

Ministry of Nature Protection of Turkmenistan

**National Institute of Deserts,
Flora and Fauna**

R E P O R T

**on implementation
of the UNCCD in Turkmenistan**

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INTRODUCTION

Arid land, which occupies more than 30 % of world's dry land, is characterized with highly extreme natural conditions. About 900 mln people or one fifth of the Earth's population live there. At the same time, this zone possesses great mineral-raw, biological, heat and labor resources. About 80 % of irrigated land, more than 170 mln ha of boghara, 316 bln ha of pastures are concentrated in this zone, which are considered as a huge strategic reserve for the society development.

According to the UN Convention, desertification, one of the most serious global environmental and social-economic problems, is defined as the land degradation in arid, semiarid and dry subhumid regions resulted from different factors including changes in the climate and man's activity.

Desertification is a problem of interaction between complex, fragile and unstable environment of arid zone and reclamation of this land by a man to support his life. It is developed in two directions: on one hand, it is a natural process of stable aridity of land, and on the other hand, it is an artificial process caused by irrational man's activity.

Desertification processes start when a degree and rate of anthropogenic influence on arid land exceeds the ability of landscapes to self-restorability.

Desertification is a complex and many-sided process with both general natural and social-economic aspects.

Growth of population strengthens a pressure on environment, based on different branches of industry and agriculture. Superposition of anthropogenic and natural factors causes great environmental changes, exceeding many times as much the summary impact of separate natural components.

Undoubtedly, international cooperation in this sphere is of primary importance. However, all regional and national tasks could not be solved only on an international level. Special, unmitigated efforts of countries under the process of desertification are necessary.

Territories of Central Asian countries such as Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan with total area of 3,881.8 square km and the population of more than 50 mln people, are subject to deep processes of desertification.

Desertification involves about one third of plains, where it is caused by the degradation of vegetation at 77 % of area, by wind erosion - at 1.5 %, water erosion – at 5.9 %, land salinization due the Aral Sea level drop – at 9.1 %, technogenic factors – at 2.4 % and swamping of desert pastures at 0.5 % of area.

In 1993, in view of the unprecedented development of desertification processes in the region, Presidents of states of Central Asia established an International Fund for the Aral Sea Rescue.

Turkmenistan is a new state on the political map of the world with the Presidential government, which proclaimed its independence on 27 October 1991.

The First President of Turkmenistan, Saparmurat Niyazov, is a head of the state and executive power, which are guarantors of independence and territorial integrity of the country.

Turkmenistan pays great attention to the protection of environment for the purpose of reservation of health and prosperity of people. Turkmenistan deeply realizes its role as a keeper of those environmental resources, unique in the world. This double responsibility is entrusted to the Ministry of Nature Protection of Turkmenistan.

The territory of Turkmenistan is situated in the desert zone with rather fragile ecosystem, where every unreasonable step in land management could cause irreversible catastrophic consequences. Therefore, after gaining independence Turkmenistan is interested in conservation of nature integrity and environmental stability of the country.

In 1995 Turkmenistan, attaching specific importance to environmental-economic problems and expressing its determination to participate in developing environmental security in interests of present and future generation, joined the UN Convention to Combat Desertification, and in 1996 the Parliament of the country ratified it.

In the same year a Governmental Commission for working out a conception and a strategy for combating desertification was established. Its main goal is to estimate processes and define indices and criteria of desertification, to develop science intensive but economically acceptable technologies for rehabilitation of damaged landscapes and rational management of natural resources based on environment-protective principles. Before development of the conception and a program, centuries-old traditions and techniques of the local population for rational land reclamation were studied. The National Institute of Deserts, Flora and Fauna of the Ministry of Nature Protection of Turkmenistan was committed with the responsibility for the development of the National Action Program to Combat Desertification. In 1997 the first version of the National Action Program to Combat Desertification was completed and submitted to the Government of Turkmenistan for consideration and making decisions on its implementation.

Turkmenistan having arid landscape takes active part in implementation of the UN Action Program to Combat Desertification on its every stage, beginning from 1977, when important decisions were made at the First International Conference in Nairobi. As early as in 1978 at the Institute of Deserts of the Academy of Sciences of Turkmenistan International Scientific Training Courses were organized, which during 1978-1990 gave the possibility of summarizing valuable experience of scientists and specialists of the sphere and of transferring it to specialists in many countries. During 12 years 600 specialists of developing countries of Asia, Africa and Latin America have studied at the courses. An international scientific journal "Problems of Desert Development", which has been published from 1967 at the Institute of Deserts, was a good assistance to them. From 1980 an English version of the journal has been published in the USA. A plenty of papers on the subject belonging to scientists of Turkmenistan were published in the CIS countries and abroad.

The given report on implementation of the National Action Program to Combat Desertification in Turkmenistan gives an account of the main environment-forming factors of the nature connected with the development of desertification processes, theoretical and practical results of combating desertification gained on the level of Government and state organizations, research institutions, agricultural and industrial enterprises, local population and non-governmental organizations. In addition to general information the report figures an

attempt to estimate these results and to give some recommendations on further activities for solving planned tasks on the theoretical and practical basis. The report highlights issues of wide usage of the unique experience of local population, having been developed during millennia.

The final part of the National Report is devoted to issues of planning and managing during implementation of the Action Program to Combat Desertification in Turkmenistan.

1. ENVIRONMENT-FORMING COMPONENTS OF THE NATURE

1.1. Geographical situation

Turkmenistan is situated in the western part of Central Asia between latitude 38°08' and 42°48' north and longitude 52°27' and 66°41' east. Its territory is stretched out for 1,100 km from the west to the east and for 650 km from the north to the south. The occupied area is 491,200 square km. In the north Turkmenistan borders with Kazakhstan, in the east – with Uzbekistan, in the south – with Iran and Afghanistan, in the west – across the Caspian Sea with Azerbaijan. Its population is 5.2 mln. The capital of Turkmenistan is Ashkhabad with the population of 600,000 people. The territory of Turkmenistan in the west is open to the waters of the Caspian Sea, in the north – to the vast Turan lowland, of which Turkmenistan is a part. In the south Turkmenistan borders with Turkmen-Khorasan mountain systems, and in the east – with spurs of Parapamiz and Pamirs-Alay.

Mountains in the south of Turkmenistan are the source of drift of great masses of friable deposits, which formed alluvial plains on the vast territory. Its surface declines from south-east to north-west and west. These friable deposits served as a substratum for aeolian relief. Due to their different age, and therefore, to different influence of aeolian relief-forming processes the surface of sand deposits differs from each other significantly.

Tectonic differences in the history of geological and geomorphologic development as well as different age of different parts of the territory resulted in the fact that in the deflection zones vast areas of monotonous clay-sand masses were formed (Lowland and Zaunguz Karakum), and in zones of heaves-swells, hangs – separate isolated areas of sand massifs, alternate with other types of deserts – brackish, clay, stony ones (Uchtagan, Chilmamedkum, Oktumkum).

The most ruggedness of aeolian relief is characteristic to ancient and uniform friable sand precipitation. Aeolian forms are of weak ruggedness at the young Quaternary sand-clay deposits.

1.2. Climatic Features

Radiation and general circulatory factors are of great importance for climate formation of Turkmenistan. Main features of the climate are as follows: the CIS highest temperature of the air and soil, significant dryness of the summer period, as well as weather contrasts in the cold and even in the warm periods, that is stipulated just by those factors. During the Turkmen summer (May-September), due to the exclusive clearness of the sky, concentration of the solar radiation is so high that the atmosphere circulation is entirely subject to the powerful climate-establishing factor – or radiation, that is stipulated by its geographical position.

Average annual duration of the solar shine in the east of the Central and South-Eastern Karakum reaches 2,800-3,100 hours, and something less in coastal regions.

Summary radiation heat varies within 145-163 kcal/cm² per year. 65-70 % of this annual heat accounts for direct radiation. Long-term average air temperature in July is 28-32°C.

In winter arctic air masses freely get to the extreme South that causes the sharp temperature decrease. Average air temperature in the coldest month of January in the north of the country is between -2°C and -4°C. In most severe winters air temperature here falls up to -30-32°C.

Air temperature in summer in Turkmenistan reaches 48-50°C. Absolute maximum of the air temperature of 50.1°C was on 28 July 1983 in South-Eastern Karakum (Repetek).

Difference between the day and night air temperature is 10-12°C and soil temperature – 20-25°C. Annual amplitude of air temperature fluctuation is between 31°C and 34°C.

Precipitation is caused mainly by humid air masses, which are formed in the Atlantic Ocean. Highly heated and dried on its way through the continent the precipitation penetrates to Turkmenistan's territory. Because of this the climate in the country is rather arid. Minimum atmosphere precipitation – less than 100 mm per year – falls in the Gulf of Karabogaz-Gol. Annual precipitation in the northern part of the country is 105-125 mm. To the south and south-east coming near piedmonts and mountains the amount of atmosphere precipitation increases and reaches 396 mm in the Kopetdag Mountains (Kheirabad).

The major atmosphere precipitation falls in the autumn-winter-spring period, being considerably decreased in summer. It is caused by intensive development of cyclone activity in the cold period (March, April – are the most rainy months), and in summer – by development of the thermal depression.

Relative air moisture in January is the highest. Average relative air moisture in January along the territory varies between 70 and 80 %, and in July in plains and piedmonts it varies between 20 and 30 %.

A great period with relative air moisture not higher than 30 % is typical for Turkmenistan. On the main part of plains and piedmonts a number of such days reaches 150-249, on the Caspian seashore it reaches 40-90, and in the Kopetdag Mountains – 120-130. During the summer there is 70-85 % of dry days, and in the south nearly all days are dry.

Wind regime is formed under the influence of circulating factors and local physical-geographic features. In January on the Caspian seashore there are mainly east winds, in the Central Karakum the most often are east and north-east winds, and in the south-east of the country there are south-east and north-west winds.

Average annual wind velocity is mainly low. In plains it varies within 2-4m/sec. But the Caspian seashore from Cheleken to the north and a corridor between the Great and Minor Balkhans are notable for high wind velocity, the average annual value of which is 6 m/sec. Storm wind with the velocity more than 15 m/sec could be noted during 32-66 day per year, on average. Hurricane wind reaches the velocity of 35-40 m/sec. In the Amudarya River valley 5 tornadoes were recorded, with the velocity of 60-70 m/sec.

The probability of a drought in Turkmenistan is of 50-75 %. Damage to agriculture caused by droughts is rather significant. In drought years the yield on dry (boghara) land comes down up to 20-40 %. Though the influence of drought in irrigated regions is

mitigated, the agricultural crop capacity decreases up to 30 %. Dependence of pasture vegetation on droughts is more evident. In drought years the simultaneous influence of the soil and air droughts accelerates withering of pasture vegetation by 15-20 days, and its crop capacity decreases (Table 1).

Dust storms usually appear in any season and in any place when wind velocity exceeds 5-7 m/sec. During the year a number of days with dust storms on plains are more frequent in spring and summer (39 and 30 % of cases, respectively), in piedmonts – also in spring and summer (29 and 33 %, respectively), in mountains – in winter (33 %). In separate years a number of days with dust storms reaches: 49 – in the Murgab River valley, 66 – in the Amudarya River valley, 83 – Kopetdag valley, 86 – in the Tejen River valley, 113 – in the Central Karakum Desert, 106-145 – between Great and Minor Balkhan Mountains.

Table 1

Recurrence of droughts of different intensity and duration

Meteorological station	Years of observance	Years with droughts	Recurrence, %	Years with droughts				Duration of droughts, years				
				Normal	Medium	Strong	Very strong	2	3	4	5	>5
				Intensity								
Cheleken	72	41	55	32	1	3	5	4	1	0	1	2
Ashkhabad	93	45	48	42	9	1	3	8	2	0	1	2
Bairamali	95	57	60	44	7	2	4	5	2	2	2	2
Gushgy	57	33	58	23	7	3	-	9	2	1	-	-
Repetek	60	30	50	22	3	2	3	8	1	2	-	2
Turkmenabat	90	60	67	48	6	3	3	4	1	4	-	2

Phyons and garmsils in Turkmenistan usually appear in the cold period when cyclones come from the south. Phyons phenomenon overlaps the air mass changes when warm front. The temperature grows intensively and relative moisture drops. A very strong and hot phyons are called garmsil. South-eastern and south-western regions are subject to garmsils. Garmsils cause damage to agriculture.

1.3. Surface and ground water

Continental position of Turkmenistan and aridity of the climate, lack of precipitation predetermines a weak hydrographic network and utterly small number of water resources that develop on the territory of Turkmenistan. Run-off of the main rivers as Amudarya, Murgab, Tejen and Atrek are formed outside the state.

The Amudarya is the largest river of Central Asia. Its average run-off for many years is 68.1 km³ per year, and a run-off of the 90%-providing is 0.9 km²/year. The Murgab River water was fully depleted and nowadays its basin is supplied from the Karakum River.

The Tejen River has an average long-term run-off not more than 0.8 km³/year, and a run-off of 90%-providing is 0.4. Water of the river is also fully used and water of the Karakum River is supplied to its basin.

In the south-east of the country the border Atrek River flows. An average long-term run-off of the river is 0.19 km³ per year, and a run-off of the 90%-providing is not more than 0.1.

Water resources of different water sources are shown in Table 2.

Table 2

Water sources	Volume
1. Surface waters of the river run-off (Amudarya, Murgab, Tejen, Atrek and minor rivers)	23414
2. Ground water	3300
3. Water of the temporary surface run-off, formed on takyrs and takyr-like soils	332
4. Static resources of fresh water of large subsand lenses	99680
5. Fresh water of streamside and canal-side lenses	307
Total:	127033

More than 80 % of total water is used in agriculture. Virtual consumption of water for irrigation (gross) on average in the country is more than 15,500 m³/ha.

Given data are evidence of low technical level of water usage in irrigated farming, where efficiency of water usage does not exceed 0.60. the major part of irrigation and collector-drainage network is built in ground bed that leads to great losses of water because of filtration (more than 20 %). Even greater water losses happen in the farm irrigation network (its length is more than 30,000 km), the main part of which is also built in ground beds. Modern engineering irrigation network (with coating, in chutes and pipelines) has been built only on new irrigated lands.

With the development of irrigation system the volume of eliminating of drainage water (DW) grows. In 1996 there was eliminated 6.20 km³ of water, which mineralization reaches 10/20 g/l. Drainage effluent to the desert has led to underflooding and salinization of desert pastures, and DW elimination to rivers and water reservoirs deteriorated the quality of water.

1.4. Soils

Soils of flat zones of Turkmenistan are characterized with brownish, desert sandy, takyr-like soils and takyrs. Intrazone soils of halomorphic row are represented with typical takyr-like and meadow (hydromorphic) solonchaks.

Soils are mainly characterized by low humus content, high carbonate content, and often by high saline and gypsum content. Due to their structure, halomorphic soils belong to chloride-sulfate type. The zone of the Caspian Sea belongs to sulfate-chloride and chloride types.

Table 3

Water usage in agriculture

Indicators	Velayats						Total
	Ashkhabad City	Ashkhabad	Balkan	Dashoguz	Lebap	Mary	
Total water scoop for all needs of economy, mln m ³	150.7	5933.2	1092.2	7191.1	5257.2	6725.7	26350.1
Total usage of water, mln m ³	129.5	4312.2	992.7	4635.3	3700.3	5340.6	19110.6
Agriculture:							
Water scoop, mln m ³	0.02	5337.5	445.4	6144.6	4644.1	5281.5	21853.1
Water supply to plots, mln m ³	0.02	4270.0	412.4	4620.3	3572.4	4514.1	17419.2
Share of water used in agriculture, %	0.01	90.0	41.0	85.4	88.3	78.5	83.0
Norm of water for irrigation (gross), m ³ /ha	-	14704	7953	16562	18502	14510	15554
Modern irrigation network (coated, in chutes and pipes), km	-	3267	380	48.2	78.0	717.7	4490.9
Share of engineering irrigation network, %	-	37.0	37.3	0.6	1.2	9.6	14.7
Water losses, %	-	24.7	7.9	33.0	30.0	16.1	25.2

On lands with ancient irrigation top-soil is represented by old irrigated soils of different damping rows. They are developed on the thick seam of agro-irrigation deposits (0.5-2.0 m) and characterized by moderate and high levels of fertility.

In general, desert sandy soils (38.9 %), sierozems (13.5 %), brownish soils (11.4 %), takyrs and takyr-like soils (7.3 %), poorly bound sands (9.1 %), solonchaks (5.5 %) and non-soil formations (7.5 %) prevail in the structure of available land.

In the structure of available land the share of meadow, alluvial and hydromorphic soils (almost 5.8 %) is considerable. Because of low-height mountains and their low damping a share of brown soils (0.6 %) and hydromorphic soils (0.4 %) is rather small.

Soils of light (sandy and sandy loam) mechanical composition amount to 66.1 %. Soils of medium mechanical composition are represented with takyr-like soils, sierozems and old irrigated soils of ancient agricultural oases (24.4 %). A share of soils of heavy mechanical composition is not large (almost 9.5 %), represented with takyrs, takyr-like soils, mountain brown soils and heavy diversity of irrigated soils.

In the structure of available land non-saline and weakly saline soils prevail (almost 67.3 %). Rather large is the share of medium-saline (8.3 %) and highly-saline (almost 5.5 %) soils (Table 4).

Table 4

Distribution of available land in Turkmenistan (thous. ha)

Land category	Total area	%
1. Land for agricultural purpose	39981.6	81.93
2. Land of populated area	86.8	0.17
3. Land for natural, recreation, historical and cultural purpose	787.8	1.61
4. Land for forests	2158.2	4.42
5. Land for water reservoirs	427.2	0.87
6. Land of the state reserve	5368.4	11.0
Total:	48810.0	100.0

1.5. Natural resources

Turkmenistan is rich in diverse natural resources: oil, gas, native sulfur, potash and rock salt, thermal springs, building materials, etc. Turkmenistan possesses significant oil reserves. Oil production in the country has continuously grown: in 1940 there was extracted 387,000 tones of oil, in 1960 – 4.3 mln tones, in 1970 – 14.5 mln tones, and in 1975 a maximum was extracted – 15.9 mln tones. In accordance with the conception of oil and gas complex development in Turkmenistan oil production by the year 2002 to reach up to 28 mln tones. Explored reserves of gas amount to 3.8 trillion of m³. Prediction resources are estimated at 7.1 trillion of m³.

Reserves of many types of mineral resources not only meet the existing levels of production and processing, but, by increasing production, give a possibility to gradually develop industries based on mineral resources. The Government of Turkmenistan plans to expand and introduce new industries on production iodine, bromine and their derivatives,

calcined salt and caustic soda, magnesium oxide and refractory products, table salt, ceramic tile and sanitary engineering, mineral fibers, polyethylene, etc.

1.6. Biodiversity

Flora in Turkmenistan accounts for more than 2,600 species of higher plants belonging to 105 families. Among living forms there is a predominance of herbaceous plants (2137 species), 47 species belong to trees, 88 – to bushes, 44 – to dwarf shrubs, and 238 – to subshrubs. Plant communities with predominance of xerophytic dwarf shrubs and halophytes, rare groups of Haloxylon as well as shrub psammophytes, ephemers and ephemeral-like organisms determine a landscape of desert zone.

Fauna of Turkmenistan is notable for rather large zoologic-geographical and environmental diversity. Among living forms insects, represented by several thousands species, prevail. Among them are aphid, bugs, darkling beetles, lamellars, weevils, lepidoptera, diptera, etc. Darkling beetles are predominant representatives of insects in desert landscapes. Species composition of Arachnida is also numerous.

372 species of birds inhabit different biotopes. Reptiles include 786 species, and mammals – 91 species. Fish are represented with 60 species, of them main food fish are sturgeon, salmon and others. Amphibia consist of 5 species.

For the purpose of studying and preservation of biological diversity 8 reserves with the total area of more than 800,000 ha function in Turkmenistan.

In 1999 the second edition of the two-volume Red Data Book was published.

2. DESERTIFICATION AND IMPLEMENTATION OF THE NATIONAL ACTION PROGRAM TO COMBAT DESERTIFICATION

2.1. General issues

Desertification is a result of complex interaction between social-economic conditions and natural factors. Therefore, the system “man-desert-desertification” is interpreted as a global one, which has serious environmental, social-economic and political consequences. Currently arid land is considered, on one hand, as a region with high economic potential and, on the other hand, as a place of collision of cardinal social-economic and political problems.

Estimations of current losses of fertile land show that by the end of the century the world will lose almost a third of arable lands in arid regions. Such a loss, when the growth of population is unprecedented and the need in food is increased, will have catastrophic consequences.

Geographic differentiation in scales and character of the anthropogenic desertification on the national level is determined first of all by an extent of economic activities of the local population which uses, on one hand, historically developed techniques and, on the other hand, modern technologies often unadapted to the specific conditions of fragile arid ecosystem.

Practical activities of a man consists of many aspects, some of which having degradation impact on environment. First of all, this is the plant degradation and concomitant soil degradation (erosion and deflation) as a result of excessive pasturing of the cattle and cutting down plants for fire-wood.

As is known the land in arid zones is mainly used for distant-pasture cattle-breeding. Existing earlier a strictly local approach of intensive anthropogenic impact on environment while total increase of a number of cattle began expanding again. Unregulated cattle-breeding complicates introduction of progressive methods of planned pasture agriculture. Overpasturing and cutting down of plants for fire-wood is observed particularly inside and around oases. Therefore, this land becomes first of all a site of desertification and causes great troubles to the local population.

Erosion and deflation processes develop intensively on the light soil, that is connected with irrational agricultural technologies or with one-crop farming. With this deflation of sandy soils often leads to aggravation of sand storms.

It is known that irrigation develops an efficient foundation for agriculture in arid regions. It provides high stability of agricultural systems, eliminates threat of drought and uncertainty in future. Meanwhile, irrigation farming is the most complicated agricultural system managed by a man, breach of managing principle of which leads to such dangerous processes as secondary salinization, swamping and underflooding of land. This leads to withdrawal of fertile land, and the local population because of economic factors is unable to undertake appropriate engineering ameliorative measures.

Negative impact on environment is exerted by engineering construction, which is conducted without taking into consideration of environmental conditions of the place. This leads not only to “technogenic zones”, aggravates geochemical features of the soil, but accelerates erosion and deflation processes in the soil, and loss of fertility.

Uncoordinated tourism and recreation activities of the urban population also belong to rather active factors of desertification, because this activity leads to a cutback or even to a full destruction of rare and the most valuable for the national economy populations of plants and animals.

Based on mentioned above it becomes evident that the problem of anthropogenic desertification is not only a scientific-technical problem, but mainly is a social-economic and political problem. So, for the purpose of scientific analysis of this problem and development of specific technical measures of combating desertification we should use the following definition of this process:

desertification – is an interdependent natural and anthropogenic process of irreversible changes in the top-soil and plant covers of the arid zone decreasing its biological productivity, which in extreme situations could cause full destruction of environmental-resource potential of the territory and transform it into anthropogenic desert.

Currently, definite knowledge has been accumulated, a technology has been developed and an experience in combating separate processes of desertification has been gained. However, in practice such measures were not always successful. This failure was stipulated by different reasons. The most obvious is a tardy diagnosis and palliative measure of control, insufficiently considering all factor of desertification.

For Turkmenistan, due to its huge territory and relatively small in number population, processes of desertification are not of disastrous character and is not of serious danger (see a map).

Despite this fact, negative natural phenomena control in Turkmenistan has been performed for a long time and significant experience has been gained on the governmental and local level. On the other hand, this problem attracts attention of scientists and specialists of Turkmenistan, mainly, because of global importance for the whole mankind.

2.2. Main reasons of desertification

Integrated estimation of the current state of desertification on the territory of Turkmenistan was carried out in 1998 by the Institute of Deserts based on space images, observations at stations, subject maps and statistic materials. A map of desertification was made on a scale 1:2,500,000 based on parameters, as follows:

- Plant cover degradation,
- Sand surface deflation,
- Erosion of irrigated and pasture land in piedmont regions,
- Salinization of irrigated soils,
- Salinization and dust-salt removal from the dried seabed of the Aral Sea,
- Swamping of pasture land with overflow collector-drainage water,
- Technogenic desertification in regions of new buildings.

On the map three classes of desertification are singled out: weak, moderate and heavy (see the map). Summary data on deserted territories of Turkmenistan are given in the Table.

One of the main indices of desertification processes development is the degradation of the plant cover. Vegetation of Turkmenistan plays a protective environmental role. In extreme conditions of deserts forests and forest plantations protect soil from deflation and

erosion, serve as a fodder and fuel, biological drainage, protect populated areas and fields from hot wind and dust storms.

Table

Areas of deserted land in Turkmenistan (km²/%)

Type of desertification	Classes of desertification			
	weak	moderate	heavy	Total
Plant cover degradation	<u>323442</u> 66.2	<u>43680</u> 10.0	<u>400</u> 0.1	<u>367522</u> 76.3
Sand deflation	<u>2530</u> 0.5	<u>2140</u> 0.4	<u>3970</u> 0.8	<u>8640</u> 1.2
Water erosion	<u>6900</u> 1.4	–	–	<u>6900</u> 1.4
Salinization of irrigated land	<u>6140</u> 1.3	<u>25130</u> 5.2	<u>9040</u> 1.8	<u>40310</u> 8.3
Salinization of soils, caused by a drop of the Aral Sea level	–	–	<u>15015</u> 3.0	<u>15015</u> 3.0
Swamping of pastures	–	<u>5360</u> 1.1	<u>1620</u> 0.4	<u>6930</u> 1.5
Technogenic desertification	–	<u>920</u> 0.2	–	<u>920</u> 0.2
TOTAL	<u>339012</u> 69.4	<u>77230</u> 15.9	<u>30045</u> 6.1	<u>446287</u> 100.0

The total area of forests of Turkmenistan as of 1 January 1998 is 9,568,800 ha, including covered with forests – 4,126,800 ha. Area of reserves is 814,600 ha including covered with forests – 104,000 ha; 6,458,100 ha are used as pastures.

As a result of long-term exploitation of forests their area and reserves were considerably reduced. The total area of fully cut-down of *Haloxylon persicum* plantations is about 5.5 mln ha, and *Haloxylon affilum* – about 0.5 mln ha. Districts with destroyed forests are mainly on the border of the desert and populated areas, near highways and railway roads. In this districts seed plants and natural restoration of plantations does not occur. Former methods of cutting-down impede natural restoration of forest plantations, as when providing firewood the wood-shrubby plants were uprooted with the root system.

Forests of Turkmenistan in accordance with their importance for the environment and categories of protectiveness are subdivided into: antierosive (1,997,700 ha), forests along rivers' banks (36,700 ha), forest-fruit (43,000 ha), forests of natural park (54 ha), sanitary forests (5,100 ha) and others, which are of importance for environment protection (7,125,000 ha). During last 10-15 years artificial forests plantation were created on the area of more than 900,000 ha of sands, of which 650,000 ha were transformed into area fully covered with forests.

Factors provoking desertification are technological facilities used while developing deserts (construction linear and area sites). According to contour of manifestation the so called “technogenic desertification” is divided into area, linear-area and spotted, contours of

manifestation of which could 4-8 times exceed areas of erected projects. Currently deserts of Turkmenistan have become arenas for intensive industrial development. Particularly great engineering construction is performed in connection with discovering and developing new oil and gas fields, establishing of large industrial sites. New railway roads and highways, pipelines and electricity transmission lines stretch out across the desert.

Any construction is connected with earth-moving resulting in new forms of relief, which are not peculiar to these places, - grooves, embankments, sand-pits, trenches, etc, which aggravate deflation processes. Only around one derrick (from beginning of drilling till running) surface of sandy deserts is destroyed on the area of 3.4 ha. By the year 2010 exploration and running of other ten new natural-gas fields is scheduled.

Recently, dragging of assembled derricks with the help of a great number of powerful caterpillar tractors has been practiced. As a result sand dunes of 100 m wide and 150-200 km long are destroyed.

Linear-strip foci of desertification occur under the influence of motor and caterpillar transport, and as a result of earth-moving or digging. In sandy deserts transportation destroys sod of sand Sedge protecting sand surface from deflation. As a result, stable sand surface is destroyed, sand is moved with wind and laid on sides of roads in the form of tail areas 50-100 m wide.

When laying pipelines a strip of technogenic soil of 20-200 m wide is formed, where vegetation is destroyed and deflation becomes stronger. So, along the route of the main water pipeline in the Central Karakum of 180 km long and its tees the sand dunes of the total area of 5,000 ha formed because of the lack of recultivation.

Technogenic desertification also occurs as a result of construction and running of large irrigation canals.

2.3. Monitoring and desertification database

Monitoring allowed scientists and specialists to determine duration period of desertification processes, to evaluate their spatial-time dynamics and validate prognosis of further development. Such work is one of important section of the National Action Program to Combat Desertification of Turkmenistan. Data gained with monitoring underlay theoretical and methodological recommendations, which were elaborated at the Institute of Deserts. Images gained from the artificial satellites "Meteor-Priroda", equipped with survey facilities for visible, infrared and microwave spectrum, were widely used in the monitoring of desertification processes.

The database on desertification control comprises information as follows:

- On topographical maps;
- On thematic maps;
- On aerial images;
- On space images;
- On desertification processes analysis;
- On bibliography;
- On implementation of projects to combat desertification.

Ground-based monitoring is conducted at research stations and reserves. For instance, such a work has been conducted for more than 25 years by the Repetek biosphere reserve.

For summarizing and evaluation of desertification processes a database has been created, representing information-reference system. It contains cumulative and maintained in working conditions aggregate information and software necessary for achieving set objects. Database provides information to user groups or material for environmental expertise, for solving problem-oriented, or prediction and managerial tasks.

2.4. Land tenure system

Analysis of agricultural enterprises and private land tenants show that almost 90 % of land are pastures. The share of irrigated land is about 2 mln ha of 12 mln ha suitable for irrigation. The most labor-intensive but profitable branch of agriculture is irrigated farming. Volume of products in terms of value produced on 1 ha of irrigated land almost 40 times exceeds production capacity of 1 ha of non-irrigated land.

Currently, the level of irrigated farming does not satisfy country's requirements and that is connected with small yields and low incomes. Reasons for general tendency of lowering productivity of irrigated land in Turkmenistan are rather varied. One of them is worsening of ameliorative state of land as a result of land salinization that is one of conditions of the desertification processes development.

Currently a land reform is being implemented in Turkmenistan. On 12 October 1990 a "Land Code of Turkmenistan" was adopted according to which rural citizens are provided with plots for private farming and urban citizens and citizens of populated areas – for individual construction, horticulture and truck farming.

Particularly, citizens of Turkmenistan at their request are provided into private ownership plots with the area of up to 50 ha for free enterprise without the right for selling, donation and exchange.

In realization of the National Action Program to Combat Desertification an important role is given to the local population. In 1992 the President of Turkmenistan, S.Niyazov, proclaimed a Program "10 Years of Stability" and a Program "New Village". Within the framework of implementation of these programs a national front – "Milli Galkynysh" (Movement of National Revival) is actively formed. A complex of measures for social security of the population and providing of necessary living and labor conditions for people is undertaken in the country. With all-round gasification and electrification of rural populated areas the necessity in cutting down plants and shrubs for firewood disappears that considerably improve environmental situation.

A new organization – Gengeshi, as a representative body of people's authority in cities and villages, which activity is based on the principles of territory-social self-government, takes an active part in nature protection. Within its commissions Gengeshi makes decisions obligatory for being executed on its territory.

People's Councils of Elderly play a special role among public organization.

2.5. Review of implemented projects within the National Action Program to Combat Desertification

Representatives of Turkmenistan took an active part in the work of the International Conference on Desertification Control Problems in Nairobi in 1977. Special training courses for interested countries of Asia, Africa and Latin America were organized on the basis of the Institute of Deserts of the Academy of Sciences of Turkmenistan as a first step in implementation of adopted Action Plan to Combat Desertification. They were devoted to such projects as “Improvement of productivity of desert pastures”, “Control of salinization of irrigated soils” and “Stabilization and Afforestation of Moving Sand”. During the courses, 1979 through 1991, 600 people from 62 countries raised the level of their skills.

In 1967 in accordance with the Decree of the State Committee of the USSR in Science and Technology and the Presidium of the Academy of Sciences of the USSR the Institute of Deserts of the Academy of Sciences of Turkmenistan received the status of the leading research institute and coordinator for the scientific work to combat desertification executed on the scale of the Soviet Union. In 1985 on the basis of the Institute of Deserts the National Center for Research and Training in Desertification Control for countries of Asian-Pacific Region was established.

In February 1987 a meeting of the UN Advisory Commission on Science and Technology Development was held, which was devoted to the implementation of the Action Plan for desertification Control.

In April 1988 on the basis of the Institute of Deserts a special conference of the inter-agency working group on desertification was held in which the representatives of UNEP, FAO, UNESCO, ESCAP, WMO and others took part. One of the main issues of the agenda was “Conception, financing and functions of regional networks to combat desertification”.

Currently the Institute of Deserts is an organizer of a network of research and training centers of the CIS to combat desertification. This network includes large research, educational, public and scientific institutions and organizations of Turkmenistan, Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, Azerbaijan and Russia for which a problem of desertification is of great importance.

Within the project USSR/UNEP FP 6201-87-05 “Support to Countries of Western Africa for Strengthening National Activities to Combat Desertification” (1988-1990) certain measures were fulfilled, such as “Elaboration of a Scheme of Complex development of Mali” and training courses “Pasture Land Reclamation and Desertification Control” and “Evaluation, Mapping and Monitoring of Desertification”.

In 1995 scientists and specialists of Turkmenistan prepared a methodological guide for evaluation and mapping of desertification processes, which was submitted to the UNEP for distribution.

During 1992-1993 the Institute of Deserts worked out and transferred to the UNEP and ESCAP a package of project proposals on rational arid land reclamation and desertification control in the Asian-Pacific region. Within the framework of scientific activities during the period of 1991-1998, 16 methodological recommendations for studying desertification processes and control of landscape degradation were prepared and published in Turkmenistan. A specific attention was paid to the criteria and indices of desertification and interdependence and interaction of natural and anthropogenic factors.

In 1995 a concept of evaluation and technique of mapping of desertification processes with regard to the world-round experience was elaborated at the Institute of Deserts of Turkmenistan. Regional criteria of desertification in conditions of Turkmenistan were worked out and a map of anthropogenic desertification in the Aral Sea basin on a scale 1:250,000. Definition of types and scales of desertification allowed to elaborate main measures to combat desertification processes and forecast their development up to the year 2010.

In 1994 scientists of the Institute of Deserts prepared a proposal on making up “Atlas of desertification of arid land of Asia” in which scientists and experts of Kazakhstan, Uzbekistan, China, India, Pakistan, Mongolia, Iran and other countries of the region will take part. The Institute of Deserts of the Academy of Sciences of Turkmenistan in cooperation with the Institute of Geography and Geocryology of the Academy of Sciences of Mongolia made a map of desertification of Mongolia, methodological approaches of which could be used in making similar maps for other countries. To support studying and summarizing the world experience on problems of arid zone special English-Russian, Russian-Turkmen and French-Russian dictionaries of terms on desertification were issued by specialists of the Institute of Deserts, Flora and Fauna. Turkmen explanatory dictionary on problems of deserts of 8 printer’s sheets has been prepared there.

An important role in implementation of the National Action Program to Combat Desertification is played a scientific-practical journal “Problems of Desert Development”, in which not only results of scientific investigations but international experience in development of dry land is illustrated.

In January 1994 a conference for scientists and specialists of Central Asian countries was held, in which results of working out national action programs were discussed within the National Action Program to Combat Desertification.

In August 1998 a workshop was held devoted to issues of national approach to implementation of the National Action Program to Combat Desertification and preparation of the Central Asian Regional Convention to Combat Desertification.

In implementation of the National Action Program to Combat Desertification the German Agency for Technical cooperation GTZ provides wide assistance, as well as the Secretariat of the UN Convention to Combat Desertification through the UNDP/UNSO project.

Due to the support of GTZ in 1997 a Consulting Center to Combat Desertification was established which was equipped with modern computers, telecommunication facilities and software for operation of the Geographic Information Systems (GIS).

In 1999 with the help of the “Springer” Publishing House a book “Problems of Deserts and Desertification Control in Central Asia” was published under the editorship of Professor A.Babaev with the foreword of Mr M.Lehman, the head of the Department of Central Asia and Caucasus of the Ministry of Economic Cooperation and Development of GFR.

In 1999 the project UNDP/UNSO “Implementation of the National Action Program to Combat Desertification in Turkmenistan” started. For the purpose of ecological education of the local population together with the German Agency for Technical cooperation GTZ workshops were held in Sakachaga etrap of the Mary velayat, in Tagta etrap of the Dashoguz velayat; calendars and posters highlighting the National Action Program to Combat Desertification were issued. For participants of competitions on desertification

control 500 T-shirts with the emblem “NAP CCD” were made as souvenirs. A popular book about deserts and UN Convention to Combat Desertification in the Turkmen language is being prepared for publication.

Along the highway Ashkhabad-Dashoguz, crossing the Karakum Desert southwards, near the settlement Bakhardok pilot projects were implemented for moving sand stabilization and afforestation on the area of 8 ha. 30 solar batteries were purchased for lifting water out of wells and lighting shepherds' houses in distant desert pastures.

One of the important linchpins in desertification control is participation of the local population in the implementation of the National Action Program to Combat Desertification in Turkmenistan. In this connection a very important work was performed in the cattle-breeding farm “Erbent” located in the Central Karakum, with the population of about 10,000 people. Under social-economic conditions this farm directly suffers from the impact of typical desert ecosystems. This category of people keenly experiences an impact of desertification processes. Therefore, particularly their ecological awareness directed towards rational nature management is of importance for preservation of the nature integrity.

On the territory of the cattle-breeding farm in the Central Karakum more than 100,000 sheep and almost 2,500 camels are kept, of which nearly 50 % are in the private sector. The farm has 860,000 ha of the round-year desert pastures and 900 ha of irrigated land which are used for growing insurance fodder stocks, wheat, grapes, and vegetables for their own needs. The farm runs a water pipeline, with the help of which water is pumped from the Karakum River to the distance of 120 km.

A new approach of scheduling actions “top-downward” is used. This means that people in provinces have a right to participate in scheduling and implementation of primary tasks of action. To reach participation of people in scheduling primary tasks and optimum way of their realization an investigation with the use of worked out techniques was conducted. It was revealed that workshops with the participation of old people, young shepherds, schoolchildren, women and other people are very efficient. Efficacy of implementation of the National Action Program to Combat Desertification rises if investigators and local people work together. Establishment of Scientific Production Organization for different target groups is outlined.

In 1999 under a Decree of the President of Turkmenistan Saparmurat Niyazov a Joint-stock Company “Gyok Gushak” (Green Belt) was established, which started a wide front of work for creation of six-row shelterbelt around Ashkhabad and other towns and etrap centers. In conditions of deserts such implantations are able to safely protect populated areas from burning and dust winds, to create a favorable microclimate and beautify a landscape.

During a short period more than 3 mln of conifers, deciduous trees, fruit trees and other species of trees have been planted, which are carefully cared. Efficient measures of mass nature protection policy are being developed.

In December 1999 at the meeting of representatives of people's elders and the movement “Galkynysh” (Renaissance) the President A.Niyazov proclaimed a new large-scale Program “Strategy of Social-economic Reforms in Turkmenistan for the period till the year 2010”, in which a great attention is paid to the nature protection within the context of implementation of the National Action Program to Combat Desertification.

3. LEGAL ASPECTS OF NATURE PROTECTION, RESERVES AND IMPACTS OF AGRICULTURAL-INDUSTRIAL COMPLEX ON THE DESERTIFICATION PROCESSES DEVELOPMENT

3.1. Standard-legal acts

Protection and rational management of the nature is one of the fundamental principles of the state policy of Turkmenistan. The Law “On nature protection” passed in 1991 underlies activities of all branches of industry and is directed to ensuring of priorities of environmental interests of the society with regard to scientifically grounded combination of social-economic and environmental problems. The Law stipulates actions of the state when extreme environmental situations, control in the sphere of nature protection, responsibility for violation of the nature protective legislation.

For the purpose of providing protection of the nature monuments, unique and under the threat of vanishing species of animals and plants of big scientific and esthetic importance, in 1992 there was promulgated a Law “On state especially protected territories”.

In 1993 a Law “On flora protection and rational management”, and in 1997 a Law “On fauna protection and rational management” were passed, which are directed to preservation of gene pool and biological diversity of flora and fauna of Turkmenistan as a basis for stability and sustainability of ecological systems and the biosphere as a whole.

The Law “On depths” was passed in 1991 and the Law “On hydrocarbon resources” – in 1996, which is directed to ensuring rational and efficient management of hydrocarbon resources and conservation of natural resources of Turkmenistan and regulates relations appearing during implementation of oil and gas projects on the territory under the Turkmenistan’s jurisdiction including the sea and its internal reservoirs. On 6 June 1997 within the Law and under the Presidential Decree a Competent Body for Exploration of Hydrocarbon Resources at the President of Turkmenistan was established, which is a body of the state government conferred with exclusive powers on negotiations on the governmental level, licensing and conclusion of treaties.

For the purpose of atmospheric air protection, prevention and decreasing of harmful chemical, physical, biological and other atmospheric impacts in 1996 the Law of Turkmenistan “On protection of atmospheric air” was passed.

In 1993 a Forest Code of Turkmenistan regulating forest relations in Turkmenistan and directed to creation of conditions for rational management of forests, their reproduction and protection.

The Law of Turkmenistan “On state ecological expertise” being passed in 1995 is directed to ensuring environmental protection from disturbances while industrial construction.

Under the Presidential Decree of 1995 the Regulations about hunting and hunting management in Turkmenistan was approved, and in 1998 a Law “On hunting and hunting management in Turkmenistan” was passed, regulating relations in the sphere of hunting and hunting management and directed to preservation and rational management of fauna of Turkmenistan.

There are a number of legislative acts regulating nature protection activities. They are as follows: “Regulations on depths use taxes” (1992), “On horticulture and greenery planting

development in Turkmenistan” (1992), “On park zone creation in the piedmont of the Kopetdag Mountains” (1998), and then “On park zone development in the piedmont of the Kopetdag Mountains” (1998).

Administration and Criminal-judicial Codes steadily have been improved. In particular, the Criminal Code includes an issue on water, land and air pollution, pollution of the sea water with agents dangerous for the health of people and living organisms or with other waste products and materials; on illegal hunting and cutting down forests, unauthorized land and water usurpation, violation of rules set to combat diseases and pests.

In 1996 under the Presidential Decree “Regulations on the State Fund for the nature protection of Turkmenistan” was passed. In accordance with these Regulations the State Fund for the nature protection is established for financing the nature protection actions, reproduction of natural resources, restoration of environment losses, liquidation of environmental consequences of possible accidents and catastrophes, and reparation of caused damages as well as for covering unforeseen expenses for this purpose.

The Ministry of Nature Protection is entrusted with the control and interdepartmental management in the sphere of the nature protection and natural resources management including the Forest Fund of Turkmenistan.

Turkmenistan has joined and its Parliament ratified a number of international Conventions on environmental protection: “On Desertification Control”, “On Biological Diversity”, “Basle Convention of Transborder Transportation of Dangerous Waste Products”, “Framework Convention on Climate Changes”, “Vienna Convention and Montreal Protocol on Ozone Layer Protection”. For the purpose of the efficient meeting of Turkmenistan’s engagements on implementation of provisions of Conventions and UN programs on environment protection under the Decree of the President of Turkmenistan # 4091 of 01 March, 1999, a State Commission was established with seven working groups consisting of managerial officials, scientists and specialists of ministries, departments and public institutions.

The problem of the Aral/Caspian Sea basin is still urgent.

At the Meeting in Ashkhabad on 8-9 April, 1999 Heads of states discussed issues of rehabilitation of ecosystem of the Aral Sea basin and the work carried out by the International Fund of the Aral Sea.

Within the framework of the Caspian Environmental Program (CEP) in May 1998 in Ramsar (Iran), a decision was reached on establishing 9 regional theme centers. A Regional Theme Center to Combat Desertification was established in Turkmenistan. The Center has become leading institution in this direction along the whole waters of the Caspian Sea. Its specialists have worked out a project for desertification control in the Caspian Sea basin, which was submitted to the appropriate international organizations.

In general all standard-legal acts regulating the nature protective activities correspond to the existing situation, however, when working out new acts or revising existing ones, it is necessary to regard the environmental policy, at least, equally with the policy in other spheres, as environmental requests, secured in the Constitution of the country, are obligatory for all natural and juridical persons at the national and local level.

3.2. Desertification and Industry

Industry is a leading branch of Turkmenistan's economy. Currently more than 4,800 industrial enterprises of all forms of ownership are functioning in the country. The share of industry in the economic profit of the country is 80 %. In the sectoral structure of output of industrial products the share of fuel and energy complex is 55.6 %, light industry – 20.2 %, food industry – 10.8 %, building materials industry – 6.3 %. The share of extractive industries in the structure of industrial production is 22 %.

Intensification of nature use, functioning and development of industry, particularly its extractive branches, promote the growth of anthropogenic load on environment, that leads to desertification of its separate components. According to specialists, 66.7 % of the country's territory is subject to desertification, of them 11.5 % - because of wind erosion, 43.6 % - pasture degradation, 5.4 % - salinization of irrigated land and 3.1 % - because of technogenic desertification. With that air, soil, surface and ground water pollution takes place as well as the reduction of biodiversity.

The most intensive impact on nature is exerted by the oil and gas field development. Disturbance of the natural relief takes place because of drilling works, construction of the pipeline networks and building sites for engineering works, moving of numerous machines. When constructing main pipelines a design stripe varies from 50 to 200 meters, on which a turf cover is fully destroyed. Commissioning of one gas field strips turf relief on the area of about 600 ha and sands are transformed into moving ones. In regions of oil extraction when technological losses or breakdowns with emission of condensate and oil on the bordering territory, considerable local soil pollution and vegetation cover destruction may be observed.

The most dangerous situation occurs at pipelines located on the coast of the Caspian Sea because of the sea level fluctuations, where during storms the ground around pipes is washed out that sometimes leads to discontinuation of pipelines and leakage of oil products into the sea.

In separate regions when constructing open-cast mines for mining building materials the fertile land is put out from circulation. For instance, 6,000 ha of sierozems in the piedmont plain of the Kopetdag Mountains were degraded.

Significant air pollution is observed in connection with discharges of industrial enterprises and transportation. In the country there are 261 enterprises with discharge into the air, and a number of sources of discharge is 6,465, of them 4,893 (1995) are organized sources. In 1995 507,500 tons per year of contaminants were discharged without purifying, which are concentrated mainly in the Balkan (80 %) and Akhal (about 7 %) velayats (97 % of them are gaseous and fluid ones).

In pollution of water resources the share of fuel-energy complex is 8-12 % and of municipal economy – 2-3 %.

For the problem to be solved, structural-environmental reforms of the country's economy are being realized based on the development of the resources-economy technologies, deep processing of wastes with gradual transition to low- and wasteless industrial processes.

3.3. Desertification and agriculture

Environmental problems in Turkmenistan are tightly connected with agriculture as the main user of land and water resources.

Of total lands of agricultural holding, which are of 40 mln ha, the share of arable-fit land is 12 mln ha, of them highly fertile are 4.0 mln ha. Currently 1.8 mln ha are irrigated. Land used in agriculture substantially are subject to the processes of desertification.

Irrigated land constitutes a little part in the structure of available land, however it is used with high capacity load on environment. On the area of 664,000 ha (38.5 %) of irrigated land ground water are located at a depth of 2 meters. So, this is a reason of the secondary salinization of soils and their poor productivity. As of 1 January 1999 irrigated soils were divided as regards degree of salinity as follows: nonsaline – 4.08 %, slightly saline – 27.11 %, moderately saline – 57.22 %, and heavily saline – 11.58 %. The main reason of high development of soil salinity is the poor supply of soils with artificial drainage, which on average is 42 % in the country, and in velayats it varies within the range of 29 and 70 %. Degradation and desertification of lands are also caused by irrational usage of mineral fertilizers, pesticides and defoliant, extensive system of agriculture with cotton monoculture, irrational water management, insufficient system of crop rotation, collector-drainage water, wide development of soils with low content of humus (almost 75 % of the total area), decrease in pasture productivity, etc.

3.4 Reserves as subjects of inquiry

Reserves, sanctuaries, national, historical-natural and memorial parks, monuments of nature, botanical and zoological gardens, arboreta, natural territories of sanitary assignment are especially protected territories. Other categories of especially protected areas could be stipulated by the legislation of Turkmenistan as well as by decision of the local executive authorities.

There are eight state reserves (Amudarya, Badkhyz, Kopetdag, Kaplankyr, Kugitang, Repetek biosphere, Syunt-Khasardag, Khazar reserves) and fourteen sanctuaries, which are under jurisdiction of the Ministry of Nature Protection of Turkmenistan.

Protected territories yet do not cover all main landscapes of Turkmenistan, but the most species diversity of flora and fauna is concentrated there.

Amudarya reserve (founded in 1982, the area of 48,500 ha) consists of the tugay forests ecosystem of the Amudarya River valley as well as of bordering desert areas. 48 species (subspecies) of animals, 203 species (subspecies) of birds inhabit the area; 1,040 species of higher plants grow here. Among vertebrates there are such rare species as dzeiran, Bukhara deer, honey badger, otter, spoon-bill, teal, fish hawk, etc.; of fishes they are big and little Amudarya shovel-nosed sturgeons, pike-like carp.

Badkhyz reserve (founded in 1941, the area of 87,700 ha) consists of ecosystems of hilly-ridge height in the foothills of the Paropamiz mountain range. 40 species of mammals, 250 species of birds and 34 species of reptiles inhabit the reserve. The include: dzeiran, Turkmen mountain sheep, kulan, striped hyena, caracal, leopard; of birds: golden eagle, houbara bustard, boiga, etc. 1,050 species of vascular plants grow in Badkhyz, among which 75 species and subspecies are endemic.

Kaplankyr reserve (founded in 1979, the area of 282,800 ha) occupies the main territory of clay plateau-like height Kaplankyr, which is the southern spur of Ustyurt. 26 species of animals, 147 species of birds, 918 species of higher plants dwell there. Rare animals are preserved: dzeiran, Ustyurt mountain sheep, honey badger, etc; of higher plants: salsola, Turkmen tulip, gypsophila, sand acacia, etc, 55 endemic species altogether. Huge populations of saigas migrating here in winter period from Karakalpakia are also protected.

Kopetdag reserve (founded in 1976, the area of 49,800 ha). Ecosystems of mountain forests are studied and protected in this reserve. The protected territory occupies the high and medium mountains belt of the Central Kopetdag Mountains, or between meridians crossing the Archman station in the west, and Gyaurs station in the east. 68 species of animals, 280 species of birds live there; more than 960 species of higher plants grow here, of which 40 species are endemic.

Repetek international biosphere reserve (founded in 1928, the area of 35,000 ha) is located at the turn of the Central and South-Eastern Karakums. 20 species of mammals and 25 species of birds inhabit the reserve; 269 species of higher plants represented by 84 families and 206 genera. Of 132 species of native (aborigine) plants of the reserve, 42 species (31.8 %) are endemics of deserts Karakums and Kyzylkums.

Syunt-Khasardag reserve (founded in 1978, the area of 13,400 ha) covers ecosystems of the Western Kopetdag (dry subtropics) and bordering plain territories. 37 species of mammals, 217 species of birds inhabit the reserve. Flora of the Western Kopetdag numbers 1,266 species of higher plants belonging to 223 genera and 500 families, among them 150 are endemics.

Khazar reserve (founded in 1968, the area of 192,300 ha) is situated on the south-eastern coast of the Caspian Sea. It is included into the list of water-marsh areas of international importance, protected under the Ramsar International Convention. 18 species of mammals and 372 species of birds inhabit the reserve, of them almost a half is water-fowl and near-water birds (more than 85 % of the territory-waters of the gulf and sea).

Protected territories represent the most unique landscapes of the country, places, where long-term observations of ecosystem are performed and tasks of forecasting are decided.

3.5 Priority ecological-economic problems

Turkmenistan for the eighth year has been on the independent stage of sustainable development. The Program “10 years of stability” is being successfully completed, which has played its key role in transformation of Turkmenistan into the prosperous state. During this small period deep and qualitative reforms are taking place in political, economic and cultural life of the country, as well as a deep process of the national revival.

Beginning from the year 2000 a new comprehensive Program of the President of Turkmenistan S.A.Niyazov “Strategy of social-economic reforms in Turkmenistan for the period up to the year 2010” made a good start. It more strongly requires further development of industrial and agricultural production without any prejudice to the environment.

At the same time it is of prime importance on this stage to distinctly determine the main priority ecological-economic trends, to be the foundation of the sustainable development of Turkmenistan.

The priority ecological-economic and social problems hindering from sustainable development of Turkmenistan could as follows:

1. Problems of combating desertification control. Land desertification is mainly connected with irrational nature management (overgrazing, soil overmoistening and the secondary salinization of irrigated lands, soil erosion and deflation as a result of industrial, transportation and irrigation construction, cutting down plants for firewood). It would be difficult for Turkmenistan to reckon on sustainable development of the country without solving these problems.

2. Problems of exhaustion and deterioration of water. In this connection the main alert was caused by irrigation, which, because of the irrational usage, has led to salinization and swamping of vast areas of irrigated land, and water deterioration is directly connected with the population health.

3. Problems of the employment growth and settling down of the population. In this aspect the task is to direct the man's activities into the wholesome course and to create favorable social conditions to the population. Ecological situation is most urgent in regions of the Aral and Caspian Seas.

4. Problem of repeated usage of collector-drainage water. Annually about 7 km³ of collector-drainage water, dirty with different salts, pesticides and insecticides, are dumped from irrigated fields. This water is usually dumped to either Karakums, where currently almost 400,000 ha of pastures are flooded, or to the existing river beds, where the landscape degradation is becoming worse.

5. Problems of forest rehabilitation and afforestation. During last 20-30 years the area covered with forests has decreased almost by 32 %. Instead of forests the processes of desertification began developing (moving or drifting sands, solonchaks and bogs, and in mountains – gullies, badlands and washing out of fertile soils).

6. Problems of the Aral Sea and Turkmen Aral Sea region. This is the most crisis environmental problem, which is caused by the Aral Sea drying. It resulted from unchecked development of irrigated farming and growth of irreversible water usage. As far back as in 1960-s the disastrous lowering of the sea level and increase in mineralization of water, abolition of the fish populations and the whole coastal flora and fauna began. This resulted in great social-economic damage to the population and economy.

7. Problems of the Caspian Sea and Turkmen Caspian Sea region. The Caspian Sea, the largest closed reservoir in the world, is washing the western borders of Turkmenistan for 600 km. Transgression, which began in 1978, led to the flooding of vast coastal territory. This caused damage to the industrial objects, roads, and populated areas. The sea water is polluted with oil and gas products and products of their processing, communal wastes. Fragile ecosystem of the Caspian land is suffering from desertification.

All these priority environmental and social-economic trends are connected with implementation of a new State Program, which stipulates an improvement of the nature protection legislation, support of the modern scientific-engineering techniques for the estimation of the technogenic factors impact on environment, introduction of modern methods and techniques of rational land and water management, learning of the world

experience in controlling desertification, protection of rare and vanishing species of flora and fauna, creation of information databases and software for their processing, control and management of processes of technogenesis.

The denoted above priority problems envisage first of all the improvement of the population's prosperity through establishing healthy biosphere, and sustainable development of the social and economic foundation of the state.

SUMMARY

Introduction. Turkmenistan, a new state on the political map of the world, proclaimed its independence on 27 October 1991. Turkmenistan is situated in the western part of Central Asia between latitude 38°08' and 42°48' north and longitude 52°27' and 66°41' east. The occupied area is 491,200 square km. Its population is 5.2 mln.

The territory of Turkmenistan fully lies in the zone of Central Asian deserts and its nature conditions are characterized with extreme climate. Its northern territory is a part of the Aral Sea ecological disaster. In this connection the country is actually under the pressure of desertification processes and this situation imprints on the whole economy and social sphere of Turkmenistan. Therefore, Turkmenistan pays great attention to the protection of environment for the purpose of reservation of health and prosperity of people.

Due to the vast territory and small number of the population processes of desertification do not constitute a serious menace. Nevertheless, nature fragility and its extreme sensitiveness to man's activity set the territory of Turkmenistan into the zone of great environmental risk.

Taking into consideration topicality of studying and working out techniques for complex development of dry lands, in the system of the Academy of Sciences of Turkmenistan in 1961 an Institute of Deserts was established. His tasks included not only research work but coordination of work in working out the techniques on a scale of the USSR. Beginning from 1967 up to present moment an international scientific journal «Problems of Desert Development» has been published at the Institute of Deserts, and from 1980 an English version of the journal has been published in the USA. Consequently, Turkmenistan has already obtained considerable and scientific experience before 1977 when a «World Plan to Combat Desertification» was passed at the international conference in Nairobi. Therefore, Turkmenistan joined in implementation of the Plan as an active member. From 1979 till 1991 International Scientific Training Courses functioned in Turkmenistan for improvement knowledge in the sphere of desertification control for representatives of developing countries of Asia, Africa and Latin America. During 12 years (before collapse of the USSR) 600 specialists from 62 countries had studied at the courses.

In 1995 Turkmenistan joined the UN Convention to Combat Desertification and Drought Mitigation, and in 1966 the Parliament of the country ratified it. In the same year a Governmental Commission for preparing the National Program to Combat Desertification in Turkmenistan was established. On the whole, appropriate ministerial structures, departments, scientific institutions, institutes, NGO's and rural communes were involved into the successful implementation of the Convention on the national level.

1. Strategy and priorities determined within the plans of sustainable development

Analysis of the land management structure in Turkmenistan shows that 90 % of the territory is characterized by desert landscape, which serves as a round-year pastures for sheep and camels. About 2 mln ha fall to the share of irrigated lands concentrated in oases. Pasture farming in the country is one of the most profitable and least labor-intensive industries of economy. However, pastures on the significant territory were deserted and have low fodder capacity. So, of 39.5 mln ha of pastures 69 % are degraded, 37 % are not flooded and 5 % have been transformed into bare moving sands. If now about 10 mln heads of cattle are being pastured, the appropriate phyto-ameliorative measures, probably, will allow to 2-3 times increase their productivity and bring up a cattle head up to 20 mln heads.

One of the key issues of sustainable development is the problem of water supply and irrigation. 100-150 mm of precipitation falls in Turkmenistan during a year mainly as a rain and evaporation more than 20 times exceeds precipitation. Hence, Turkmenistan suffers great deficit of fresh water. Rivers have unstable run-off and do not meet the country's requirement in water. Therefore, search for additional sources of water supply for the growing economy and the population of the country is of great urgency.

Almost the whole plain territory of Turkmenistan belongs to sandy deserts formed by ancient deposits of the river run-offs, which are exposed to deflation. Dune sands formed during this process are of big harm to different valuable objects. Railways and highways, irrigated land, canals, reservoirs, populated areas, pipelines, etc., suffer from sand drifts and deflation. Control of sand deflation and erosion give the possibility to preserve productivity of hundreds of thousand hectares of land and run trouble free the important engineering constructions and people's life support objects.

In regions of irrigated farming a great disaster is the land salinization, an important factor of desertification. Currently 30 % of irrigated land is at the stage of high salinization, and 50 % - of moderate salinization. Only 20 % of land are in more or less favorable ameliorative state. As a result of land salinization agricultural crops capacity drops by 50 % and sometimes even lower. That means that a complex of measures should be performed in this direction including construction of ramified drainage network.

Ecological situation in the Aral Sea basin is of negative impact for the sustainable social-economic development of the country. In this region the Dashoguz velayat of Turkmenistan is situated, in which the population suffers from drinking and irrigation water of poor quality, with which the development of different diseases is connected. The country pays a great attention to this region, provides a large financial and technical support. In 1998 the National Program of Environment Protection in Turkmenistan was developed on the Governmental level in cooperation with the UNDP, in which measures for desertification control were defined, and now it is at the stage of implementation. Issues of desertification control are reflected in plans of the Ecological Fund of Turkmenistan, Nature Protection Society, NGO «Catena», Turkmen geographical Society, etc.

In 1996 the State Fund for Nature Protection of Turkmenistan was established, which within the limits of the possible provides financial assistance to organizations for their nature protective activities. All these strategic trends and priorities are clearly determined in the Program of the President of Turkmenistan «Strategy of Social-Economic Reforms in Turkmenistan for the period up to the year 2010».

The main state executive body in the sphere of environment protection is the Ministry of Nature Protection of Turkmenistan.

2. Institutional, organizational and legislative measures for implementation of the National Action Program to Combat Desertification

Protection and rational management of nature is one of the fundamental principles of the state policy of Turkmenistan. The Law «On Nature Protection» passed in 1991 underlies activities of all industries and directed for ensuring priority of environmental interests of the society with regard to scientifically grounded combination of social-economic and environmental problems. The Law stipulates actions of the state when extreme environmental situations, control in the sphere of nature protection, responsibility for violation of the nature protective legislation.

Laws «On state especially protected territories» (1992), «On flora protection and rational management» (1993), «On fauna protection and rational management» (1997) were also passed.

The Law «On hydrocarbon resources» (1996) is directed to ensuring rational and efficient management of oil and gas resources. On 6 June 1997 a Competent Body for Exploration of Hydrocarbon Resources at the President of Turkmenistan was established, which is a body of the state government conferred with exclusive powers.

In 1996 the Law of Turkmenistan «On protection of atmospheric air» was passed, and in 1993 — a Forest Code of Turkmenistan directed to creation of conditions for rational management of forests, their reproduction and protection.

The Law of Turkmenistan «On state ecological expertise» being passed in 1995 is directed to ensuring environmental protection from disturbances.

There are a number of legal acts regulating nature protective activities: «On development of horticulture and planting of greenery in Turkmenistan» (1992), «On creation of park zone in the Kopetdag piedmont» (1998).

The Ministry of Nature Protection of Turkmenistan is entrusted with control and intersectorial management in the sphere of nature protection and rational usage of nature resources.

Turkmenistan has joined and its Parliament ratified a number of international Conventions on environmental protection: «On Desertification Control», «On Biological Diversity», «Basle Convention of Transborder Transportation of Dangerous Waste Products», «Framework Convention on Climate Changes», «Vienna Convention and Montreal Protocol on Ozone Layer Protection». For the purpose of the efficient meeting of Turkmenistan's commitments on implementation of provisions of Conventions and UN programs

on environment protection, in March 1999 a State Commission was established with seven working groups.

In April 1999 Heads of States of Central Asia at the sitting of the International Fund of the Aral Sea arrived at decision on accelerating stabilization of ecological situation in the Aral Sea basin.

In the framework of the Caspian Environmental Program (CEP) in May 1998 a Regional Theme Center to Combat Desertification was established in Turkmenistan (Ashkhabad).

Among especially protected territories there are reserves, sanctuaries, national, historic-nature and memorial parks, nature monuments, botanic and zoological gardens, arboreta, natural territories for health improvement.

Protected territories yet do not cover all main landscapes of Turkmenistan, but they concentrate the largest species diversity of flora and fauna of the state.

Protected territories represent the most unique landscapes of the country, where the monitoring of environment is executed.

3. Process of participation of state, non-governmental organizations and rural communes in the implementation of the National Action Program to Combat Desertification

The National Action Program to Combat Desertification in Turkmenistan was developed in 1996 under the support of the UNEP and ESCATO and discussed at the National Conference. It was published in the journal «Problems of Desert Development» (# 1, 2000). In late 1996 it was approved by the State Commission on working out the National Action Program to Combat Desertification and submitted to the Government of Turkmenistan for consideration, then submitted to the UNDP, the World Bank, Secretariat of CCD, UNEP, ESCATO and embassies of the USA, GFR, Great Britain, Chinese Republic and IRI.

In March 1999 a State Commission on ensuring the implementation of commitments of Turkmenistan, arising from the Convention and the UN programs on environment was established. The National Action Program to Combat Desertification is tightly connected with the Presidential programs «10 Year of Stability», «New village», «On planting greenery and horticulture». A project for creation of shelterbelt around Ashkhabad, 140 km in length was prepared and submitted to the Khyakimlik (Municipality) for its implementation. In October 1998 more than 2.5 mln trees were planted. Stabilization and afforestation of sands along highways of the Balkan and Akhal velayats is being performed.

An application was submitted to the World Bank for USD 219,000 credit for mini plant producing drinking water purifying devices.

Within the framework of the National Action Program to Combat Desertification two projects are being implemented with the support of the German Agency for Technical cooperation (GTZ) on problems of natural resources management in the central Karakum with the participation of the local population.

For decentralization of decisions on sustainable development of villages the position of a head of the daikhans' association and elected position of archyn were united in Turkmenistan. He is at the same time a head of Gengeshi, which consists of population-elected aksakals (elders) and women — active and respected people — for solving all problems of the village development.

In order to activate the local population for participation in planning of primary project tasks and optimum ways of their solving, the investigations, PRA surveys, workshops and competitions were held. Non-governmental organizations (NGO) have been established in villages for different target groups with regard to gender policy. This work is done within the framework of Memorandum of Understanding between the Government of Turkmenistan and the UNDP/UNSO. For the period 1999-2000 USD 50,000 have been allocated by sponsors to support the National Action Program to Combat Desertification implementation. On 2-5 March, 1999 an international seminar «Implementation of Convention to Combat Desertification and Convention on Biodiversity: a new approach» was held for solving regional desertification problems.

On 17 June, 2000, a Conference is scheduled devoted to the World Day to Combat Desertification, as well as the National forum before COP-4 starts.

Foreign partners mean to further provide an organizational, technical and financial support for the National Action Program to Combat Desertification implementation in Turkmenistan. In particular, under the initiative of the Secretariat of UNCU and under the financial assistance of the German Agency for Technical cooperation (GTZ) in early 2000 a seminar was held, in which an issue was raised about necessity of working out the most priority regional projects for the Central Asian region (CAR).

On 16-17 July, 2000, a meeting of CAR representatives will be held on the coast of the Issyk-Kul Lake. In its work the highest officials, national coordinators and representatives of non-governmental organizations will take part. The German Agency for Technical cooperation (GTZ) could commit itself to be an intermediary between governments of the CAR countries and international financial institutions.

4. Consultation process to support the National Action Program to Combat Desertification implementation

Having joined almost all conventions and agreements in the sphere of nature protection, Turkmenistan actively supports deepening of international cooperation for implementation of the National Action Program to Combat Desertification and obtaining effective practical results. Its participation in this cooperation on the bilateral or multilateral basis is founded on principles and conceptions ensuing from national tasks.

Economic, scientific and cultural agreements of Turkmenistan with Germany, India, China, Russia and other countries stipulate the usage of the positive nature protection experience, joint issuing of books, posters, and information sheets in the sphere of desertification control.

In the National Action Program to Combat Desertification implementation Turkmenistan closely collaborate with the German Agency for Technical cooperation (GTZ), UN Secretariat on desertification control through the UNDP/UNSO project, with the Tacis on desertification problem within the Caspian Environmental Program, with the World Bank on water supply and health protection. With the financial support of the German Government the Publishing House «Springer» has published in English a book «Problems of arid lands and desertification control in Central Asia» of 18 printer's sheets. In accordance with the agreement between the Institute of Deserts of Turkmenistan and Research Institute of Arid Land of India a book «The Karakum Desert and the Tar Desert» was published in English and Russian. The National Institute of Deserts is plotting an Atlas of Desertification of Asia with participation of scientists of China, Mongolia, Iran, India, Kazakhstan and Uzbekistan.

During consultations and implementation of agreement on partnership in the sphere of desertification control a new national approach in preparation and planning of actions is used. It is an approach «top-downward». This means that people from rural communes have a full right to participate in the implementation of the programs connected with the nature protection and sustainable development. Favorable relations developed between Turkmenistan and international organizations such as UNEP, ESCATO, the World Bank, USAID, UNICEF, etc. Due to financial assistance of the UNEP in 1996 a book of Professor A. Babaev «Problems of Arid Land Development» of 21 printer's sheets was published in English. Publishing House «Alerton-Press» in New-York regularly publishes an international scientific journal «Problems of Desert Development», 6 issues per year.

5. Measures planned or undertaken within the framework of the National Action Program to Combat Desertification in Turkmenistan

To analyze the past experience in the sphere of desertification control in 1994-1999 several books were prepared and published as follows: «International cooperation in desertification problem solving» (1994) in Russian and Turkmen, «Problems of arid land reclamation – National aspects» (1995-1996) in Russian and English, «Problems of deserts and desertification control in Central Asia» (1999) in English. In cooperation with the German Agency for Technical cooperation (GTZ) a project «Activation of the local population participation in desertification control and in sustainable development of a farm». Beginning from 1998 the project is being implemented in the cattle-breeding farm «Erbent» situated in the Central Karakum. At the National Institute of Deserts a Consulting Center to Combat Desertification was established which was equipped with modern computers, telecommunication facilities and software for operation of the Geographic Information Systems (GIS). Beginning from the year 2000 such work is being executed in the Sakarchaga etrap of the Mary velayat, in mountain settlements Nokhur of the Bakharden etrap of the Akhal velayat and in the Tagta etrap of the Dashoguz velayat.

The project UNDP/UNSO «Implementation of the National Action Program to Combat Desertification in Turkmenistan» is at its final stage, within the UNDP a project «Development of potential of countries of the Aral Sea basin» is being implemented.

For the purpose of intensifying a role of the local population in implementation of projects and programs in the sphere of the nature protection, including the National Action Program to Combat Desertification, in separate farms of the Sakarchaga, Gyaurs, Bakharden and Tagta etraps with participation of labor veterans (aksakals), teachers, doctors, shepherds and farmers, women, schoolchildren, representatives of the local authority.

In 1999 a Joint-stock Society «Gyok Gushak» (Green Belt) was established, which started a wide front of work for planting greenery and afforestation around all cities and populated areas. A six-row shelterbelt around Ashkhabad of conifers, deciduous trees, and fruit trees has been already planted. In general during two years more than 6 mln trees have been planted in the country, which are carefully cared. Nearly all ministries and departments, industrial and agricultural associations, research institutions, students, pupils, citizens and countrymen take part in this activities. All expenditures for forest plantations are covered by the state. Forest planting is performed along linear objects — irrigating canals and highways. In early 2000 new railways and motor highways of 550 km of length, which will cross the Karakum Desert, have been built. The National Institute of Deserts, Flora and Fauna is entrusted with the scientific-methodological provision of ameliorative work.

The state commission has been established for the control of planting greenery work.

6. Budget allocations to support the National Action Program to Combat Desertification in Turkmenistan

Turkmenistan as a young state continues suffering from difficulties of transition period. Therefore the Government for the time present is not able to allocate the necessary budget means for implementation of the nature protective measures including desertification control. Nevertheless a definite amount is envisaged in the national budget for implementation of the primary, extremely necessary nature protective measures. In addition, the list of financial sources includes some ministries and departments (the Ministry of Agriculture and Water Management, the Ministry of Energy and Industry, the Ministry of Nature Protection, banks, companies, and khyakimliks) and foreign companies' investments in Turkmenistan.

An important role in the nature protection has been played by a Decree of the President of Turkmenistan of 1993 on free natural gas, electricity and fresh water for the population. By the present time almost 90 % of cities and populated areas are supplied with gas and 70 % are provided with water pipelines. All these measures allowed to sharply decrease the anthropogenic pressure on environment and to improve ecological situation in the country.

Under bilateral and multilateral agreements signed between Turkmenistan and foreign partners their executors are entrusted with the nature protective measures that are also

important for financial allocations (partners of the USA, Italy, Turkey, Iran, Israel, Germany, Japan and China).

In connection with the fact that the nature of the arid zone even in natural conditions is on the verge of degradation, larger budget allocations are necessary for successful implementation of the National Action Program to Combat Desertification in Turkmenistan, mainly for purchasing technical equipment.

7. Criteria and indices used for analyzing and estimating results of implementation of the National Action Program to Combat Desertification in Turkmenistan

Monitoring studies in Turkmenistan have a long history and started in 1912 when the Repetek sand-desert station was established. Later on the monitoring of environment was regularly performed in all eight reserves located in different landscapes of the country. Monitoring data allow scientists and specialists to determine the beginning and duration of desertification processes, to estimate their space-time dynamics and prove predicted conclusions on further development of environmental components. In the monitoring of desertification processes, in addition to the ground images, images obtained from artificial satellites «Meteor-Priroda» are widely used. These satellites are equipped with the facilities for survey in visible, infrared and microwave range of the spectrum.

For the analysis and estimation of results of implementation of the National Action Program to Combat Desertification in Turkmenistan a database was created at the National Institute of Deserts, Flora and Fauna, which is an informational-reference system. It contains a combination of information and computer programs, accumulated during a long time and necessary for scientific analysis, planning and implementation of the nature protective measures and for rational management of natural resources. The database uninterruptedly provides executors with a necessary information or materials for environmental expertise and preparation of proposals for officials and for solving of forecast or management tasks.

The database on the desert problems and desertification control contains an information as follows: on topographic maps, on subject maps, on aerial and space images, on desertification processes analysis and estimation, on criteria and indices of current state and tendencies in desertification development, on world experience in desertification control, on international and partner cooperation and on bibliography.

The specialists of the National Institute of Deserts, Flora and Fauna have worked out techniques of monitoring and instructions for plotting maps of desertification, which were discussed and approved in appropriate departments of the UNEP, ESCATO and FAO.

On the basis of accumulated base data a chart of the current state of desertification on the territory of Turkmenistan on the scale 1:1,000,000.