

# **NATIONAL ACTION PROGRAMME TO COMBAT DESERTIFICATION IN TURKMENISTAN (RÉSUMÉ)**

## **INTRODUCTION**

Desertification is one of the most serious ecological and socio-economic problems which worry the mankind on the threshold of XXI century. Desertification is the result of interaction of many physical and antropogenic processes leading to the lost of biological potential of the Earth. Desertification is a destructive which becomes apparent mainly on arid lands, it includes degradation of land, water, plant and other resources together with demographic outburst and ecological stress.

International Conference on Environment and Development held in Rio de Janeiro in 1992 recommended the preparation of the United Nations Convention to Combat Desertification. the Convention was ready in 1994 and many countries of the world signed it. Sovereign Turkmenistan also signed the Convention. The Convention on Desertification is to be implemented through regional and national action programmes. It promotes participation of national institutions, NGOs and the people whose joint activities could provide a long-term policy and sustainable development. The Convention could be considered as a basis of socio-economic development and conservation of natural resources.

Turkmenistan is a newly independent and neutral on the political map of the world, its sovereign was proclaimed on 27 October 1991, after disintegration of the USSR. Turkmenistan has enormous land and forage resources, natural gas and oil and raw material for chemical, food, light and building industries.

Serious ecological degradation occurred in Turkmenistan before finding the independence due to unlimited or even rapacious exploitation of natural resources. That is desertification in sevetal regions of the country where potential was damaged or lost. So conservation and rehabilitation of degraded lands is a problem of high priority for Turkmenistan. The State Programme "10 Years of Stability" initiated by the president of Turkmenistan Saparmurat Turkmenbashi promoted sustainable utilization of natural resources.

National Action Programme to Combat Desertification was prepared in the frame of this Programme.

National Action Programme to Combat Desertification pursues the objects: assessment of physical and economic potential of Turkmenistan by transition to market relations, identification of criteria of land degradation, development of new modern technologic by rehabilitation of degraded lands and sustainable utilization of natural resources. Local reasonable traditions and technologies were also taken into consideration.

In the first Chapter of National programme natural conditions and resources are described, in the second Chapter — socio-economic conditions, in the third Chapter — antropogenic desertification including causes and criteria of desertification; degradation of rangelands, forests and irrigated lands; wind and water erosion; reducing of biodiversity; economic damage and social desertification consequences. In Chapter 4 strategy and action plan are described.

Convention on Desertification recommends partnership arrangements by implementation of National Action Programmes. Traditional planning has often been

"top-down". The Convention turns this approach up-side-down. Local communities should play a key role in this activity. Technical experts, researchers, NGO's and other voluntary participants could also make a valuable contribution to the Programme.

The role of science and technology is also very important in desertification control. Local and traditional technologies should be protected. New technologies and know-how should be developed, tested and adapted to local conditions.

It is very difficult to estimate just now how much money will be needed to achieve the objectives of the Programme. This calculation could be only done for several key projects given in Chapter 5. Financial instrument on funding measures on desertification control could include various sources, in particular: State budget, donors, international aid etc.

The Convention stresses the need of cooperation with other national programmes and international conventions, particularly with the Convention on Climate Change and the Convention on Biodiversity.

**The main objectives of practical activity on desertification control are as follows:**

1. Development of National Monitoring System (NMS);
2. Conservation of water resources;
3. Melioration of lands affected by desertification;
4. Rational management and improvement of rangeland;
5. Conservation and restoration of forests;
6. Stabilization and afforestation of moving sand dunes;
7. Conservation of biodiversity;
8. Improvement of legislation on nature conservation;
9. Involvement of all people of Turkmenistan in anti-desertification activities through participation of women, students, young people and other groups of population;
10. Scientific researches of high priority;
11. International co-operation;
12. Programmes to combat desertification of high priority.

1. Desertification monitoring system will include global level, regional level (e.g. the whole Asia), subregional level (e.g. Central Asia) and national level, particularly Turkmenistan. All Parties of the Convention should develop a standard approach in assessment of desertification.

National Centre on Desertification Control (NCDC) will be set up in Turkmenistan. It will summarize information collected in velayat (provinces) and etrap (administrative counties). Information on desertification status and on socio-economic conditions will be collected and published in "bulletin of early warning". This bulletin will be distributed among national institutions and population.

2. While developing the strategy of using water resources, it is necessary to take into account that water is one of the most important resources which determine the geographical distribution of productive forces. In 1992 utilization of water resources in Turkmenistan exceeded the annual river now. Deficit of water resources could reach 1-2 km<sup>2</sup> of water in dry years. The share of water resources used in agriculture totals 92%. Irrigation rate totals 1,700 m<sup>3</sup> of water per hectare exceeding the recommendations of scientists. Efficiency of water use in irrigation agriculture doesn't exceed 0.60.

In connection with development of agriculture the volume of drainage water has been increased. This water is conducted from irrigated fields. Drainage water contains

not only salts but also several chemicals harmful to people. The problem of drinking water of good quality has become very actual.

3. Irrigated farm lands are affected by desertification. This process is resulted in worsening of meliorative status of soils, decrease of crop yield and potential soil fertility. It could be mainly explained by the fact that irrigation canals are constructed in earth beds and considerable amount of water is lost due to filtration.

Above that the level of ground waters is raised, that testifies to degradation of irrigated soils.

4. Range management and improvement play an important role in the Programme of desertification control in Turkmenistan. Desert rangelands are provided with watering points irregularly. Tracts better provided with water are overgrazed and severely degraded lands occupy vast areas. Rangelands surrounding desert wells have been degraded because of excessive cutting of shrubs for fuel.

Rangelands of piedmont plains occupy the area of 3,000,000 hectares. Their productivity totals 0.5-0.8 MT per hectare. They are good grazing lands in spring and summer but their utilization in autumn and in winter is limited because of absence of shrubs and semishrubs. Partial seeding of shrubs (*Salsola* genus) will be conducted here in tilled strips of land. Realization of the Programme on piedmont plains of Akhal, Mary and Lebap velayats will give the possibility of livestock increase by 300,000 heads.

Range seeding will be conducted on poor stabilized sand dunes and barkhans in the Karakum desert. Seeds of shrubs, semishrubs and herbs will be sown without treatment of soil. So the productivity of degraded lands will be restored.

5. While implementing the programme to Combat Desertification, it is important to preserve and restore forests as for the period 1983-1988 forested area in Turkmenistan was reduced by 994 thousand hectares. Desertification resulted in destruction of the vegetative cover, loss of productivity of forests and provoked erosion.

Establishment of protective forests and shelter belts will eliminate the further development of destructive processes, in particular loss of upper productive soil layer and formation of barkhan sands. Protective forests in the desert will provide the increase of biological productivity and conservation of biodiversity.

As a result of the realisation of the Programme main tracts of desert woodlands destroyed by excessive cutting will be restored.

6. So stabilization of moving sand dunes is the problem of great importance. The main types of works are as follows: protection against sand drifts of engineering structures, settlements, cattle-breeding farms, highways, railways etc.; afforestation of sand tracts inside oases and around oases aimed on regeneration of the vegetative cover; protection and management of forest plantations with the objective of utilization of wood; amelioration of microclimate near settlements and farms by planting of *Haloxylon*, *Calligonum* and other species.

7. Conservation of biodiversity is very significant for sustainable development and plays an important role in desertification control. Loss from natural ecosystems of several plant and animal species results as a rule in reduction of biological productivity. The quantity and quality of forage at desert rangelands falls. Many plant and animal species should be conserved as a genopool for future selection of new varieties to the benefit of people. At least, riches of biological life have an aesthetic value by contacts of people with nature.

8. Nature conservation legislation needs improvement by transition to market relations. So the society needs special legislative regulations which could define the interrelations between the man and nature and which could protect the man from ecological disasters.

United Nation Convention on Desertification stresses the needs of decentralization in nature conservation activities. Special regulations of the government should support this system.

In 1992 a new system of local self-government was introduced in Turkmenistan. The former "Soviets" were replaced by new self-government bodies "gengeshi". Gengeshi are elected by universal participation of population. The functions of gengeshi include: identification of social, cultural and economic policy in villages, regulation of local land use based on the laws of Turkmenistan, approval of local budget and reports on its implementation, introduction of local taxes and collecting of taxes, development of measures on conservation and exploitation of natural resources.

Management structure of nature protection activity in Turkmenistan also demands further improvement. For example, each department using its own judgment realize measures on wind and water erosion control, on rehabilitation of irrigated farm lands and desert rangelands etc. All these measures are not planned and not coordinated at the national level. By implementation of the NAPCD all activities need special coordination.

9. One of the significant programme items is ecological training, involving of population into nature protection and combat desertification, but ecological education is not yet universal in the country. A considerable part of population stays beyond the existing system of ecological education. Farmers, housewives, pensioners, especially in rural country belong to these groups of population. Workers of small private enterprises and commercial companies in towns are also social groups not embraced by ecological education. Successful implementation of the National Action Programme will be possible if the awareness of desertification will be integrated by overwhelming majority of population, in perspective by 100% of capable people.

10. The programmes of research should include the topics of priority, in particular:

**Study of desert landscapes** (classification and mapping, human pressure, mechanism of desertification, retromonitoring, anthropogenic landscapes).

**Conservation of arid ecosystems** (rare and endangered plant and animal species, conservation of typical landscapes and nature monuments, conservation of rare plant species in botanical gardens, recreation land utilization, ecological education of population);

**Reclamation of saline soils** (development of new agricultural technique, leaching of soils, new water saving technologic, biological method of soil salinity control, crop rotation, application of mineral and organic fertilizers);

**Plant-growing development of sands and sandy lands** (classification of plant habitats, selection of new species of agricultural crops, use of progressive technologies including drop and sprinkler irrigation);

**Rangeland improvement** (selection of new forage species, establishment of forest protective belts, application of mineral fertilizers, transformation of seasonal rangelands to grazing land for utilization all year round);

**Development of new technologies of moving sand stabilization** (new concepts, use of new substances for sand stabilization, new technology of

establishment of forest belts, use of hydrogel for improvement of physical properties of soil);

**Utilization of wind and solar energy** (cultivation of agricultural crops in hothouses with water reserved cycle, obtaining of energy for water desalinization, lighting, power supply and other consumers).

**Social aspects of desertification** (impact of desertification on social conditions of people, people diseases in desertified areas, new sources of income, adaptation of human organism to severe desert conditions).

11. United Nation Convention on Desertification stresses the need of international cooperation. Regional Implementation Annex for Asia is a part of Convention.

According to the Convention countries affected by desertification could strengthen their efforts in desertification control in the frame of sub-regional and joint action programmes. Desert Research Institute developed a proposal on Sub-regional Implementation Annex for Central Asia. This proposal was submitted to INCDD (Intergovernmental Negotiating Committee on Desertification) in Geneva.

Sub-region of Central Asia could be considered as a part of Asian region. The sub-region includes five newly independent countries: Kazakhstan, Uzbekistan, Kyrgyzstan, Turkmenistan and Tadjikistan. The whole size of the area of the sub-region is 3.94 mln km<sup>2</sup>, population totals 53.79 mln.

12. In the last fifth Chapter four projects of National Action Programme to combat desertification of high priority are defined:

- 5.1. Development of long-standing all the year round rangelands.
- 5.2. Development and creation of small solar generator.
- 5.3. Rehabilitation of ecological conditions in Priaral increasing standard of life of population in Tagty etrap of Tashauz velayat of Turkmenistan.
- 5.4. Protection of the most important engineering structures from sand drifts.

### ***Development of long-standing all the year round rangelands***

#### **1. Background and project contribution to overall programme implementation**

##### **1.1. Background**

Rangelands of Turkmenistan are effected by degradation due to shortage of water resources overloading and overgrazing. The existing policy in rangeland exploration is a result of anti-scientific and anti-ecological approaches in this branch or economy. Awareness of this situation dictates the need of conservation grazing lands and protection of the biodiversity of forage plants. Desert rangelands are a valuable national property, a biological resource which should be used with care on the benefit of people living in the desert.

From vast areas of degraded rangelands 1.7 mln. hectares need improvement in the first place. Moderately degraded lands on the area of 17.3 mln. hectares could be improved in a distant future. The rest needs conservation and proper management.

Several research institutions of Central Asian countries have elaborated a technique which includes reseeding and rangeland improvement.

##### **1.2. Project contribution to overall sub-programme implementation**

Practical realization of the Project is an important step in rangeland management. The Project will provide a future increase of rangeland productivity, seasonal rangelands will be transformed to rangelands suitable for utilization the whole year round, the potential carrying capacity of rangeland will be raised. As a result the Project

will make a valuable contribution to implementation of the National Action Programme to Combat Desertification.

## 2. Needs and results

### 2.1. Needs

Foothill lands of Turkmenistan with dominance of ephemers and ephemeroids in plant cover are suitable for grazing mainly in spring and summer and are less suitable for utilization in autumn-winter period. So these rangelands have a low potential carrying capacity and they can't be used for grazing the whole year round. Melioration of foothill rangelands by reseeding could eliminate these two shortcomings, namely: 1) Productivity of rangelands will be raised; 2) Rangelands will be suitable for grazing the whole year round.

### 2.2. Results

As main achievements of the Project implementation the following results should be mentioned: rise of productivity of rangelands, creation of rangelands suitable for whole year round exploitation; creation of plantations or forage plants for collection of seeds, selection of new species and varieties of forage plants suitable for introduction in Turkmenistan.

## 3. Outputs, activities and follow-up

### 3.1. Outputs

1. New grazing lands suitable for whole year round exploitation will be created on the area of 300,000 hectares. The area of autumn-winter rangelands will total 800,000 hectares.

2. Forage productivity of improved rangelands will be raised from 0.26 MT per hectare to 0.66 MT per hectare. The total increase of forage stock on the area of 100,000 hectares will reach 400,000 MT. That could provide with forage an additional livestock in number of 30,000 heads.

3. New plantations of forage plants for seed collection will be created on the area of 5,000 hectares.

4. Improved rangelands will be used as an experimental area for training of pastoralists from the countries of Central Asia.

### 3.2. Activities

Main points of technique are as follows. In October-November strip ploughing is carried out, it is accompanied by harrowing with "Zig-Zag" harrow. The strips usually are 2 m in width. Within these strips furrows are made by application of three furrow gang plough. Natural vegetation between these furrows is not disturbed. Seeds of forage plants should be sown in December-January. It is the most suitable season for sowing. Mixture of various plant seeds (35-40 kg per hectare) is used. Usually the seeds of the following plants are used: *Haloxylon persicum* 5 kg per hectare, *H. aphyllum* — 5 kg per hectare, *Salsola paletziana* — 10 kg per hectare, *Kochia prostrata* — 2 kg per hectare, *Artemisia species* — 6 kg per hectare.

### 3.3. Follow-Up

1. Till next step in follow-up activities include assessment and mapping of degraded rangelands of Turkmenistan. A map of rangeland degradation, scale 1:500,000 will be prepared. The map will contain information about all tracts of lands to be improved.

2. A computerized database of rangelands needed improvement will be created.

3. In Southwestern Turkmenistan where takyrs and takyrs like soils are common reseeding of rangelands will be carried out on the area of 1.2 mln hectares.

Agrophytocoenosis will be created with productivity of forage plants 0.14-0.16 MT per hectare.

4. In Northwestern Turkmenistan gypsiferous graybrown soils are widely distributed. Reseeding of the rangelands in this region will be carried out on the area of 1.5 mln hectares. Productivity of the land will be raised by 20%.

5. In Central Karakum reseeded of rangelands will be carried out on the area of 400,000 hectares. Harrowing is recommended here to loose a moss crust which is formed on the soil surface. Thereupon seeds of shrubs and grasses will be sown in a loose earth. Forage productivity will be increased here by 40% reaching 0.10-0.14 MT per hectare.

6. In Central Karakum, on sandy soils reseeded will be carried out on the area of 1.8 mln hectares. Seeds of psammophylous plants will be sown accompanied with repeated driving flocks of sheep upon this area. Animal will loose the soil surface, that stimulate the process of seed germination. Productivity of rangelands will be raised by 60%.

7. In Southeastern Karakum where physical conditions are more favourable the improvement of rangelands will be carried out on the area of 1.5 mln hectares. New agrophytocoenosis will be created for grazing the whole year round. The productivity of these pastures will be doubled on the account of introduction of new shrubs and perennial herbs.

### ***Development and creation of small solar generator***

#### **1. Background and project contribution to overall sub-programme implementation**

##### ***1.1. Background***

The whole desert territory of Turkmenistan is used as a rangeland. Mine wells are here the main source of water. Pumping out water is a labour-consuming work usually conducting without any mechanization. Engines functioning on liquid fuel are very expensive, especially deliver of fuel costs much. Water in many wells has the salt content 15 gramme per litre and more, so it is not suitable for watering the livestock. Desert land is not included in centralized energy system of the country.

But the territory of Turkmenistan has vast resources of solar energy. On the latitude of Ashgabat, by clear sky 10,000 MgJoule of sun radiation falls on 1 m<sup>2</sup> of the surface located perpendicular to the direction of sun rays. By medium cloud cover this amount of energy is reduced to 6,500 MgJoule. The amount of solar energy within the limits of Turkmenistan varies slightly. These feature testify to the possibility of application of solar generators in Turkmenistan.

##### ***1.2. Project contribution to overall programme implementation:***

Only 64 % of desert rangelands in Turkmenistan are supplied with water. Rangelands located close to cultural zone are exploited severely and remote rangelands are not utilized. Practical application of solar generators will stimulate the development of remote rangelands. Animal pressure around cultural zone will be decreased and desertification will be reduced. So the Project will contribute greatly to implementation of the National Action Programme to Combat Desertification.

#### **2. Needs and results**

##### ***2.1. Needs***

Animal raising in the Bakharden etrap (county) is the main branch of economy. Desert rangelands are overloaded by the livestock. Scarcity of water is one of the bottlenecks of sustainable use of rangelands. Desert well in the locality of Karrykul has

salt water (10-15 gramme of salts per litre). Experimental station of the Desert Research Institute is located here. Long-term hydrological research work has been carried out here for many years. So the area is suitable for construction and test of a solar generator.

## *2.2. Results*

Experimental solar generator will be constructed and tested. It will provide the pumping out water from the well, desalination of water for animals, freshening water for people and energy supply of shepherd and his family (radio, TV, refrigerator etc.). The generator will include: a) solar power panel, 2 Kwt; b) electric battery for energy supply in the night; c) big electric distiller which produces water for animals lowering the salt content from 15 gramme per litre to 5 gramme per litre; d) small water freshener which produces potable water for people lowering the salt content from 5 gramme per litre to 0.5 gramme per litre.

## 3. Outputs, activities and follow-up

### *3.1. Outputs*

1. An experimental solar generator will be constructed and tested in the locality of Karrykul in Central Karakum;
2. The solar generator will provide the potable water for a team of shepherds (20-30 persons) and watering a flock of sheep (3,000 heads);
3. The solar generator will be used as prototype for mass production of such solar generators in desert regions of Turkmenistan.

### *3.2. Activities*

Budget of solar energy in the region will be computed. These data will be used for estimation of technical parameters of a solar generator. Prospecting walks will be conducted in the locality of Karrykul and an experimental solar generator will be constructed and tested. Special methodological guide will be elaborated for installation of solar generators in other regions of Turkmenistan.

### *3.3. Follow-Up*

1. Realization of the Turkmenistan territory will be done to identify the areas for installation of solar generators. Two maps will be prepared: Map of distribution of solar energy fluxes over the territory of Turkmenistan; Map of optimal placement of solar generators on desert rangelands of Turkmenistan depending of physical conditions and economic features.
2. An experimental solar generator will be submitted to industrial enterprises "Ashneftemash" and "Ashprod mash" for mass production.
3. Special training course will be conducted for farmers and shepherds on exploitation of solar generators.
4. Methodological guide on exploitation of solar generators will be published in Turkmen, Russian and English. It will be used as an instruction for pumping out and freshening water on desert rangelands of Turkmenistan on the basis of solar energy.

## ***Rehabilitation of ecological conditions in Priaral increasing standard of life of population in Tagty etrap of Tashauz velayat of Turkmenistan***

### 1. Background and project contribution to overall sub-programme implementation

#### *1.1. Background*



The yield of agricultural crops on irrigated soils is limited by several factors, depending first of all from soil salinity and quality of irrigation water. In several regions of Turkmenistan physical and chemical properties of soil are worsened on the account of bad drainage and shallow water table.

Soil salinization is resulted in loss of yield of agricultural crops by 20-40%. By severe salinization irrigated soils lose fully their productivity. Especially loss of productivity of cotton, the main crop in Turkmenistan does harm to national economy. So melioration of saline soil is a problem of high priority for implementation of the National Action Programme to Combat Desertification in Turkmenistan.

### *1.2. Project contribution to overall sub-programme implementation*

The project is aimed at creation of better soil conditions in irrigated areas. In Tagty etrap degradation of irrigated farm-lands is especially severe to be compared with soil degradation in other parts of the Aral Sea bordering area. The project could pave the way to implementation of soil melioration works in other regions of Turkmenistan.

## 2. Needs and results

### *2.1. Needs*

At present time 50,000 hectares of irrigated soils of Tagty etrap need melioration. 50% of these soils are moderately and severely effected by salinization. 70% need leaching and repairing the irrigation network, 20% need construction of new drainage and irrigation canals. 72% of soils have shallow table of ground water (less than 5 m from the earth surface). Soil content in ground water totals 5 gramme of dry salts per 1 litre.

Under these conditions the annual loss of yield of agricultural crops totals 20-25%. At the first hand soils of moderate and severe degree of salinization should be meliorated. The proper drainage network should provide the lowering of ground water table and conduct the salt water beyond the area under irrigation.

### *2.2. Results*

Melioration of irrigated soils will be carried out on the area of 50.000 hectares. The old drainage and irrigation network will be reconstructed and new irrigation canals will be constructed. The yield of agricultural crops will be raised by 25% owing to better fertility. Soil melioration will create a basis for long-term development of irrigation agriculture in the etrap.

## 3. Outputs, activities and follow-up

### *3.1. Outputs*

Improvement of irrigated soils on the area of 50,000 hectares will be carried out through realization of the following measures: construction of drainage network on the area of 8,600 hectares, repairing drainage network — 24,200 hectares, capital soil leaching — 33,700 hectares, exploitation soil leaching — 11,900 hectares, reconstruction of drainage network — 14,300 hectares.

### *3.2. Activities:*

The main point of the project is rehabilitation of soil fertility in root layer. This result will be achieved by conducting several measures on soil melioration and agrotechnique. Hydrological study will be also carried out. Operative control on the depth and mineralization of ground water will give an additional information for implementation of the project. Seasonal and annual dynamics of soil salinization will be monitored on several key areas, each 600 hectares in size.

### *3.3. Follow-Up:*

1. The assessment of irrigated farm-lands in Turkmenistan will be conducted after the implementation of the project.
2. Computerized database will be created on soil salinization areas in Turkmenistan.
3. On the basis of obtained data recommendations will be developed on leaching of soils affected by salinization.
4. For each zone of irrigation in Turkmenistan a set of agricultural crops will be selected for application after the soil leaching.
5. The present project will be used as a model for conducting soil melioration works in other velayats of Turkmenidtan.
6. A monitoring system will be created to study the processes of soil salinization in other regions of Turkmenistan.

### ***Protection of the most important engineering structures from sand drifts***

#### 1. Background and project contribution to overall programme implementation

##### *1.1. Background:*

Human impact on desert environment is sharply increased by exploitation of oil and gas deposits. That is especially distinctive for the sandy desert where the inherent risk of desertification is great. For extraction of oil and natural gas several structures should be build, in particular roads, electric lines, oil and gas extraction complexes, pumping stations, labour settlements etc. By this activity the plant cover is destroyed and new tracts of moving sands appear. These sands put obstacle in exploitation of gas extracting equipment.

So these technogenic sands should be stabilized. Desert Research Institute has developed a complex technique of moving sand stabilization. The technique includes construction or mechanical barriers, growing sand binding plants and chemical sand stabilization. The present project is based on use of this technique.

##### *1.2. Project contribution to overall sub-programme implementation*

Implementation of the project will reduce the expansion or desertification processes in the Karakum. Gas and oil extraction complexes, protected from sand drifts will continue the normal exploitation of gas and oil fields. Stabilization of moving sand dunes will improve the ecological situation in the region. So it will be a considerable contribution in realization of the National Action Programme to Combat Desertification in Turkmenistan.

#### 2. Needs and results

##### *2.1. Needs:*

Gas fields have been exploited in the Transunguz Karakum during 20 years. Several vast oil fields are located here. Hundreds hectares of moving sand dunes around gas extraction stations have been formed. Around each site with technical equipment 500-600 m<sup>3</sup> of sand are accumulated annually. That makes obstacle in exploitation of technical equipment and further wear and tear of machinery. Stabilization of moving sands in this region is very important measure for further economic development.

##### *2.2. Results:*

The main tracts of moving sands will be stabilized around the roads, gas-mains and sites with technical equipment. Mechanical barriers and shrub belts will diminish the movement of loose sand. In two or three years the movement of sand dunes will be transformed step by step to grazing land.

### 3. Outputs, Activities and Follow-Up

#### 3.1. *Outputs:*

1) On the area of 500 hectares stabilization of moving sand dunes will be carried out around such objects as compressor stations, complex gas installations, gas structures, power stations.

2) On communication tracks (gas-mains, water-mains, communication cables etc.) protection of them from deflation on the area of 400 hectares will be carried out.

3) On the area of 200 hectares measures on protection of main roads from sand drifts will be taken.

4) On the area of 100 hectares protection of electroline from deflation will be carried out.

#### 3.2. *Activities:*

For protection of engineering structures from deflation complex method is used. At first semi-latent or cover mechanical protections of vegetative material are installed. The height is 40-50 sm. Sprouts of rush or reed mace are used. Cover mechanical protections are installed by rows 20-30 sm wide, they are fixed by sand through 1.5-2.0 m. Moreover camel's-thorn and *Stipogrostis Karelinii* are used. Between rows seedlings of saxaul (*Haloxylon*) and *Calligonum* at a rate of 3,300 pieces per hectares are planted.

For stabilization of sandy surface chemical astringents (tar, mazut and others) are used. Chemical are inserted by stripes 1.0-1.5 m wide. Their usage is especially perspective while protecting of main roads from sand drifts.

#### 3.3. *Follow-Up:*

1. After the implementation of the Project the assessment of technogenic sands in Turkmenistan will be done. A map of economic structure, scale 1:500,000 need protection against sand drifts will be compiled.

2. A computerized data base will be created, it will contain information about all tracts of technogenic sands in Turkmenistan.

3. In the Akhal velayat sand stabilization along the main roads will be carried out on the area of 375 hectares.

4. In the Balkan velayat where the wind erosion is especially severe sand stabilization works will be carried out on the area of 2,750 hectares, including: shelter belts along main roads - 750 hectares, shelter belts along railroads — 1,500 hectares and sand stabilization around gas derricks and along gas mains — 500 hectares.

5. In the Tashauz velayat sand stabilization will be carried out on the area of 2,760 hectares, including: shelter belts along railroads — 2,000 hectares, sand stabilization around gas derricks 500 hectares and shelter belts along main roads — 200 hectares.

6. In the Mary velayat sand stabilization will be carried out on the area of 1,100 hectares, including: 800 hectares around gas derricks, 100 hectares along the main roads and 200 hectares along the railroads.

## CONCLUSION

Realization of the NAPCD needs a long period of time. While this period possible changes of environmental conditions, economic development and demographic trends must be taken into consideration.

On forecast of climatologists air temperature and evaporation will increase in Central Asia in the first quarter of the XXI century. It could result in further water resources scarcity in Turkmenistan. So the problem of water supply could be solved only on the basis of mutually beneficial relations between all countries of Central Asia. Implementation of the Interstate Programme of Saving the Aral Sea will also play an important role.

Demographic trend will also change. It is expected that population of Central Asia will double, reaching more than 100 mln people by 2025. Under existing conditions all national programmes of Turkmenistan (New Village, Public Health, Drinking Water etc.) need co-ordination.

Successful realization of the NAPCD depends on the economic development. At present time economic reforms in Turkmenistan serve the purpose of transition to market relations. Implementation of this Programme will be especially successful if the model of sustainable development will be introduced into the economy of Turkmenistan.

Implementation of the NAPCD needs great technical means and finances. On the first foreign sources of financing will play an important role. By further development of the national economy the role of inner financial resources will increase.

There are also difficulties in capacity building, especially in professional training and material resources. Infrastructure of professional training existing during the Soviet period has been destroyed. So we need a new system of ecological education of children, youth and adults. Agricultural machinery used by desert reclamation have become obsolete and needs modernization.

These problems and difficulties in implementation of the NAPCD need solution at international, regional and local levels. All that is to be done for the prosperity of people and for the conservation of environment.