyrgyzstan where there has been an epidemic outbreak for over 30-35 years (Gninenko, 1986; Orozumbekov *et al.*, 2003). Thus, this complicated situation requires more study of the ecology of the gypsy moth and characteristics of outbreaks in the walnut-fruit forests of Central Asia.

3.3 Impacts of Forest Degradation and Loss

Forests are exposed to internal and external factors which lead to degradation and loss. The exact loss of forests is unknown as statistics are not available. The remaining forests are typically used for collecting firewood and grazing of livestock in spring and autumn, before going to and after returning from the summer pastures (Fisher *et al.*, 2004).

Scientific studies on changes in the forest sector have shown that the main negative factors affecting forests and the forest sector are forest fires, illegal felling, pests and diseases. The main external factors which can lead to significant changes in forest conditions are as follows:

- Demographic changes;
- Social changes;
- Economic changes;
- Environmental factors; and
- Political and institutional changes.

In some areas of the flood-plain forests where human settlements are located close to the forest (such as in the Talas Region), the forests are under high pressure because of illegal cutting of firewood. Where the forests contain dense bushes, firewood is the main product. Other products collected in the riverside forests, both for self-consumption and for sale, include berries, mushrooms and medicinal plants (Roth and Murzakmatova, 2003). In more open areas the land is intensively used for both legal and illegal grazing.

The juniper forests are located on the higher mountain slopes, and far away from permanent settlements. These forests play a role in the household economy of rural people only a few months per year, when people temporarily reside in the jaiлоos (high summer pastures). The use of trees and timber is strictly prohibited, but people collect dry branches for firewood and graze cattle in the open juniper stands. Medicinal herbs, various berries and mushrooms are collected mainly for local use (Roth and Murzakmatova, 2003), although marketing prospects are developing in some areas. In the longer term, the local population who will participate in the elaboration of the new Integrated Management Plans (IMP), together with other local stakeholders, are intended to benefit from improved management of these forests and their increased involvement in forest management will be promoted by this project (Chorfi, 2004, EU Project on Integrated Management Plan in the Juniper Forests 2004-2006).

Spruce forests are in an intermediate position between the walnut-fruit forests and the juniper forests in terms of playing a role in people's livelihoods. The forests are at intermediate distance from villages, and people can relatively easily collect firewood. The most important source of income from the spruce forests is the timber. However, so far, this has never been

accessible to the local people. Harvesting and selling of round timber has been exclusively in the hands of the forest farms (Ieshozes) (Fisher *et al.*, 2003).

Cattle grazing and hay making in walnut forests are major obstacles to the regeneration of walnut stands. Seedlings and young shoots of saplings are preferentially browsed. Moreover, grazing leads to the compaction of loess soils and is harmful to the uppermost root layers, particularly in spring, when soil water content is high. Soil compaction results in increased surface runoff. Under drier conditions during summer, forest soils are less susceptible to compaction by grazing animals. Forested areas that are used for hay making have increased in recent years. An extension of hay meadows is equivalent to a reduction of stand densities and forest areas.

3.4 Forest Utilization

A long term continuation of the presently high utilization intensity would seriously threaten the maintenance of the manifold functions of the unique and global important walnut-fruit forests and would even put their existence at risk. On the other hand, the local rural population depends on the use of the forests for their livelihood. A pressing problem in recent years in the walnut-fruit forests has been the increasing use of firewood by local people. It presently concentrates on deadwood as well as on the shrub layer and on small trees. From year to year, longer distances to collect firewood have to be covered. Wood of *Prunus*, *Crataegus*, *Acer*, and *Malus* is primarily used as firewood.

At present, timber harvesting in walnut stands is not carried out on a large scale. However, there is a growing international demand for valuable burls (in Russian “kap”) and for root wood. After having removed the root wood and burls, the production of coppice shoots is no longer possible. Cutting of walnut trees often contradicts the interests of local people who depend on nut harvesting (Kyrgyz-German VW Project 2003-2005; Schmidt, 2005).

4. Forest Rehabilitation

4.1 Targets of Forest Rehabilitation

The Ministry of Forestry (later transformed into the State Agency of Environmental Protection and Forestry) was created in 1947. One of its central tasks has been to enact measures that would restore forest areas that were depleted in the 1930s and 1940s, during which time almost 7 million m³ of timber and firewood were harvested.

Unsustainable and destructive logging during this period gave rise to severe soil erosion, destruction of natural reforestation processes, impairing the protective function of forests and the watershed balance. During this time, natural reforestation processes were also disrupted by constant grazing of livestock in fresh clear-cuts. However, since 1948, more than 200,000 ha of forests have been planted throughout the Kyrgyz Republic in a concentrated effort to conserve, reforest, and expand the nation's forested areas. From 1930 to 1966, the forest area decreased to 2.9% or 574,200 ha mainly because continuous logging led to forest degradation. In contrast, from 1966 to 2000, the forest area increased by 1.2% or 245,100 ha as a result of stopping regular logging, natural regeneration of forests and tree planting.

The Forestry Code of the Kyrgyz Republic of 1999 provides the forests with an exceptional protection status assigning them mainly soil-protecting, water-protecting, ecological, health,

sanitary, and other similar functions. Industrial logging is prohibited. The forests of the Kyrgyz Republic are State property and form a unified State Forestry Fund (SFF) which includes forests and lands that are not covered with forest but earmarked for future forestry activities.

In 2003, the total area of the State Forest Fund lands was reported to be 3.3 million ha. Forests cover 4.3% or 865,000 ha of the territory of the Kyrgyz Republic. Nevertheless, the Government's efforts to develop forests in Kyrgyzstan are insufficient. Availability of sufficient financial resources is a major impediment to reforestation and restoration. Preliminary estimations which take into account the situation of mountainous forests in Kyrgyzstan and interests of various economic sectors of the country (i.e. agricultural sector) show that the area should be raised up to 6.0% (1194.0 thousand ha) in 2025 from a level of 4.3% (864.9 thousand ha)(National Forest Program for 2005 - 2015., Bishkek, 2004).

4.2 National Policy Program on Forest Rehabilitation

One of the most important priorities of the State Policy Program is the profound reorganization and improvement of forest management for the purpose of pursuing an efficient policy of sustainable economic development of the State.

The process of a new national forest policy working partnership based on the participation of all stakeholders (forest governance, bodies, research, local communities, private sector and civil society) was the main approach in sector policy development. The National Action Plan provides for the annual potential possibilities of forest farms (leshozes) with regards to rehabilitation of field protection through shelterbelts, forest stands protecting against soil erosion, and afforestation activities outside the State Forest Fund. Forest farms (lezhozes) will carry out the rehabilitation work based on projects and agreements submitted by land owners.

The Action Plan also calls for the development of a new National Forest Policy ensuring the establishment of the necessary conditions for conservation, reproduction, rehabilitation, sustainable use and development of the forest sector in the period 2000-2005. The contemporary forest policy is aimed at the transition from the use of forest resources to efficient management of forests. For that, it is necessary to reconsider the system of forest management as a whole, in terms of its various ecological, social and economic functions.

With regard to forest rehabilitation, the Forest Code (1999) contains a separate section which is dedicated to forest rehabilitation and afforestation called "Reproduction of Forests".

Article 91 on forest rehabilitation includes the following main aspects:

As stipulated in Article 91 of the Forest Code, forest rehabilitation is to be carried out on land of the forest fund observance with the following requirements:

1. Compulsory reforestation of land after felling; reforestation should concentrate on valuable tree species
2. Lands not covered by trees and bushes need to be rehabilitated
3. Improvement of the composition of tree species and increase of forest productivity, protection and environmental functions
4. Conservation of genetic resources and forest biodiversity

Article 92. Afforestation:

Afforestation should be carried out on non-forest lands of the forest fund and other lands for

the purpose of increasing the forest cover of the Kyrgyz Republic and as a means to prevent soil erosion and improve the overall ecological conditions of the land. Afforestation works will be carried out by special programs and projects established by the authorized forest department.

4.3 Methods of Forest Rehabilitation

Forest rehabilitation methods mainly involve silvicultural practices. Silviculture is a complex discipline and requires sound ecological and technical knowledge. The main objective of silviculture is to timely and properly harvest and restore economically valuable forest stands after felling, or on areas damaged by fire or where no trees have grown for many decades.

Forest rehabilitation is guided by the following main criteria:

1. Forestry aspects: management objectives of forests, range of available forest species and their site requirements and the forest fund category;
2. Economy aspects: available manpower and expertise, financial possibilities of forest farms (leshozes) and cost of work; and
3. Social aspects: local population needs and reduction of impact on the forest, etc.

Forest rehabilitation techniques are dealing with appropriate methods of forest re-establishment, either by natural or artificial means, depending on forest type and site-specific ecological conditions. Such work is guided by the following aspects:

- Soil properties must be maintained;
- Negative impacts on the soil must be eliminated;
- Under-storey vegetation should be retained;
- Forest areas of more than one hectare with valuable advance growth must be selected;
- Forest plots requiring supplementary regeneration materials must be identified; and
- Young trees must be retained in the mountain forests in connection with all kinds of cutting regardless of their volume and location:

Artificial regeneration is a work intensive process involving the following basic stages:

- Seed production including maintaining seed orchards, collection, storage, tree nurseries with seedlings (1 to 2-year-old plants) and saplings (3-5 years old), growing in greenhouses or outdoor, in containers or seedling beds. It also involves soil preparation and treatment, mechanization, watering and fertilization.
- Transplanting of saplings to the site in desired spacings, spatial mixture and species composition, and
- Future stand treatment including fire prevention, thinning, pest and disease control.

4.4 Walnut-Fruit Forest Rehabilitation

Walnut-fruit forest rehabilitation and expansion of its area is a priority in the Kyrgyz forestry sector. The reason for this priority is the walnut-fruit forests' significance for local people in terms of their timber and non-timber products.

Having experienced long periods of human exploitation, the historical natural cover of these forests in Southern Kyrgyzstan is hard to reconstruct (Lavrenko and Sokolov, 1949; Gan, 1970). The original cover may be in the order of up to 630,000 ha, while at present, the area of dense walnut-fruit forest stands is estimated to be as low as 40,000 ha (Musuraliev, 2004) (Table 4). When the Russian administration first introduced forest protection measures, the forests seemed to have been already massively degraded. This was mainly due to fire set by Kyrgyz nomads to extend their grazing areas and cutting of trees for charcoal production (Lisnewsky, 1884).

From 1938 to 1944, the USSR industrial enterprises of “Narkomles” and the “Narkompischeprom” conducted tree felling operations under special assignments in order to produce high quality walnut timber. Before the walnut-fruit forests were declared as protected areas in 1945, many trees had been felled for timber production. According to the numbers recorded by the Academy of Sciences of the USSR, 140,000 m³ of timber, mainly walnut, were felled between 1938 and 1944 (Musuraliev, 1998). The timber harvesting was very wasteful: sometimes, clear cutting had even been practiced with the intention of later rehabilitating the land as forest plantation.

Systematic and large scale reforestation works started in 1948, after the forests had been transferred to the forest farms (Ieshozes) for management. Within 20 years, from 1948 to 1967, 60,200 ha had been treated. In 1955, revised instructions on walnut-fruit forests were issued by the Ministry of Forest Farming and the Forest Research Institute of the Academy of Sciences of USSR entitled: “Measures for the rehabilitation, conservation, development and improvement of soil protective properties of the walnut-fruit forests of Kyrgyz SSR”. These guidelines also specified the boundaries of walnut-fruit forest reserves and prescribed a system for their sustainable use.

Based on the above, the main method of regeneration should be plantations of different types, both of forest and fruit bearing species. It should be noted that, in the past, no special attention has been paid to the creation of walnut plantations in Kyrgyzstan.

For forest rehabilitation two different approaches were employed: (a) reforestation of open space and (b) enrichment planting of seedlings under mature parent trees after the felling of overmature trees of the upper canopy layer. However, in addition to sanitary and maintenance felling, complex and extensive felling was also conducted on a commercial scale, with the aim of transforming overmature walnut stands into more productive forests to increase nut yield.

Juglans regia is a light and heat demanding, but hygrophilous tree species. At the same time, walnut is sensitive to cold and frost. Flowers and buds are heavily damaged by late frost. Although new buds might be produced, late frost causes lowering of the vitality of trees, and sprouting of new buds does not result in fruiting.

As walnut is a light demanding species and suitable felling methods have not been developed, no felling in the parent cover was made. The greater part of young growth established from the parent cover, therefore perished due to lack of light. In addition, plantations were established from ordinary seeds, which of course influenced their productivity.

The analysis of existing research materials on the ecology and biology of walnut-fruit forests as well as practical experience of silviculture, methods of rehabilitation and regeneration, increasing of forest productivity and also forest area covered by most valuable cash crops and varieties (primarily walnut, pistachio, almond and apple) suggest the need for changes of

forest management and policy in the walnut-fruit forest areas (Venglovsky, 1998; Kolov, 1998).

Unfortunately, the consequences of the presently unsustainable forest use include the reduction in forested areas and the decrease of stand densities, decline of the regeneration capacity, loss of genetic diversity, and the loss of protective functions such as soil conservation and regulation of water supplies. Thus, the conservation and sustainable management of these unique walnut-fruit forests are currently uncertain. Therefore, new visions and approaches to forest management with the participation of the local population assuring the conservation of the walnut-fruit forest, its biodiversity and rehabilitation are urgently needed.

Table 4: Dynamics of walnut area changes from 1930 to 2003

No.	Years	Area, thousand / ha
1	1932 – 1935	44
2	1966	25,7
3	1990	28,2
4	1993	31,3
5	1998	33,3
6	2003	40,5

4.5 Rehabilitation of Juniper Forests

Among the forests of the Kyrgyz Republic, treelike juniper and elfin wood forests are of special importance occupying 277,000 ha or 33.1% of the total forest area (Musuraliev, 2004). There are five species of juniper on the territory of the Kyrgyz Republic, with the most common treelike forms represented by *J. seravschanica*, *J. semiglobosa*, and *J. turkestanica*. Juniper species grow in evergreen, light coniferous woods and under a wide range of soil and climatic conditions. Juniper species such as juniper (Archa) are very long-lived and some specimens reach the age of more than 1,000 years. The natural appearance of these trees creates a high aesthetic value in mountain landscapes which is particularly important for recreation.

According to inventory data of the forest fund, juniper forests occupied 479,200 ha in 1930, 319,300 ha in 1955, 253,300 ha in 1970, and 277,000 ha in 2003. Thus, degradation of juniper forests is being slowly stopped, and their area increased as a result of silvicultural operations and afforestation.

Main juniper forests are located in the southern regions of the Kyrgyz Republic (Osh and Batken occupy 145,000 ha or 54% of juniper forests). Forest cover in the Batken Region is 27.8%, and in the Osh Region 22.7%. The total stock of juniper wood in these areas is 3,913,000 m³ or 91% of all stocks of juniper woodlands (Musuraliev, 2000).

Changes in high-altitude borders of the various forest zones on the northern slopes of the Turkestan and Alai mountain ranges are related to the latitudinal distribution of forests. Archa forests, by the proposal of K.D. Muhamedshin (1977), are divided into four sub-zones:

- Low mountain zone, covering the territory from 1,800 to 2,000 m asl represented by *J. seravschanica*;

- Middle mountain zone – 2,000 up to 2,500-2,700 m, occupied by *J. semiglobosa*;
- High mountain zone - from 2,500 to 3,000 m occupied by *J. turkestanica*; and
- Subalpine zone - over 3,000 m where elfin wood species of *J. turkestanica* grow.

The juniper wood was widely used in pencil manufacturing, construction, and during the Second World War. It was one of the main sources of fuel supply for the country. Such excessive use of juniper wood led to significant depletion of the juniper forests, both in terms of area and timber stocks.

Irrational economic activities and reduction of the forest area gave rise to the so-called "juniper problem" in terms of conservation and restoration of these forests. Realizing high the aesthetic value of juniper forests, the State National Nature Park "Kyrgyz-Ata" covering an area of 11,172 ha was established in the southern part of the Kyrgyz Republic.

The rehabilitation of juniper forests is a difficult undertaking. Growing seedlings in nurseries lasts 3-4 years, and subsequent care in the area of silviculture requires at least another 10-15 years. The allocation of forest reserves is also uneven. The lowest area is occupied by *J. seravschanica* (84,000 ha) with an average growing stock of 30.4 m³/ha. *J. semiglobosa* takes the second place (72,000 ha) with an average stocking of 28.9 m³/ha. A smaller area is occupied by *J. turkestanica* (55,000 ha), with an average stocking of 27 m³/ha, and elfin woodland has the smallest area (9,500 ha) and the lowest stocking of 7 m³/ha.

As early as in the last century, first researchers of juniper forests paid attention to their protective properties and noticed that occurrence of landslides, mudslides and floods depends on the state of the forests. At the same time, first attempts of reforestation were made by planting juniper seedlings. However, these attempts failed because of the absence of sufficient knowledge of the biology of juniper species and their characteristics.

In the Kyrgyz Republic, various scientists intensively dealt with juniper forests, their ecology and restoration. Among them were V.M. Dzhanayeva, Y. Nikitinskiy, K.D. Muhamedshin, A.V. Chub, K.A. Azhibekov, R.D. Golovina, V.G. Shevchenko, S. Sartbaev, L.A. Krylyshkina, Toktoraliev, Kosmynin, Kenjebaev, Shamshiev, Amatov and others. They developed not only theoretical, but primarily practical approaches and techniques for afforestation and reforestation.

During the reforestation works, gradually more knowledge was generated about the juniper forests and their establishment. A new technology of growing seedlings in nurseries with the subsequent establishment of forest crops on the slopes was developed. Juniper is practically the only forest forming species on the slopes of the Alai and Turkestan ranges. Based on the results of site mapping by Mukhamedshin (1967), sites that are favourable for juniper growth could be identified.

Although the technology of growing seedlings of juniper under the conditions found in the Kyrgyz Republic was developed by Chub as early as 1962 and immediately applied on forest farms (leshozes), the major difficulty of growing seedlings of juniper significantly constrained the cultivation of this tree species. On the basis of work experience, own studies and research works of A.V. Chub (1986-2003), guidelines for cultivation of juniper in nurseries were drafted. As a result, more than 5,000 ha of forest plantations in the juniper zone, including about 4,500 ha of juniper, have been created since the late 1960s.

4.6 Rehabilitation of Spruce Forests

The main areas of spruce forests in Kyrgyzstan (44%) are concentrated in the eastern part of the Issyk-Kul basin. In the south-west of the Issyk-Kul Lake spruce forests are found again in the basin of the Naryn River, where they also occupy a large area (up to 35%). In the north-west direction spruce forests are found in the Talas and Chatkal mountain ranges. In the south - in Osh and Jalal-Abad oblasts - spruce forests occupy only 13,200 ha (Kolov, Musuraliev, Zamoschnikov 2001). In 1925-1931, the area covered by spruce forests in Kyrgyzstan was about 160,000 ha.

As a result of selective logging in the 70s, the area of spruce plantations declined by almost 50% (down to 77,700 ha). At the same time, the stocking density of the remaining stands decreased significantly. This situation ultimately led to a complete lack of natural regeneration, and this raised the need to restore the spruce forests exclusively by artificial means.

As a result of excessive exploitation of the forest fund area in Northern Kyrgyzstan, in 1947, an area of about 35 ha was clear-felled and required rehabilitation. Rehabilitation measures in spruce forest commenced in 1947, when the Government decided to rehabilitate forest ecosystems for commercial purposes based on best silvicultural practices.

The first crops were not successful, because almost all planted seedlings died. However, by 1959, considerable experience had been gained in the production of forest plantations of spruce.

It should be noted that since 1931 attempts had been repeatedly made to establish forest plantations in the spruce forest zone. Thus, for the period from 1931 to 1943, 3,387 ha of forest plantations were established (Chebotarev 1960), of which only 33% survived by 1943 (mainly pine plantings). It should also be emphasized that the establishment of Tien Shan spruce trees failed completely. For this period, no spruce planting was carried out, and the attempts of growing Tien Shan spruce in nurseries also failed. Thus, the whole previous experience of creating crops in the zone of spruce forests shows the complexity and difficulty of solving this problem.

In 1948, the Kyrgyz Forestry Experimental Station began to develop and test methods of artificial afforestation in the zone of spruce forests of the Tien Shan. This research work included:

- To develop methods for the artificial afforestation of the Tien Shan spruce on the area previously occupied by this species.
- To find a range of fast-growing and technically valuable species for afforestation in the zone of spruce forests of Tien-Shan to enhance protective properties and productivity of crops, and increase forest cover through the involvement of forest land previously not occupied by spruce.

Solving these problems required long-term studies using field observations on permanent plots. The problem of choosing a site for the establishment of spruce forests arose because of their sparse and scattered distribution. It was decided to conduct basic research in the area around the Issyk- Kul Region because the most valuable spruce forests representing half of the stock of all fir forests of Kyrgyzstan are located in this region. Also, for a long time, these forests were subjected to heavy exploitation.

In order to increase the forest cover in any region, it is necessary to introduce new species to fill niches where local breeds can not grow. To this end, the work in the Tien Shan spruce

forests focused on fast-growing and technically valuable species of trees and shrubs from other regions, so as to significantly improve the overall productivity of the forest area.

The purpose of the introduction of forest woody plants is to improve the quality of forests: the improvement of their environmental functions, productivity, sustainability, and aesthetic values. Such species introduction can only be successful if there are clear and very specific action programs based on sound research and closest to the theory of creating optimal forest phytocoenosis under specific site conditions.

Significant fluctuations in climate from the lower to the upper border zone of spruce forests allowed to split these zones into the following three climatic sub-zones Ghan (1990):

Subzone I - the lower one, extends from the lower border of the forest (1900-2000 m above sea level) until 2,100-2,200 m asl. Here, spruce forests do not exceed 5.2% of the total area.

Subzone II - middle, is located at altitudes ranging from 2,100-2,200 to 2,400-2,500 m asl. The area of spruce forests is 37.2%.

Subzone III - the top one which is located at altitudes ranging from 2,400-2,500 m to 3,100 m asl. Here, there was the maximum development of spruce forests, and they occupy 57.5% of the total area of spruce forests.

Overall efforts to rehabilitate spruce forests led to an increase in its area, which was down to 77,700 ha in the 1970s and reached a level of around 125,000 ha in 2003 (Musuraliev, 2004) (Table 5). This recovery was also facilitated by the fact that many spruce areas following reforestation had officially been transferred to forested area. Thus, their protection and sustainable use has improved.

Table 5: Dynamics of spruce area changes from 1896 to 2003

No.	Years	Area, thousand / ha
1	1896-1929	218,5
2	1925-1931	160,0
3	1940	140,2
4	1956	105,3
6	1993	116,5
7	1998	115,1
8	2003	124,1

4.7 Forest Rehabilitation Outputs and Future Directions

The national forest policy has been established by the Government in order to ensure the conservation and use of the forest resources according to common principles of sustainable development adapted to the socio-economic situation in the country. As most of the forests of Kyrgyz Republic are mountain forests, special attention needs to be given to their protective functions and to the conservation of forest biodiversity. In order to achieve this, complex forest inventories and management planning processes are applied on the whole territory of the forest fund. The forest inventory results allow for more effective planning and developing realistic forest management plans containing prescriptions of the necessary forestry activities. An example of systematic planning and implementation is the National

Program “Les” (Forest) for the period 1995-2000. Under this plan, a total area of 18,000 ha of degraded and treeless areas had successfully been rehabilitated.

Due to the fact that the majority of the forests of Kyrgyz Republic are over mature, new strategies in silviculture need to be introduced, promoting forest rehabilitation and restoration, improving the forests’ protective functions through appropriate timber harvesting and grazing regulations.

At the moment, the State Agency of Environmental Protection and Forestry is implementing the national forest action plan for the period 2006-2010. The plan prescribes reforestation activities within the territory of the forest fund up to a total of 10,000 ha, outside the forest fund up to 5,000 ha, regenerating areas by natural means on an area of 40,000 ha, and the production of planting stock of 25 million seedlings per year. The plan also pursues a step-wise introduction of the concept of multiple use forest management with emphasis on multi-stakeholder participation, thus linking forestry activities with societal needs.

One of the priorities of the Government policy on forests is to raise awareness among society about the importance of forest conservation and restoration. Therefore, it is necessary to carry on with forest rehabilitation in the future, particularly afforestation on non-forest areas. In this way, the intention is to increase the forest area from today’s 4.3% to 6.0% in 2025.

Despite the problems associated with the economic transition of the country, forest rehabilitation remains a priority of the State with main focus on the improvement of environmental conditions, securing long-term water supply and overall improvement of livelihoods in Central Asia.

5. Capacities in Forest Rehabilitation

5.1 Institutional Capacities

The present main task within the forest sector of Kyrgyzstan is the re-definition of the role and responsibility of the State in implementing forest policy, and controlling and monitoring of forests and forestry operations at the national level. In addition, the forest sector of the Kyrgyz Republic is in the process of institutional transformation towards a market-based economy, affecting forest management on the ground and the ways economic returns are derived from forest products and services. The ongoing reforms focus on an institutional separation of the State control and management functions as well as re-directing forest uses to be in line with national forest policy. The current national forest program process for the period 2005-2015 is an important activity in order to ensure consistent implementation of forest policy in the country.

Evaluations on the progress made in forest development implementation conducted in 1999 and 2004 pursued the following objectives:

- Provision of sustainable forestry development;
- Bringing civil society and local communities into joint forest management; and
- Re-definition of the role of the State in forestry

According to the concept of forestry sector development in the Kyrgyz Republic, approved by the Decision of Government, one of the basic strategic directions of the concept is to enhance the knowledge and awareness of the population about forests and the forestry

sector. In this context, comprehensive public relation campaigns are being implemented in order to inform the public about the useful role of the forest sector in promoting nature conservation and local development. In addition, integrated forest management requires contemporary forest managers not only to be knowledgeable in technical aspects such as silviculture, but they also need to be familiar with socio-economic aspects and social development. In this way, forest management decisions can be optimized.

5.2 Civil Society Involvement

Civil society has great interest in the use of forest resources. Responsibility of conservation of forest resources, their rehabilitation and management should be vested with society in general and various forest stakeholders, in particular.

The current national forest policy provides for the necessary conditions for conservation, dynamic revision of aspects of sustainable use of forests and steady development of the forestry sector as well as improvement of the overall ecological conditions and functioning of the environment and protection of the unique natural heritage of the Kyrgyz Republic. To this end, specific goals and strategic directions have been formulated in a new edition of the Concept for Development of the Forestry Sector for the period until 2025.

It is important to note that the Forestry Concept takes into consideration the necessity of fostering “wide attraction of civil society to forest management to support socio-economic development of the regions and forest conservation through sustainable multipurpose (multifunctional) utilization.” Civil society participation in natural resource management with different stakeholders such as village governments, and non-governmental organizations (e.g. Oikos, Regional Ecological Centre (REC), Development of Juniper Forests, Centre of Beekeeping, Biom, Taza, Bioresources) is a very significant component of the whole system of sustainable use of forest. As mentioned above, without civil society involvement forest reforms on rehabilitation and restoration will not be successful. Therefore, local people are involved in the creation of forest plantations, restoration activities, protection and conservation of forests as partners with the territorial forest service. This contributes to spreading information about the importance of forests. Local authorities will also be in-charge of disseminating information about the forests and forestry activities.

5.3 Research and Education in Forest Rehabilitation

Research and education related to forestry in Kyrgyzstan is carried out by various research institutions including the Institute of Forest, Institute of Nut Farming and Fruit Cultures, and the Institute of Biology and Soil of the National Academy of Sciences as well as universities with the Department of Silviculture, the Department of Biology and the Centre of Innovation Technology in Agriculture of Kyrgyz National Agrarian University, the Department of Ecology and Forestry of the Jalal-Abad State University, the Department of Ecology, the JUMP Centre of Forests of the Osh Technological University and the Department of Ecology of the Issyk-Kul State University under the Ministry of Education and Sciences of the Kyrgyz Republic.

The Kyrgyz-Swiss Support Program on Forestry (KIRFOR Program, 1995-2009) operating within the bilateral agreement between the Governments of Switzerland and the Kyrgyz Republic is currently making its input in the development of the national forest sector, in particular, in the transfer of advanced technologies.

The forest research has been defined as one of the main KIRFOR project components from the very beginning, since everywhere forestry is based on scientifically defined technical norms and recommendations. KIRFOR is paying a lot of attention to the links between science and application with identification of applied research as one priority for support. The major activities of the programme include:

- support to research studies;
- strengthening of the links between research and field application;
- support of publications;
- provision of infrastructure and equipment; and
- support to scientific staff in developing future education and training programmes.

Within the framework of the Project “Orech Les” the Kyrgyz-Swiss Program on Forestry Support, in cooperation with the Swiss Technical Institute, carried out research on the improvement of existing forest typology (Sorg *et al.*, 2003). A new methodology of forest typology (2009) was developed and, for separate types of forest stands, includes a rather complex set of questions ranging from soils and vegetation to social aspects and the use of non wood products. The research made use of some early studies conducted on the southern slopes of the Chatkal and Fergana ridges representing the starting point for further comparative research on the history of landscape development(e.g. Kashkarov, 1927; Sapirjagejeva, 1938). In 1934, the Ak-Terek Research Field Station was established for permanent research into walnut-fruit forests. After World War II, the station was integrated into the Arstanbap-Ata Fruit Forest Experimental Station under the Forest Institute of the Academy of Sciences of the USSR.

It is worthwhile to note that a first comprehensive scientific expedition of the walnut-fruit forests of the southern part of the Kyrgyz Republic was conducted by one of the highly qualified specialists under the supervision of the well-known academician Sukachev V.N. from the USSR Academy of Sciences. As a result of the research conducted, several monographs on walnut-fruit forests were published as “The fruit forests of Southern Kyrgyzstan and their utilization” (Sukachev *et al.*, 1949).

From the 1955s until now, Kyrgyz forest scientists made good progress reflected in a set of published monographs, textbooks, manuals, regulative and technical documents. During this period, various publishing houses printed a number of fundamental works on forests as shown in Table 6.

In order to increase the effectiveness and efficiency of reforestation activities, the Forest Institute has elaborated and published guidelines entitled “Recommendations on Spruce Forest Plantation Establishment and Tending”. Another technical instruction (“Guidelines on Growing Planting Material with Close Root System”) dealing with probation and testing of new effective and less expensive methods of the production of planting material under the conditions reigning in the Kyrgyz Republic, has been prepared and published by the Forest Institute. Several recommendations on forest plantations, nurseries, and best practices to maintain the hydrological and protective functions of forests, regeneration, economic assessments and forest biodiversity have been prepared.

One of the leading institutions in forestry education is the Department of Silviculture of the Kyrgyz National Agrarian University established in 1999 with the support of the Kyrgyz-Swiss Program. A special education standard for forest engineering as well as a curriculum were developed by specialists and approved by the Ministry of Education and Sciences in 2000 involving a studies program of five years.

Table 6: Publication material related to the forest from 1955-2009

Date	Author	Title
1955	Gan P.A.	Practice of mountain afforestation, introduction and acclimatization of trees and bushes in spruce forest belts
1962	Kamchibekov N.K	Natural regeneration features of Tien Shan spruce
1968	Prutenskaya M.D	Diseases of the walnut-fruit forests
1967/ 1977	Muhamedshin K.D	Juniper forests of the South Kyrgyz Republic
1967	Karavaeva R.P.	Biological control with <i>Yponomeuta malinella</i> L., <i>Yponomeuta padellus</i> L. in Kyrgyzstan
1969	Ozolin V.E	The pistachio forests of the South Kyrgyz Republic
1970	Gan P.A	Forests of the USSR in five volumes. Vol. 5: Forests of Kyrgyzstan, the Central Asian Republics and the Southeast of the European part of the USSR
1971	Cheshev L.S	Types of spruce forests of the North Kyrgyz Republic
1972	Bulychev A.S. <i>et al.</i>	Recommendations on Growing Walnuts in Kyrgyzstan.
1976	Shevchenko V.S	The form diversity and walnut selection in the South of the Kyrgyz Republic
1981	Venglovsky B.I	Creation of protective plantations types from walnut
1984/ 2008	Bikirov Sh.B	The Abies plantations of the Kyrgyz Republic
1984	Uzolin A.I	Taxation for the walnut-fruit forests
1984	Romanenko K.E	Pest of pistachio in Kyrgyzstan and methods of their control
1984	Kolov O.V.	Ecological and physiological explanation of increasing of walnut productivity
1992/ 1997	Gan P.A <i>et al.</i>	The walnut-fruit forests of South Kyrgyzstan
1992	Matveev P.N.	Hydrological and protective functions of walnut-fruit forests
1993	Toktoraliyev B.A	Xylophages insects of forests of the South Kyrgyz Republic
1998	Sherbinina E.N.	The problem of conserving the biological diversity of walnut-fruit forests in Kyrgyzstan
1998	Chotbaeva E.A.	Water regime of walnut phytocoenosis dominants in the context of natural and anthropogenic dynamics
1998	Venglovsky B.I. and <i>et al.</i>	Biodiversity and sustainable use of Kyrgyzstan's walnut-fruit forests
2000	Chotonov A.	Particularities of quality estimation of forests in the Issuk-Kul Region
2004	Musuraliev T.S.	New forest policy of the Kyrgyz Republic
2004	Shamshiev B.N	Rehabilitation of Juniper forests in protected natural territories of the Kyrgyz Republic
2005	Ashimov K.S.	Dendrophyl insects of West Tian Shan
2007	Orozumbekov A.A.	Overview of forest pests of the Kyrgyz Republic
2008	Kosmunin A.V.	Juniper forests of the Kyrgyz Republic
2008	Gabrid N.V.	Pest insects in North Kyrgyzstan
2008	Bolotov S, Kenjebaev S.	Pistachio forests of the Kyrgyz Republic
2008	Orozumbekov A. <i>et. al</i>	Gypsy moth in South Kyrgyzstan
2009	Venglovsky B.I.	Forest typology
2009	Orozumbekov A.A, Musuraliev, T.S. <i>et al.</i>	Forest Rehabilitation in the Kyrgyz Republic

The curriculum of the 5-year forestry study program at the Kyrgyz National Agrarian University consists of several subjects as follows:

- In the first and second year, students are trained in basic disciplines: mathematics, physics, chemistry, basics of forestry, geodesy, machinery, logging and transportation, ecology, forest botany, wildlife biology, hunting, forest soil, tree physiology, computer science, biometry, informatics, history, philosophy, and culture.
- In the third and fourth year, students are trained in special forestry disciplines: forest ecology, silviculture, forest inventory, forest management and planning, forest protection, forest legislation, remote sensing in forestry, forest genetics, forest tree breeding, forest economics, forest guarding, forest conservation, and training in pre diploma practices on forest farms (leshoses).
- In the fifth year, students need to prepare several projects in the main disciplines: silviculture, forest management and planning, forest protection, forest regeneration and afforestation, forest economics and others. Students prepare and publicly defend their graduation diploma project before the State Examination Commission for obtaining the degree of a forest engineer at the Kyrgyz National Agrarian University.

After graduation, students find employment in forest farms (lezhoses) and forest territorial services based on their specialisations. Later, some students will continue their education and enroll into M.S. and Ph.D. programmes at the Kyrgyz Agrarian University or other universities. Post graduated courses for training of academic staff in ecology and natural resources management are organized at the Kyrgyz Agrarian University, Jalal-Abad State University and Osh Technological University.

5.4 International and Regional Cooperation in the Forestry Sector

International cooperation projects in research and development of the forest sector in Kyrgyzstan mainly focus on the conservation of flora and fauna and sustainable natural resources management. Technical assistance on a grant basis has been/is provided by:

- Kyrgyz-Swiss Forestry Sector Support Program (KIRFOR)
- The GEF and World Bank Central Asian transboundary project “Biodiversity Conservation of the Western Tien Shan”
- The Europe-aid Project for Biodiversity Conservation of the Western Tien-Shan Region
- The GTZ project (Issyk-Kul Biosphere Territory)
- The FAO project (Legal Frameworks for Forestry and Hunting)
- The FAO project (Harmonization of Legislation of the Protected Areas)
- The EU project (JUMP) on the sustainable multi-purpose management of the juniper forests in the south of the Kyrgyz Republic
- The EU Central Asian transboundary project in the Pamir - Alai Region
- The Kyrgyz-Norwegian Forest and Environment Program
- The Volkswagen Research Foundation (Volkswagen-Stiftung) project “The Impact of the Transformation Process on Human-Environmental Interactions in Southern Kyrgyzstan” (includes a component on walnut-fruit forests)
- The Turkish International Co-operation Agency (TICA) project on “Chemical Pest Control in Walnut-Fruit Forests”
- The Fauna and Flora International (FFI) Project “Forest Management Planning and Biodiversity Conservation in the Walnut-Fruit Forests of the Kyrgyz Republic”
- The FAO project “Capacity Building for National Forest and Tree Resource Assessment and Monitoring” in the Kyrgyz Republic

- The GEF and World Bank Central Asian Transboundary Project “Tien Shan Ecosystem Development” on Reforestation and Carbon Trading in the Kyrgyz Republic
- The Japan International Co-operation Agency (JICA) Project “Support for Joint Forest Management in the Kyrgyz Republic ”
- The Fauna and Flora International (FFI) Project “Community Conservation of Globally Important Fruit and Nut Forests in Kyrgyzstan”
- The Darwin Initiative Project “Conserving Eden: Participatory Forest Management in the Tien Shan Region”

6. Future Steps

The national forest policy of the Kyrgyz Republic is based on socio-economic and environmental objectives of the country within the framework of the Program for Sustainable Human Development and Poverty Alleviation, and Social Mobilization. The concept provides the foundation for the development of a new type of planning in forestry, decentralization and public action in the country to be fully operational after the year 2025. A National Forestry Program elaborating a concrete strategic framework derived from the concept of sustainable forestry is being elaborated as a basis for 5-Year Action Plans. Towards this end, the following comprehensive measures for forestry development need to be undertaken:

- Development of land rehabilitation plans for activities aimed at promoting natural regeneration, and restoration of protective and soil conservation plantations;
- Organization of efficient seed production and production of planting stocks in forest nurseries;
- Establishment of industrial plantations of fast growing tree species;
- Reforestation on degraded lands, which are appropriate for afforestation purposes, irrespective of the ownership forms;
- Organization of regular courses for forest users with the purpose of raising the level of knowledge and practical skills for proper implementation of silvicultural and forest management activities;
- Preparation of plans for the co-ordination of activities in the field of development and forest biodiversity conservation including the establishment of a network of specially protected natural territories and territories with unique natural resources; and
- Development of integrated management for all types of forests in the country.

7. References

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Forest and grazing in Kyrgyzstan (Photo taken by Almaz Orozumbekov)



Juniper forest in Kyrgyzstan (Photo taken by Almaz Orozumbekov)



Walnut forest in Kyrgyzstan (Photo taken by Almaz Orozumbekov)



Spruce forest in Kyrgyzstan (Anonymous)