Caspian Environment Programme, Phase 2

Extent of Desertification in the Caspian Region

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Chapter 1. Nature and Desertification Around The Caspian Sea

1.1. Climatic Conditions

The coastal zones of the Caspian Sea are mostly arid or semi-arid, except areas in the south and southwest.

Climatic Features of the Coastal Zones

Regions and Locations	Average Rainfall (mm/year)	Climate
Azerbaijan coast	110-1000	Arid to sub-humid, humid
Xacmaz-Deveci region	100-250	Arid to semi-arid
Absheron Peninsula	110	Arid
Qobustan	100-250	Arid
Lenkaran-Astara	800-1000	Sub-humid to humid
Russian coast	200-400 (from north to south)	Arid to semi-arid
Astrakhan	208	Arid
Derbent/Makhachkala	400	Semi-arid
Kazakhstan coast	200-140 (from north to south)	Arid
Turkmenistan coast	70-210 (from north to south)	Arid
Kara Bogas Gol Bay	70	Arid
Turkmenbashi	78	Arid
Esenguly	196	Arid
Islamic Republic Iran coast	200-2000 (from east to west)	Arid to humid
Gorgan, Gonbad-e-Qabus	400-500	Semi-arid
Rasht	900-1000	Humid
Foothills south of Anzali	2000	Humid

The Caspian Sea region has a simple climatic structure: the eastern half of the coastal zone has low rainfall and a potential evapo-transpiration of at least 1,000 mm/year, which is many times more than rainfall. The desert or semi-desert vegetation has adapted to these arid climatic conditions and normally does not cover the full soil surface. Flora and fauna depend on the microclimatological and soil structures, thus natural desert with particular soils, vegetation types and animals characterise a large part of the Caspian coastal zone.

Deserts represent one of the most fragile ecosystems. They are very sensitive ecosystems because the water available for permanent vegetation and animals is very limited. For this

reason, the United Nations and many countries have been making great efforts for a long time to protect deserts as unique landscapes.

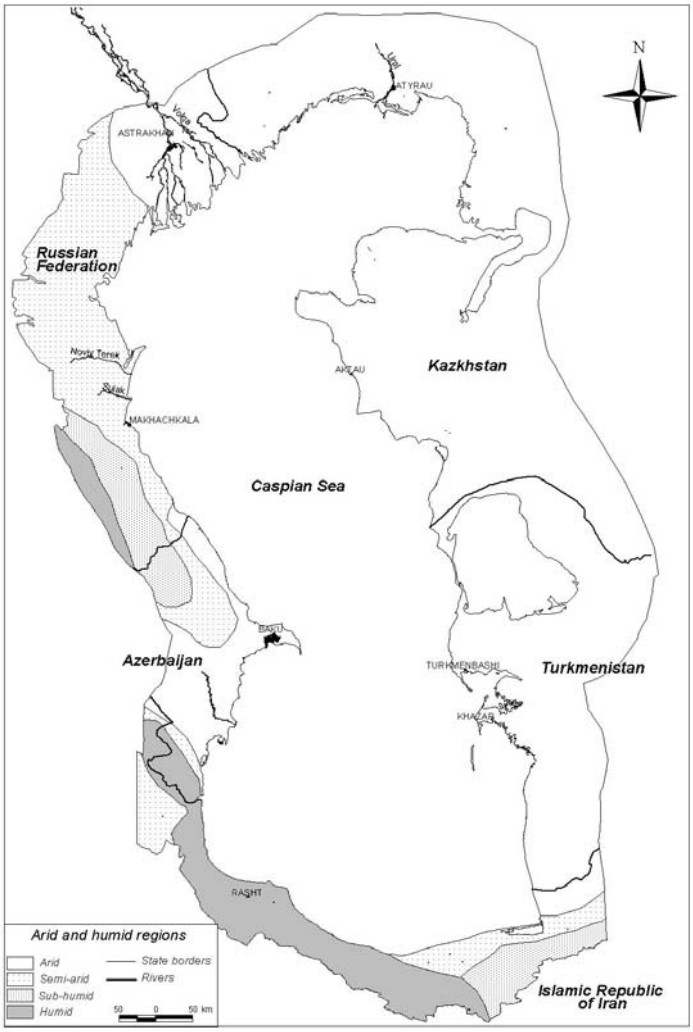
There is much less aridity in the other half of the Caspian region because of the Caucasus, Talysh and Elburs Mountains. On the northern side of the mountains the average rainfall suddenly increases and, because of the altitude, the evapotranspiration decreases. The net result is a vertical vegetation structure on the mountain slopes in an asymmetrical pattern due to the aridity on the southern slopes.

1.2. Natural Features

1.2.1. Arid Desert Regions of Turkmenistan, Kazakhstan and parts of the Russian Federation

The eastern coastal region of the Caspian Sea has less than 200 mm rainfall per year. The region including Astrakhan Oblast (eastern Caspian province of the Russian Federation), Atyrau and Mangistau Oblasts (Kazakhstan), and Balkan Velayat (Turkmenistan) are part of the inner Central Asian basin, which has arid climates.

Aridity in the Caspian Coastal Zone



The hydrological situation is characterised by the lack of perennial rivers. The only river permanently flowing to the Caspian is the Ural River (Atyrau Oblast, Kazakhstan). River Emba (Atyrau Oblast, Kazakhstan) and Atrek River (southern Turkmenistan, on the border with Iran) do not permanently reach the Sea. The Atrek River has only once in the last ten years reached the Caspian (in 1997). The Volga originates outside the region.

Both the Volga and Ural River valleys and deltas belong to this climatic region, but their soil structure and land use are rather different from the rest of the arid region. There is a high groundwater table on lower Volga terraces and the soils are fertile and suited to agricultural use. There are no substantial fresh groundwater layers beyond of the alluvial plains of the Ural River and

most smaller lenses are saline. Fresh water must thus be supplied through long pipelines from the Ural and Volga Rivers, and the amount of fresh water available is a limiting factor for natural structures such as habitats and human activities. The region is comprised of various types of desert soils and desert vegetation that depend on the type of primary rocks: sand desert, clay desert, rock desert, gypsum desert. Along the shores of the Caspian, such as around the Cheleken area (Turkmenistan), moving sand dunes can be found. From south of Turkmenbashi to north-eastern Iran marine sediments with a very flat surface border the coast. Here the saltwater influence from the Caspian Sea is predominant and saltwater lagoons and solonchaks are widespread in the Esenguly Etrab coastal zone. The 2.5 m rise of the Caspian Sea from 1979-1995 caused flooding over wide areas, especially around Esenguly Etrab. From Fort Shevchenko (northern Mangistau Oblast) to Turkmenbashi (Turkmenistan) mainly primary rocks reach right down to the coast. Compared to both southern provinces, Mangistau Oblast and Balkan Velayat, in the northwestern Atyrau Oblast is less arid. Due to the permanent run-off of the Atrek River, water supply conditions are much better. The Ural River not only delivers drinking and irrigation water for the lower river terraces, but also makes it possible to deliver water by pipeline or tankers to the areas beyond the river valley.

1.2.2. Semi-Arid Dagestan and Kalmykian Coast of the Russian Federation

The effect of the Atlantic air masses in this north-western Caspian area is considerable, resulting in a semi-arid climate with rainfall between 200 and 400 mm/year. As a result, the original steppe and semi-desert vegetation of the Daghestan Republic used to give total cover to the land surface. However, now, because of crop production and the keeping of livestock, the land has degraded severely.

Very even alluvial soils, mainly marine sediments, characterise the Kalmykian and Daghestan coast. The northern parts are called Black Lands due to the colour of the soils. This region has suffered severe degradation during recent decades because of inappropriate livestock practices.

The effects of the flooding during 1979-1995 in the areas adjacent to the coast are crucial. Furthermore, due to the lack of effective sea defences, in March 1995 a surge flood lasting one month and reaching a height of 1.7 m damaged many houses, factories, infrastructure and agricultural areas around Lagansk (formerly Kaspisk).

1.2.3. Semi-Arid Coastal Strip And Sub-Humid Foothills Of Daghestan Republic and Azerbaijan

The Caucasian Mountains and their foothills rise south of Mahachkala. The climatic, hydrological, geomorphologic, soil and land use situations are as follows: The narrow coastal marine terraces, which are in the lee of the Caucasus Mountains, receive little rainfall but they enjoy the advantage of short rivers coming down from the mountains supplying the narrow coastal zone with sufficient water. This zone is often only a few kilometres wide, but offers the only space for residential areas, crop and livestock production, transportation lines and other facilities. As a result, the land use density is very high, especially in the settled areas of Makhachkala, Derbent, Sumgayit and Baku. Land use of the Absheron Peninsula has been dominated by the exploitation of oil and gas deposits for many years.

1.2.4. Humid Coastal Strip and Foothills of Azerbaijan and I. R. Iran

The long coastal strip from Astara (Azerbaijan) to the eastern Mazandaran province (I. R. Iran) receives much more precipitation then all other Caspian coastal regions and is therefore humid. Cyclones moving on the southern side of the Caucasus Mountains from the Atlantic Ocean eastwards are the main cause and the northern slopes of the mountains are covered with a well-developed deciduous forest, although the southern slopes are dry and without forest. Many rivers permanently cross this strip and irrigate the flat coastal plain. Intensive agricultural land use cultivating: rice, vegetables, fruit, and, in the higher parts of the foothills, tea, have been developed over several centuries. The eastern Gholestan province is part of the sub-humid region with the exception of the northern areas around Bendar-Turkmen, belonging to the inner-Asian arid climatic zone.

1.3. Regional Overview of Desertification

Desertification processes have been observed by the Centre for Combating Desertification in Ashgabad, which since 1998 has assessed a belt from 50 up to 100 km wide along the coastline covering about 400.000 km^2. From this area about 325.000 km^2 or 81,0 % are natural deserts, degraded deserts (in different degrees) and other degraded landscapes.

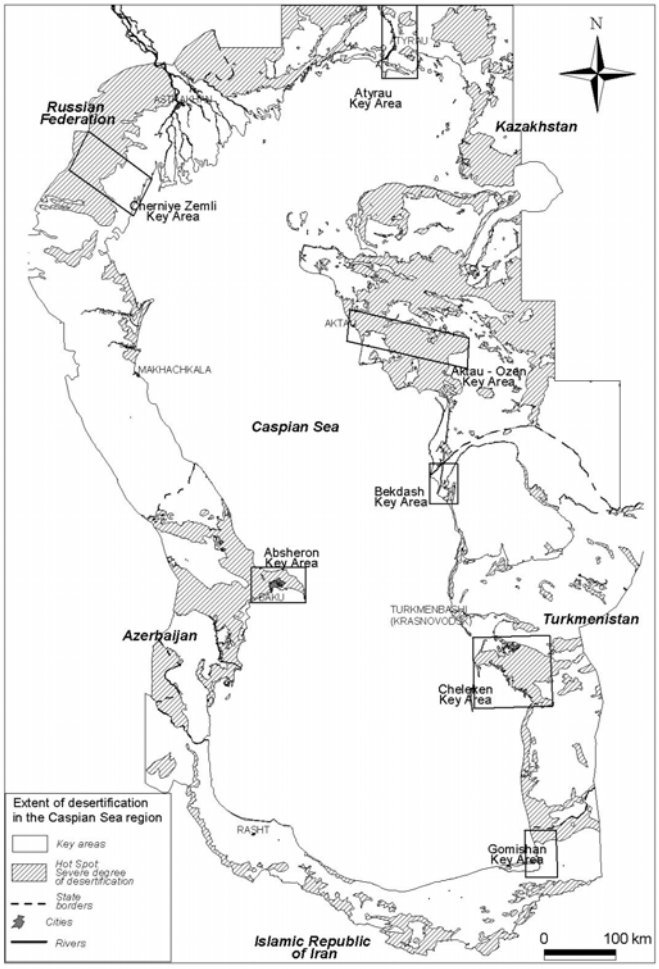
Areas of Severe Desertification in the Caspian Region

(km^2)

Country	Degraded Vegetation Cover	Water Erosion	Wind Erosion	Flooding & Saliniation of Soils	Technogenic Desertification	Total
Azerbaijan	7,990	2,890	280	3,270	1,180	15,610
I. R Iran	8,970	4,690	70	180		13,910
Kazakhstan	9,660	9,670	9,580	11,320	18,620	58,850
Russian Fed.	3,050		13,150	6,920		23,120
Turkmenistan	520	1,990	3,610	6,030	1,800	13,950
Total	30,190	19,240	26,690	27,720	21,600	125,440

Even over the past few decades, regions and landscapes around the Caspian suffered from degradation. Nowadays about 32,0 % (or 125,440 km^2) of this area is severely desertified Deserts and desertification are therefore not only concentrated on the eastern part of the Caspian coastal zone.

Extent of Severe Desertification in the Coastal Zone



Due to the high sensitivity of arid ecosystems, desertification processes are widespread in the eastern coastal zones. Areas especially prone to desertification are around

- Mining industries
- On-shore oil and gas production facilities
- Residential areas
- Water wells with certain livestock concentration
- Corridors for roads, railways, pipelines for oil, gas, and water and communication lines in the whole area.

Considering natural deserts and most desertified areas in the Caspian region the following geographical classification can be made:

Group 1: Areas with Highest Desertification[1] Coverage

- Middle area around Khazar (Cheleken) peninsula, Balkan Velayat, Turkmenistan
- All the coastal zone of Mangistau Oblast, Kazakhstan
- Atyrau Oblast except the Ural and Emba River valleys, Kazakhstan
- Absheron Peninsula north up to the Samur River and south up to the Kura delta, Azerbaijan
- Kalmykian coastal zone, Russian Federation

Group 2: Areas with a Medium Desertification Coverage

- Other parts of Balkan Velayat, Turkmenistan
- Northern coastal part of Gholestan Province, Islamic Republic of Iran
- Astrakhan Oblast (except Volga delta) and Daghestan Republic
- Emba River valley, Kazakhstan

[1] Natural deserts and severely degraded landscapes of different types including deserts

Group 3: Areas with Low Desertification Coverage

- Volga River valley in Astrakhan Oblast (Russian Federation)
- Ural River valley in Atyrau Oblast (Kazakhstan)
- Southern Azerbaijan and Ghilan and Mazandaran Iranian coastal zone.

1.4. Land Use and Main Causes of Desertification

1.4.1. Rising Sea Level

Although according to the United Nations Convention desertification is caused by human activity, natural factors also influence it. One of the most important transboundary processes in the Caspian Sea region has been the inundation of seawater during the period of rising sea level between 1979 and 1995. In certain places - especially in northern and eastern coastal areas – the severely salinised soils and steep coastal areas suffered erosion, destroying many coastal constructions. The increase in sea level has led to the onset and rapid development of such desertification processes as:

- Flooding and waterlogging;
- Soil salinisation; and
- Degradation of vegetative cover.

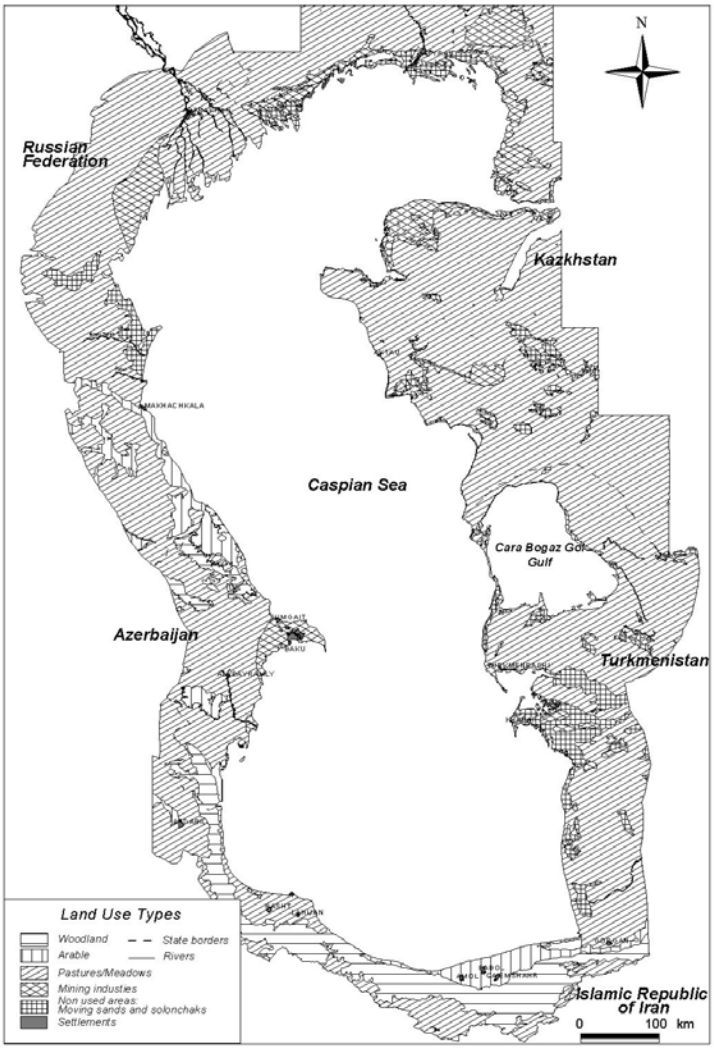
1.4.2. Oil and Gas Exploitation

On-shore oil and gas fields in the Caspian area are shown on the map (included under mining areas) in a rather primitive manner without any indication of the density of exploitation or its effects. Particularly in Kazakhstan, the large “oil exploitation” land area is devoted to secondary land use, livestock being widely distributed over the region; in the Atyrau area there is even arable land. There is also oil exploitation in parts of Azerbaijan, Turkmenistan and the Russian Federation. Drilling oil and gas wells along the coastal zone, exploitation and transportation have deposited many harmful materials on terrestrial ecosystems. The soil-vegetative complex has become severely contaminated and the degradation of soil-vegetative cover has begun. Contaminated sites include around derricks, refineries, storage points, ports and pipelines (often with leakages).

1.4.3. Woodland and Fuel Wood Cutting

Woodland is distributed in mountainous areas of Azerbaijan (Bolshoi Caucasus, Talysh) and in Iran in the Elburs Mountains.

Map 1. Land Use in the Coastal Zone



Mainly deciduous trees grow on the lower slopes of the mountains. In Iran areas have deliberately been deforested in the past to provide people with arable land. In all other areas the cutting of trees and shrub vegetation for civil works and fuel are the main causes of degradation in vegetation cover.

1.4.4. Agricultural Land Use

The climate dictates that large areas are deserts, semi-deserts and steppes, with a relatively low biomass. Agriculture on the northern and eastern side of the Caspian is characterised predominantly by livestock: sheep, goats and camels. Pastures with shrubs, grass and large areas of bare soil, degraded largely as a result of constant grazing and excessively high stocking levels. These places basically are mainly oases, settlements and temporary living places for shepherds and their families. Location is commonly determined by the presence of wells, and cutting of shrubs for fuelwood is common. Meadows are only found in valleys with a good river water supply.

Arable land is distributed in sub-humid and humid areas on the south-eastern and southern coast, where crops such as rice, cotton, vegetables, and tropical fruits are grown. Additional crop production areas can be found where the water supply is plentiful, from rivers such as the Volga, Terek, Sulak, (Russian Federation), Samur and Kura (Azerbaijan), Sefid Ruud (I. R. Iran) and Ural (Kazakhstan) .

1.4.5. Un-classified Areas

Some areas, mainly in deserts, do not have a land use classification, for instance, the large moving sand dunes and barchans in the middle of Turkmenistan. Smaller dune areas are distributed throughout the region but not illustrated because they are too small. Another area without an important land use is the solonchaks, the larger or smaller depressions on the edge of the Caspian Sea filled with saltwater.

Chapter 2. CEP Desertification Investigations

2.1. United Nations Convention on Desertification

The United Nations Convention on Desertification (1994, adopted in 1997), signed by all Caspian countries except the Russian Federation, defined desertification as “land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Under “combating desertification” the convention understands “activities which are part of the integrate development of land in arid, semi-arid and dry sub-humid areas for sustainable development which are aimed at

- Prevention and/or reduction of land degradation;
- Rehabilitation of partly degraded land; and
- Reclamation of desertified land.”

2.2. General Goals of the Caspian Centre for Combating Desertification

No institution or agency in the five littoral countries has in the past maintained an overview of the desertification status in the whole Caspian Sea region. Furthermore, Azerbaijan, Russia and Kazakhstan have had no scientific-technical Institutes specialised in desertification issues. Thus, the current status of desertification has had to be investigated by the CCCD, including:

- Investigation and assessment of the desertification status in the Caspian region (up to about 100 km from the coast) using remote sensing and field trips;
- Summarising and comparing the desertification conditions and phenomena (causes, types and degrees) in the region;
- Identification and assessment of interrelations with other environmental or economic factors and conditions (such as water level rise, technical pressure, climate change); and
- Addressing social or economic impacts on the population (such as public health, water supply need, migration and living conditions).

2.3. Methodology for Investigating Desertification Phenomena

Maps have been prepared to describe the state of desertification in the entire Caspian region in the past (1982-1984), present (1998) and projected status in the future (2010) on a 1:1.000.000 scale:

- Desertification phenomena in 1982-1984
- Desertification phenomena in 1998
- Changes and risks of desertification in 2010
- Types of desertification
- Land use
- Landscapes.

Land quality, rural population concentration and activities, and groundwater quality are inter-related. Deterioration of land capability and groundwater quality lead to reduced quality of living conditions, reduced economic yield from the land, and human migration out of the affected area.

During 2000/2001, desertification investigations had been focused on so-called desertification Hot Spots mapped on a 1:200.000 scale. Those are the areas with the highest degree of desertification and with the highest risk of further desertification.

2.4. Steps for Further Investigation of Desertification

Step 1 Installation of Equipment

The first step was the establishment of equipment for the Caspian Centre for Combating Desertification in Ashgabad. The following equipment is now available and programmes are now operable:

- GIS work-station with Pentium 4, 17” monitor, A3 scanner, A3 colour printer, A0 plotter;
- ArcView 3.2 licenses in Ashgabad, Almaty, Baku, Elista for GIS works; and
- WinChips licenses in Ashgabad, Almaty, Baku, Elista for remote sensing technologies.

The desertification groups in Almaty, Baku, and Elista have been equipped with hardware for GIS processing.

Step 2 Training

A series of training courses have been undertaken from 1999 to 2001 to train one GIS specialist within each national desertification group in order to work there independently on GIS, remote sensing and Database development.

Step 3 Purchasing Images

Images have been purchased to detect desertification phenomena from satellite data:

- "Landsat TM" with a mosaic of 1982-1984 with ground resolution of 400 m;
- "Resurs" images for 1998 with ground resolution of 150 m; and
- "Landsat 7 ETM+" images for 2000 with ground resolution of 30 m.

All desertification groups in Ashgabad, Almaty, Baku, Elista and Tehran have been provided with the relevant images from the above sources.

Step 4 PC Based Classification and Mapping

The PC-based automatic interpretation of space imageries has been applied to classify first unverified and then verified desertification structures. Desertification maps at 1:1.000.000 and 1:200.000 scales have been compiled and printed.

Step 5 Field Trips for Verification and Final Mapping

In 2001 all Caspian national groups undertook field trips addressing the most important desertification issues within the “Desertification Hot Spots” to verify the results of the analysis based on remote sensing data. As a result, changes in the cartographic representation of desertification features were made. Finally, the maps of desertification phenomena were printed. These maps have been put to use in the course of establishing the situation in particular areas of human-nature conflict, and in preparing proposals to combat desertification.

Chapter 3. Azerbaijan

3.1. Natural Conditions for Desertification

From the geological and geomorphological points of view, the general structure of the Azerbaijan Caspian coast, with the exception of the Kura river lowland and delta, is divided into two main landscapes: a narrow coastal belt and, parallel to the belt, the foothills of the Caucasus Mountains rising to 600-800m altitude and stretching down to the coast. The main natural regions in the Azerbaijan coastal area are:

- Coastal range and foothills from Sumgayit up to the River Samur
- Northern coastal belt with marine terraces
- Absheron Peninsula
- Qobustan Foothills
- Kura River delta
- Lenkaran coastal belt with marine terraces
- Talysh foothills (bordering on Iran).

The Azerbaijan lower coastal zone is generally characterised by arid and semi-arid climate with an annual precipitation of 100-250 mm. Near Baku the 110 mm/year precipitation of the entire Absheron Peninsula is due to the lee effect of the Greater Caucasus Mountains. From Baku over Qobustan up to the Kura delta the climate again with 100-250 mm is arid to semi-arid. Focussing only on coastal areas, it is the southern Lenkaran coastal region that receives the most rainfall. 600 up to 800 mm/year has been measured on average, which accounts for the sub-humid climate, in higher areas humid. Rainfall in the mountains very close to the coast is rather different. Here the orographical structure leads to a much higher precipitation.

The natural vegetation of this coastal zone is nowadays characterised by semi-arid natural deserts with meadows and shrubs (mainly plant groups like *Tamarix, Rubuseta, Punicumeta Liciumeta spp*.), and halophytic vegetation with *Artemisia.*

The coastal range parallel to the sea-coast, which is partly covered with oak forest, is a pleasant recreation and leisure area. Mountain forests all over Azerbaijan have suffered less than those in the lowlands that have been reduced in extent over the past 1,500 years to less than 10% of their former area, mainly in northern Samur-Devechi and southern Lenkaran lowlands.

Another natural factor has been land inundation from the Caspian Sea during the 1979-1995 period. Not only have areas that were previously subject to salinisation now been totally inundated, but new areas were have now been affected by salinisation.

3.2. Areas With Quasi-Natural Landscapes

Because of the high level of human activity, quasi-natural landscapes are not so widely distributed, but occur in high mountain areas affected not at all, or only slightly, by

desertification. In the coastal areas there are mainly three areas with quasi-natural landscapes. The protection of these areas is very important from the point of view of diversity of nature and for the population. These areas are:

Samur-Devechi Lowland in northern Azerbaijan bordering on the Russian Federation with smaller arid areas. Those semi-desert landscapes are only slightly degraded and, apart from the usual sandy and solonchak areas are characterised by lowland forest of 16,000 ha with oak, lime, alder and walnut stretching towards the nearby foothills.

Qobustan: south-eastern foothills of the Caucasus mountains south of Baku with arid and semi-arid climate. Processes of denudation on these slopes are responsible for developing a badlands landscape. In addition, in this quasi-natural landscape there are karst lands and mud volcanoes. Forests cover some smaller areas. Water erosion due to the semi-arid climate can be observed to some extent.

Foothills of the Talysh mountains in southern Azerbaijan: This premontain area is characterised by subtropical rainforest with oak and chestnut. The quasi-natural forest landscape area in the Girkan Nature Protection Area has had special status for many years. Some areas have been transformed into orchards for subtropical fruits, tea plantations, arable land and meadows.

3.3. Extent of Desertification

3.3.1. Naturally Desertified Areas

Whereas inundation along the long narrow coastal strips has only had a small impact on the low-lying land of Xacmas, Aghzybir and Lenkaran, large areas on the Kura river delta have been flooded (see grey areas along the coastline on the map) and severely affected by salinisation. The very flat lowlands of Kizilagach, Xacmas, Aghzybir, and Lenkaran are subject to flooding. Salinisation in this coastal zone of Azerbaijan covers an area of 3.270 km^2. Solonchaks have been formed along the coastal zones on the lowlands of Kura-Aras, Bogaz, Lenkaran and Quobustan. On the irrigated lowlands of Kura-Aras and Samur-Devechi the ground-water level has risen considerably (1-2 m) and therefore a new trend of salinisation of soils has started since the sea and groundwater rose pre-1997. Solonchaks in the coastal zones of the Kura-Aras river, Bogaz, Lenkaran, and Qobustan regions have recently formed and the high ground water table has created many lakes. The area with the highest degree of salinisation is the Qizilagac bay south of the Kura River delta.

Another naturally desertified area is located in the south-eastern Qobustan foothills of the Caucasus Mountains. Mainly processes of gully erosion, karst and mud volcanoes are found on the ridges of Alyam and Langibiz in the Qobustan region. Naturally caused desertification sometimes overlaps with man-made desertification, as in the Qobustan Mountains, where the intensive economic activities of the population involving tree-cutting and grazing have taken their toll over many years.

3.3.2. Man-Made Desertification

Azerbaijan covers a small area (86,600 km^2) compared to the other Caspian states . With a relatively large population of 8 million inhabitants the population density, especially in the coastal parts, is high and explains why human threats to the natural landscapes from traditional land use are significant. The population is mainly concentrated along the coastal zone, often only a few kilometres wide and very flat, around Sumgayit, Lenkaran, Astara, in the Kura delta, around Ali-Bairamly, and on the Absheron peninsula around Baku. Investigations into land use show that more than half of the area of Azerbaijan is exploitated. About 1,465,000 ha of land is used seasonally for meadows and pastures (72% of the mountain areas and 86% of the lowlands). The traditional land use is vineyards, and fig orchards, and arable land producing vegetables. The intensity of agrarian land use is thus very high, especially in the coastal zone, including the Kura-Aras River delta. Linked with the high population density, there is great pressure on land resources caused by constructions for industrial objects, transportation lines and residential areas. The natural conditions for a permanent water supply in this zone is one of its most important advantages due to many rivers flowing down from the mountains and sufficient ground water deposits. Linked with the traditional land use are irrigation, horticulture and livestock.

The oil industry has been the most important factor in new types of desertification for more than a hundred years. There are some places in the mountains close to the coast that have been devastated by oil production, but the largest areas with huge impacts on land degradation are found in the Absheron area.

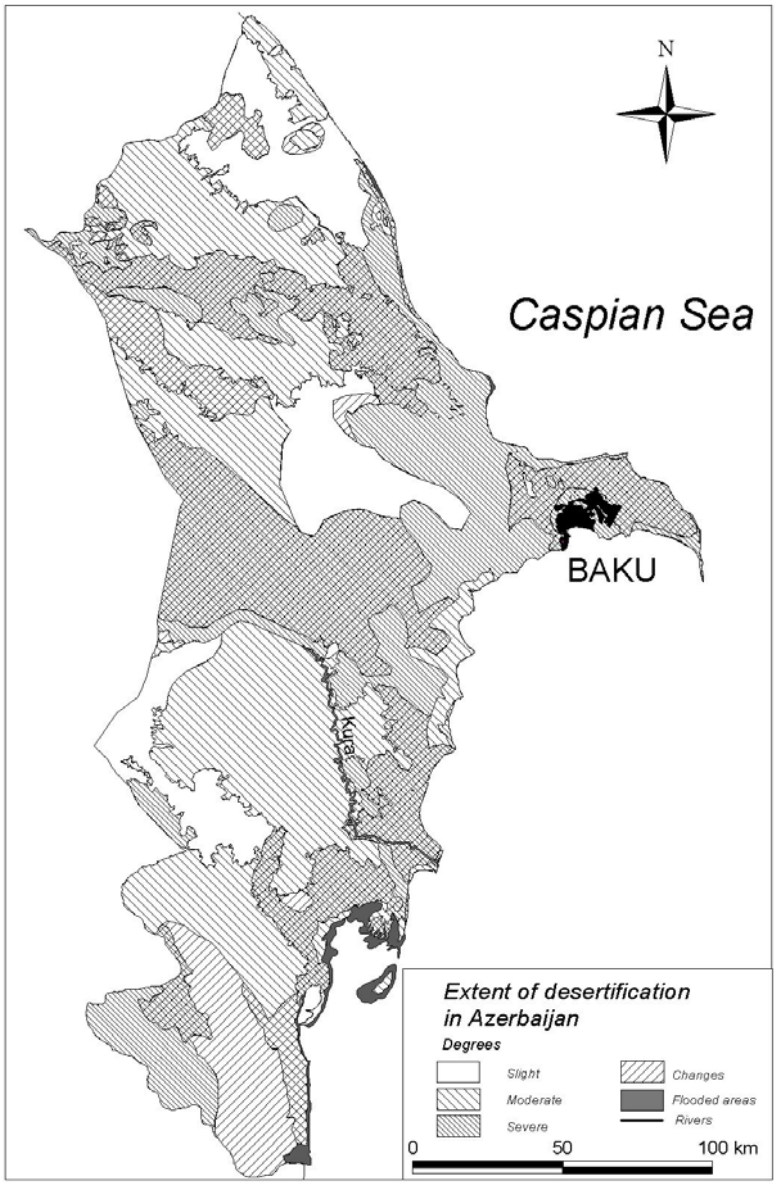
Almost half (45.5%) of the area of 34,300 km^2 examined in the coastal zone of Azerbaijan is subject to processes of severe desertification. Looking at the immediate coastal area, desertification is mainly concentrated on the slopes and alluvial fans of the coastal range and foothills of the Caucasus Mountains, on coastal marine terraces and old dunes. In this coastal area three large areas with severe land degradation can be distinguished (see map 4):

- Absheron peninsula and adjacent foothills of the Caucasus Mountains;
- Qobustan foothills; and
- Kura-Aras River delta.

The main causes here are the development of the oil industry around the Absheron peninsula and Baku, agricultural use and soil degradation by salinisation and water erosion, fuel-wood cutting around smaller settlements due to the lack of other source of domestic fuel, and also inundation by the Caspian Sea.

Further from the coast, in the middle of Azerbaijan, land degradation has taken hold mainly through deforestation. Especially on the southern slopes of the eastern Great Caucasus Mountains in the river basins of Pirsagatchay, Kozluchay, and Chikilchay, the degradation of natural forests reached catastrophic proportions a long time ago. As a result of intensive agriculture and stock breeding over the centuries, the forest belt in this area has been almost completely destroyed. Another area of deforestation is the foothills of the Talysh Mountains in the southern-most part of the country.

Map 2 Extent of Desertification in the Coastal Zone of Azerbaijan



The most common type of desertification is degradation of vegetation. This desertification type is mainly caused by overgrazing and cutting wood for fuel, but often linked with other types, such as the development of the oil industry (so-called "technogenic desertification") and salinisation. Degradation of vegetation in the coastal area of Azerbaijan is the most important land degradation process on more than the half (51.2%) of the severe degraded land. Water erosion due to the undulated land and the higher precipitation close to the Caucasus Mountains is with almost one fifth (18.5%) the second important type of desertification, similar to Iran.

Investigations comparing recent desertification since 1998 with the period about 15 years previously (using images from 1982-1984) show the greatest increase in the degree of desertification (measured on a five degree scale (see map 3) in both areas: the Absheron peninsula and the Kura-Aras delta. This underlines what a huge impact human activities have had on desertification in both these areas of Azerbaijan.

The increase in degradation on the Lenkaran coastal plain has also been investigated. Especially in the Lenkaran area, where the degree of desertification was still slight, the degradation of vegetation and soil cover has accelerated severely. There a high risk of further desertification. Both other areas were already severely desertified in the early 1980's.

3.3.3. Conflict Areas of Environment And Human Activities

Absheron and Other Oil Industry Zones

The oil industry has long been by far the greatest culprit in destroying landscapes in the coastal zone of Azerbaijan, especially in the Absheron peninsular and the area south of Baku. The “old” (pre-independence) oil production areas cover 20,000 ha of the peninsular, of which over 8,000 ha is severely contaminated with oily water and 2,000 ha is occupied by artificial oil-water lakes and pits. These areas are classified as severely degraded semi-desert landscapes. In addition, oil industry wastes have contaminated 165 natural lakes.

Marine deposits determine the soil features: predominantly sands, but also clay, shells and other friable materials. Various psammophytic (“sand”) desert vegetation types have colonised this fractured landscape, and the highest risk of further degradation is in the movable sand deposits.

Kura River Delta

Other areas in the coastal zone of Azerbaijan with conflicts between nature, economic activities and the population are mainly found in the lower Kura-Aras river delta. Because of fertile alluvial soils and good conditions for irrigation this region has a very intensive land use for crop production, vegetables, and fruits. The ground-water table is very high, and in the lower-lying areas has risen by 1 to 2 m because of sea level rise. Such high groundwater levels together with the hot climate lead to salinisation, reducing the areas of arable land, pastures and meadows. Other problems are the cutting of wood in these lowlands for construction and domestic fuel, and overgrazing by cattle, sheep and goats.

3.4. Potable Water Supply

Compared to other Caspian states the water resources of the coastal zone of Azerbaijan is sufficient, due to many rivers running from the Caucasus Mountains. Although only 7% of ground water deposits are used, the water supply to Baku and the Absheron area has always been difficult and costly. The high water demand from the large population, industry and agriculture in the Absheron area and the rapid development over the past 100 years, has meant that water supply problems persist. Other areas with insufficient drinking water supply are:

- Devechi-Sumgayit district (north of A Baku and Absheron peninsula)
- Coastal zone of Qobustan south of Baku
- Lenkaran coastal plain in most southern Azerbaijan.

The northern Samur-Devechi and the southern Lenkaran foothills are much better supplied with freshwater due to the rivers running from the Caucasus and Talysh Mountains. Water is obtained from both surfaces sources and groundwater. Only in Lenkaran region is there a centralised water supply whereas in the other regions the 3-5 m deep ground water is used.

Chapter 4. Islamic Republic of Iran

4.1. Natural Conditions For Desertification

The coastal zone of the Islamic Republic of Iran – compared to the other littoral countries of the Caspian Sea has natural conditions with a low susceptibility to desertification. The climate in the western and middle provinces of Ghilan and Mazandaran is humid. The rainfall due to the Elburs and Talysh Mountains nearby is generally higher than 800 mm/year. The result is a thick vegetation cover, as forests on natural areas but also on land used for agriculture. The climatic situation caused a west-east profile beginning with humid forests, changing to steppe, semi-desert and desert vegetation. The condition for salinisation as a naturally induced desertification process is low.

The predominantly narrow (often only around 2-5 km wide) alluvial plain north of the foot of Elburs Mountains has very fertile soils, ground and surface water conditions allowing a permanent supply for drinking water, irrigation and other purposes, and good properties for a diverse agriculture. Two areas are wider: The delta of the Sefir River running through Rasht to the Caspian Sea and the coastal plain from Amol to the east up to Gorgan and Gonbad-e-Qabus. Here the alluvial plain is 30 km up to 50 km wide.

The arid and semi-arid climate in the north-eastern parts of the Iranian coast in Gholestan result from salinisation and degradation of vegetation caused by certain human activities. This area north of Sari and Gorgan is part of the desert and semi-desert belt of Central Asia extending into southern Turkmenistan.

Due to the mountains nearby – very often the coastal zone is only some kilometres wide – and the high precipitation in this mountain area (including melting snow) the run-off directed generally to the Caspian See is high. This potentially leads to water erosion if the vegetation cover has been destroyed.

The land use is mainly as follows: The total amount of forest in these three provinces is 33%. Due to the climatic and relief conditions the forest is mainly concentrated in the western parts and on the northern slopes of the mountain belt in the south. Pastures mainly in the eastern province Gholestan demonstrate more arid and semi-arid climates. The total area of pastures is 37.7%. The approximate 30% remaining along the narrow coastal belt is used by agriculture for rice production, cotton (mainly in eastern areas), tea, and different tropical fruits. The other type of land use here are settlements and areas with transport infrastructure.

Although the extent of desertification in the Caspian coastal zone of Iran is relatively less (see map 4), the main types of desertification are degradation of vegetation and water erosion. In addition, there is a slight trend to deforestation.

Salinisation combined with vegetation degradation under livestock can be found in northeastern areas of the Gholestan lowlands. This area is the only one within the Caspian region that shows severe degradation.

4.2. Areas With Quasi-Natural Landscapes

Areas with no or a very little human stress can be found mainly in mountain areas. Map 3 gives an impression that most of these areas have not yet suffered degradation caused by human activity. The forests here are exploited for its timber, and for recreation and leisure. Thus the stress on the ecosystems is slight.

Some areas in northeastern Gholestan provinces mainly bordering on the Caspian Sea are characterised by flat conditions and wetland with open salt-water areas and generally a high ground water table. These areas are characterised by solonchaks, the typical salinated soil in arid and semi-arid areas around the world. The salt is from the Caspian Sea. The pressure derived from livestock here is, due to the very small population living here, only slight.

4.3. Extent of Desertification

4.3.1. Naturally Desertified Areas

Natural processes of desertification are important for those northeastern plains (north of Gholestan province adjacent to Turkmenistan). The marine sediments previously deposited on lower terraces of the Caspian Sea are characterised by a very high ground water table. Often these areas are flooded. So with a strong influence of the lithological structure of existing sediments a desert and semi-desert area has evolved, in which predominantly solonchaks with the related halophytic vegetation are distributed. Sheep, goats and camels only eat the halophytic plants in certain seasons. The most relevant solonchak areas are those from Agal and Bender Turkmen districts. It can be observed that the soil surface is not fully covered with vegetation because of wind velocity deflations (wind erosion).

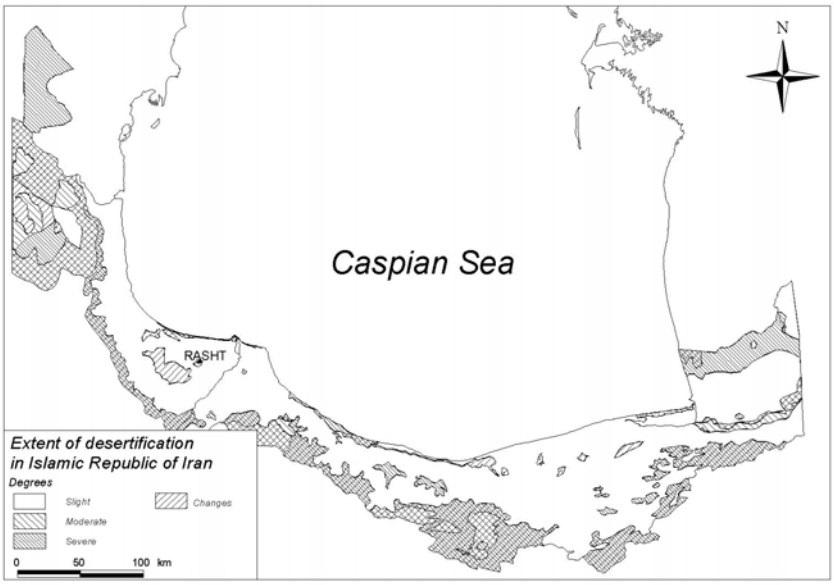
4.3.2. Man-Made Desertification

All three Caspian coastal provinces Ghilan, Mazandaran and Gholestan (from west to east) are very densely populated. The total population is 6.4 million inhabitants, and density reduces from west to east. More than 10% of the total population lives in the Caspian region of the Islamic Republic of Iran. The density of population in Ghilan is 152 inhabitants/km^2, in Mazandaran still 109 inhabitants/km^2 and in the most easterly Caspian province only 68 inhabitants/km^2. Compared to other eastern Caspian provinces this is extraordinarily high. Only 3.2 inhabitants/km^2 for example live in the neighbouring Balkan Velayat of Turkmenistan.

This situation very clearly explains that the high population density has become the biggest impact on the current pressure on land in Iranian coastal areas. The population is concentrated on one third of the total area of the three provinces. The same area has the most fertile soils. The consequence is that areas with a certain degree of degradation of vegetation and soil are given over to settlements, roads and other constructions, and also to waste disposal around the towns and villages.

But probably the most important man-made desertification in the Caspian areas of Iran is the deforestation of the foothills of the Elburs Mountains in order to supply the local very fast growing population with arable land. The other issue is intensive agriculture with the use of fertilizers and pesticides. In addition, salinisation sometimes develops during irrigation.

Map 1 Extent of Desertification in the coastal zone of IR Iran



Map 4 shows the recent changes demonstrating the increase in the degree of desertification since the early 1980s. Unless the most important increase of desertification had been observed on the southern slopes of the Elburs Mountains ranges (but this area – after the agreed definition - does not belong to the Caspian region) the small areas like a chain with the relevant increase of land degradation along the coastal range from Mazandaran to Gholestan are visible. Probably the risk for further increase in deforestation and induced water erosion here remains persistently high.

4.3.3. Conflict Areas of Environment and Human Activities

Eastern Mazandaran: Deforestation and Gully Erosion

Over the last 30 years, southern parts of Gholestan and Mazandaran provinces have suffered from deforestation. Over the past 22 years the area of forest has reduced from 3.4 million ha to 1.9 million ha, an average of 45,000 ha per year. Particularly around Sari, Babol and Amol towns (east Mazandaran) approximately 5,000 industrial installations impact on vegetation and soil cover, reducing areas available for recreation and leisure, and resulting in the cutting of wood for fuel. The areas that were forests are now mainly used as meadows or arable land. And the arable land on the northern slopes of south Mazandaran from Qaimshar to Behsahr and Gorgan is subject to severe erosion. Where there is no land cover, 20-50 cm deep gullies are formed and streams carry a heavy silt load.

Ghomishan: Salinisation and Overgrazing

The marine sediments on the lower coastal terraces in northern Ghomishan are characterised by solonchaks and halophytic vegetation. In addition to salinisation, the area is under pressure from livestock which is, apart from fishing, the main source of income in the area (mainly settled by Turkmens). The density of animals: sheep, goats and camels (and some cattle) is already high. The impact on the thin vegetation cover is high, and where the cover has already been destroyed wind is inducing severe deflation processes.

4.4. Potable Water Supply

The water resources situation in the coastal area of Iran is the best of the Caspian littoral countries. An average rainfall of 437 mm/yr provides sufficient supply. Only the eastern areas in Gholestan province bordering Turkmenistan have arid and semi-arid climate. Even north-eastern cities such as Gorgan and Gonbad-e-Qabus, with rainfall of 400-500 mm/yr do not suffer a lack of water, except sometimes during summer.

Cities are mainly supplied by deep wells through central water supply systems, whereas in rural areas springs, shallow traditional open wells and qanats are used. Because of the high portion of shallow wells, pesticides and fertilisers from agriculture and sewage water potentially contaminate the drinking water. Rivers such as Sefid Ruud in the most industrialised province of Ghilan, the Anzali Lagoon rivers and the Pol Ruud are considered the most polluted rivers along the Caspian coast of Iran. Water intakes need to be protected. Steps have been taken to control the surface waters of Sefid Ruud and Gorgan with dams that protect the numerous water supply networks.

Chapter 5. Kazakhstan

5.1. Natural Conditions For Desertification

The most important conditions for desertification of the coastal zone of Kazakhstan are the climatological situation with the continental location. The climatic situation is characterised by

- Very low precipitation with 137 mm/year to 200 mm/year; the months with the highest average of rainfalls are May-June and December (between 9-13 mm/month)
- Annual evaporation from about 900-1000 mm/year that means there is a great lack of water Dryness of the climate has an effect on the relative air humidity regime: the number of days with relative humidity less than 30% in summer reaches 24,5 days a month.
- High summer temperatures: July with an average of the air temperature of +25-26,5° Celsius, there are averages of maximum air temperature in western areas +39-45° Celsius, increasing to eastern areas far from the Caspian Sea up to +44-46° Celsius.
- Very low winter temperature (-36 up to –40° Celsius, occurring during anomalous cold winters).

The winter rainfall normally turns into a persistent snow cover, usually establishing itself in the second half of December. The average thickness of snow cover does not exceed 10-15 cm but lasts on average for 69-95 days.

Under those arid up to semi-arid climatic conditions semi and total deserts covering the entire coastal area of Kazakhstan (length about 1,600 km) have developed. Although there is more humidity in the north-eastern areas bordering on the Astrakhan Oblast (Russian Federation) the conditions for other vegetation types do not exist. The only variation comes from different rocks and soil properties such as

- Limestone, dolomites, gypsum, and sandstones on the Ustjurt plateau (altitude generally between 150-340 m, highest point Tau Bescoky 556 m east of Aktau city), mainly in Mangistau Oblast (southern Kazakhstan)
- Sandstones, sands, clay material in larger and smaller depressions inside of the Ustjurt plateau; at the edges of the depressions dry but mainly humid from ground water, which is almost saltwater
- Sand, gravel, and clay material sediment deposited by rivers and their deltas; first and foremost by the Ural and to a lesser extent by the Emba River (northern and northeastern part of Kazakhstan bay) with humid soils, sometimes with swamps
- Sand, gravel, and clay material sediment from the Caspian Sea (old and recent stages) on different terraces; the recently formed margins characterised by dunes, lagoons, marsh areas with a wide reed belt adjacent to the shallow waters.

Adjacent to the coastal area of the most eastern Kazakhstan bay (Prorva, Opornyi), the “Tengiz field”, one of the largest oil and gas deposits in Kazakhstan, has been developed.

5.2. Areas With Quasi-Natural Deserts

Due to the very small population number in the very large Kazakhstan coastal zone quasi-natural deserts are relatively widespread. Map 5 shows the area especially in

- Ustjurt plateau: One large area lies adjacent to Turkmenistan (Mangistau Oblast), a second one is around the large depression “Sor Oli Kultuk” and “Sor Kajdak”, inundated by the Caspian Sea and the area east of Tengiz field (northern Ustjurt plateau around Bejneu up to Kulsary). This region is almost flat including a lot of depressions with sedimentation of small materials (as “takyrs”). The determining soil materials are limestone, sandstone, and clay. Highly mineralised ground water is to be found at a depth of 5-20 m. The vegetation is mainly polyn (Artemisia kemrudica) and biurgun (Anabasis salsa). There is only a little overgrazing. There is a natural risk of water erosion caused by the slopes and periodic rainfalls and melting snow.
- Naryn Kum Sand areas on the alluvial plain between the Volga and Ural Rivers with arid and semi-arid deserts. Here there are mainly arid landscapes on undulated relief varied by different sand sediments. Due to the low pressure of population and livestock the desert landscapes in quasi-natural form have been preserved.
- Another unique type of landscape is the “ Berovskiye Bugriy”, distributed around the northern parts of the Caspian Sea. This old coastal formation of marine sediments has been developed with a characteristic spatial and vertical structure: 0.5 up to 5-7 km long, very narrow sand ridges with an height of about 5 m. These upper parts from sand are covered by semi-desert or desert vegetation. These ridges are often affected by wind erosion (deflation). The lower narrow depressions between two ridges are often covered by shallow water with a high salt content and/or with solonchaks and bog-meadow soils. The characteristic plant groups are halophytes.

5.3. Extent of Desertification

5.3.1. Naturally Desertified Areas

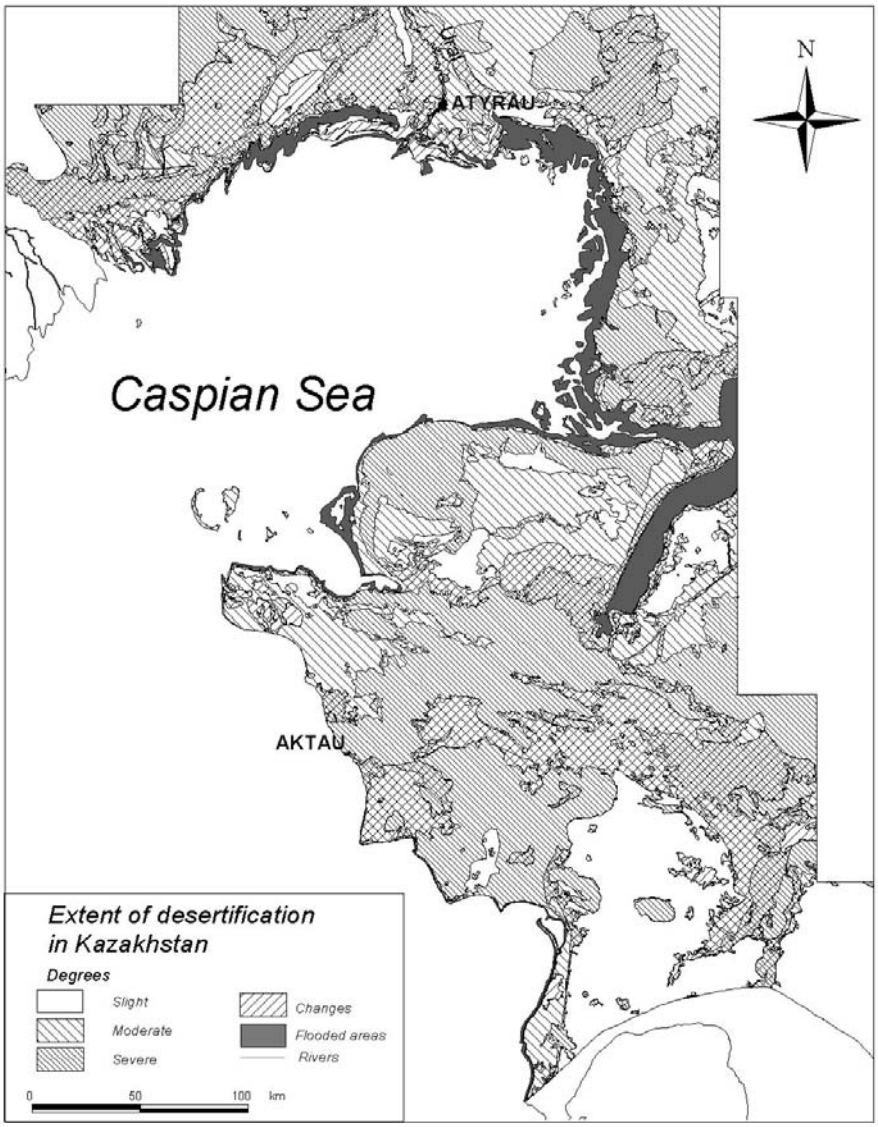
The most common type of natural desertification in the coastal zone of Kazakhstan is salinisation. In the existing arid and semi-arid climatic and geomorphologic conditions, solonchaks can be observed in almost all depressions. The extent of salinisation rapidly increased during and after the last inundation period from 1979-1995 in those depressions connected with the Caspian Sea. Huge areas beyond the current coastline of the northeastern Kazakhstan Bay (after the 2.5 m rise of the sea level) nowadays are affected by groundwater from the sea. This led to a high salinisation impact severely affecting for example the northern part of the Buzachy peninsula.

In addition, natural deflation processes are to be observed in sand massifs such as Naryn Kum, Caspian Kara Kum, Bostankum, Tuecu, Sengir Kum, and Karyn-Dsharik. Another natural process is the dust movement induced from the Aral Lake leading to some soil salinisation.

5.3.2. Man-Made Desertification

Despite the low population density 75% of the Caspian coastal zone of Kazakhstan is subject to different man-made causes of desertification – firstly, traditional livestock and, secondly, the "new" cause – the oil industry. Overuse of pastures by livestock overgrazing and hay production is widespread in Atyrau Oblast (mainly in the Ural river valley and its alluvial terraces) and in Mangistau Oblast. Unless the number of people recently employed in agriculture is low (Atyrau Oblast 9%, Mangistau Oblast 8%) livestock has been – and beyond larger settlements and the oil production areas is still - the most important economic activity. Thus desertification caused by overgrazing therefore still exists.

Map 2 Extent of Desertification in the coastal zone of Kazakhstan



The biggest recent threat can be seen in those coastal areas where research has already started. Most affected areas are the oil and gas deposits around Atyrau, the northeastern Tengiz field (Atyrau Oblast) and the areas east of Aktau (Mangistau Oblast). The Tengiz field is the largest in Kazakhstan with an estimated 780 Million t oil. The area of this field is about 560 km^2. Not only is the sulphur content of this oil high, but another issue is the large proportion of irregular high pressure of the viscous oil fluids that makes the drilling, storage and transportation works risky.

The Mangistau Oblast deposits (east of Aktau city) are aggregated from different smaller fields as Ozen, Jetibay, Kalamkaz and Karajanbaz. The total estimated amount of these deposits is approximately 500million t oil. Similar to the oil characteristics mentioned above, the pressure of the oil is, at 700-900 bar, very high. Additional features are 20-25% paraffins and 10-20% resins, a high concentration

of toxic sulphurous chemicals, aggressive fluid hydrocarbons, radioactive thorium, barium, vanadium, and nickel.

Main types of desertification are the result of degradation caused by the oil industry (31.6%). All the phenomena concerned, such as destroyed vegetation and soil cover from drilling and transportation processes, and contamination of vegetation and upper soil cover, have rapidly increased, especially in recent years, and cover more and more of the Caspian zone of Kazakhstan. The second important process is inundation of huge coastal areas (see map 6) and induced salinisation processes beyond the new coastline. All other three types of desertification - water erosion, wind erosion and degradation of vegetation – can be observed more or less to the same extent.

The main causes of the increase in desertification in Kazakhstan therefore are research, production and transportation connected with the oil industry. Overgrazing as the main cause for the degradation of vegetation has been investigated. Degradation of vegetation caused by the extensive cutting of fuel wood around small villages and summer camps of shepherds without access to gas and electricity is also linked with the traditional way of life of the Kazakh people.

Main changes in terms of progressive desertification can be observed over large areas (see map 6), especially in oil production areas east of Aktau and where livestock graze in Atyrau Oblast. High livestock concentrations in the vicinity of settlements and seasonally used pastures around water wells can lead to severe desertification.

5.3.3. Conflict Areas of Environment and Human Activities

Atyrau: Oil and Gas Industry

Serious impacts on the landscapes have resulted from the oil and gas field on the delta and left banks of the Ural River. The extensive area around Atyrau city was developed during the Soviet period. Drilling facilities, roads, pipelines, oil storage facilities, maintenance depots, temporary construction sites and homes for the oil and gas workers have been built, degrading the semi-desert and desert vegetation. Upper soil horizons and some solonchaks have been contaminated with oil, oil residues and concrete, iron and other waste. In addition, agriculture along the Ural river has resulted in salinisation of the soils and overgrazing has degraded the arid and semi-arid vegetation.

Tengiz Oil industry Conflict Area

The impacts from the newly prospected large Tengiz oil and gas field south of the Kulsary area in the last decade are similar to those in the Atyrau Conflict Area explained above. The situation is of special importance because of the closeness to the Caspian Sea. During the last transgression there was the probability of ground water and seawater contamination because the inundation extended up to 40km inland into Kazakhstan.

Aktau-Ozen Oil And Gas Industry Conflict Area

Although this oil and gas field is protected by its distance from the Caspian Sea against contamination by water a conflict situation has developed. Especially in the Jana-Ozen and

Jetibay areas there has been huge degradation of soil and vegetation by a bitumen cover in former opencast-mining areas. Furthermore, the surroundings of the city of Aktau and other settlements and oil industry facilities (roads, pipeline, storage sites) have been tttotally degraded.

5.4. Potable Water Supply

As 43.9% of the population of the Atyrau Oblast and 50.7% (1999) of the Mangistau Oblast live in the capitals Atyrau and Aktau, there is a high demand for water resources in the cities. A considerable demand has also recently arisen from the oil and gas industry in rural areas, although the water quality requirements are quite different.

Water consumption is complicated because of the climatic situation and the economic conditions. Neither the established groundwater resources nor the surface water resources are sufficient:

Water Demand and Supply from Groundwater in Atyrau and Mangistau Oblasts
(cu m/day)

Region	Demand	Proven Groundwater		Estimated Total Groundwater	
		Total	Potable	Total	Potable
Atyrau Oblast	190,600	245,400	34,100	5,224,000	115,800
Mangistau Oblast	248,600	289,100	181,200	1,218,000	679,000

A high proportion of groundwater cannot be used as drinking water because of the degree of mineralisation in many geological layers. A mineralisation content of up to 1g/l is the normal maximum for drinking water. Sometimes in the area between the Volga and the Ural ground water layers to a depth of 200-300 m are contaminated with water from the horizons above or below with highly mineralised water (predominantly sulphur-chloride, chloride-sodium), with concentrations of up to 100-150 g/l. Some waters with a mineralisation of 2-5 g/l – that are found especially in the Tengiz oilfield area southeast of Atyrau – can be used for technical purposes.

Another factor is the depth to the freshwater layer (up to 1,500 m and deeper), which makes the supply very expensive. In addition, the rate of recharge is very slow.

Other water sources are mainly surface water and to a few freshwater plants that desalinate Caspian seawater. The groundwater deficit must therefore be provided from surface water. The most important sources of surface water are:

- Ural River, lower reaches at Atyrau 16,934,400 m^3/d;
- Emba River; which only periodically reaches the Caspian Sea; middle reach in Zarkamys: 1,347,840 m^3/d
- Sagyz River (between the Ural and Emba Rivers): 137,376 m^3/d
- Two Volga tributaries in the most northwestern region adjacent to Astrakhan Oblast (Russian Federation).

The total withdrawal of surface water in the Atyrau Oblast in 1998 was 99,600 m^3/d (corresponding to about half of the total demand).

The Ural River also supplies the agricultural area on the Ural River terraces around Atyrau with irrigation water. Both Atyrau and Mangistau Oblasts utilise surface waters of the Ural and Volga Rivers for drinking water supply. In Atyrau Oblast potable water pipelines are:

Water Pipelines in Atyrau Oblast

Name	Source	Length (km)	Capacity ('000 m^3/d)
Inderski	Ural River	293	5.7
Baksaiski	Ural River	346	1.7
Kulsariy-Atyrau	Ural River	160	0.2
Primorski	Ural River	120	2.2
Zauralski	Ural River	150	4.2
Novobogatinski	Ural River	185	5.1
Dengiski	Volga River	130	6.9
Guerevski	Sagyz River	63	2.2

The water supply situation in Mangistau Oblast is worse because there is no surface water within the oblast. The oblast receives all its imported surface water through large pipelines (Koscagil-Sarikamys, Bejneu-Sai-Utes, Kigac-Mangistau, and Kungrad-Kulsary) totalling 20,000 m^3/d, mainly from the Ural River, but some even coming from the Volga River delta.

Chapter 6. Russian Federation

6.1. Natural Conditions For Desertification

The coastal zone of the Russian Federation lies in two climatic regions: the northern areas similar to the arid zone of Kazakhstan, and the remaining coast of the Kalmykian and Daghestan Republics extending to the semi-arid and partly humid areas of the Caucasus Mountains and its foothills. Although the Volga River valley is climatically characterised by the overall arid situation and Astrakhan has an average rainfall of 208 mm/year, this region is distinct from the adjacent areas because of the plentiful supply of water from the river. Thus the following natural regions can be defined:

- Sub-humid coastal foothills of the northern Caucasus mountains from Daghestan
- Semi-arid coastal terraces in Daghestan and Kalmykia
- Volga and Terek River delta.

The coastal areas of Kalmykian Republic and Astrakhan Oblast are part of the large Caspian depression. During both the Tertiary and Quarternary periods in particular the geologic Caspian Sea had had a more northern extension. This has resulted in thick marine sediments covering what is today the Russian northern Caspian coast with various rocks and material such as sandstone, limestone, conglomerates, shells, sand and clay on the land surface. These areas have great importance for fish spawning and as habitat and feeding grounds for water birds. Some of these natural and quasi-natural landscapes in the Russian Federation are highly protected (as so-called “Astrakhan Zapovednik” divided into three areas).

6.2. Areas With Quasi-Natural Deserts

Quasi-natural landscapes on the one hand are distributed in some areas of the Volga delta. These landscapes have been developed by sedimentation and erosion of the Volga River, its courses and tributaries. Despite the very intensive use of this lowland, it has, on the whole, preserved some unique natural landscapes such as solonchak depressions, old meanders, and sand massifs named “Bugriy”. Some of these landscapes are partly used for cattle, but not intensively. So the natural conditions have not been changed severely. The typical reed and dunes vegetation mainly covers the areas close to the coast, the composition of which is often shell sediments and shallow waters.

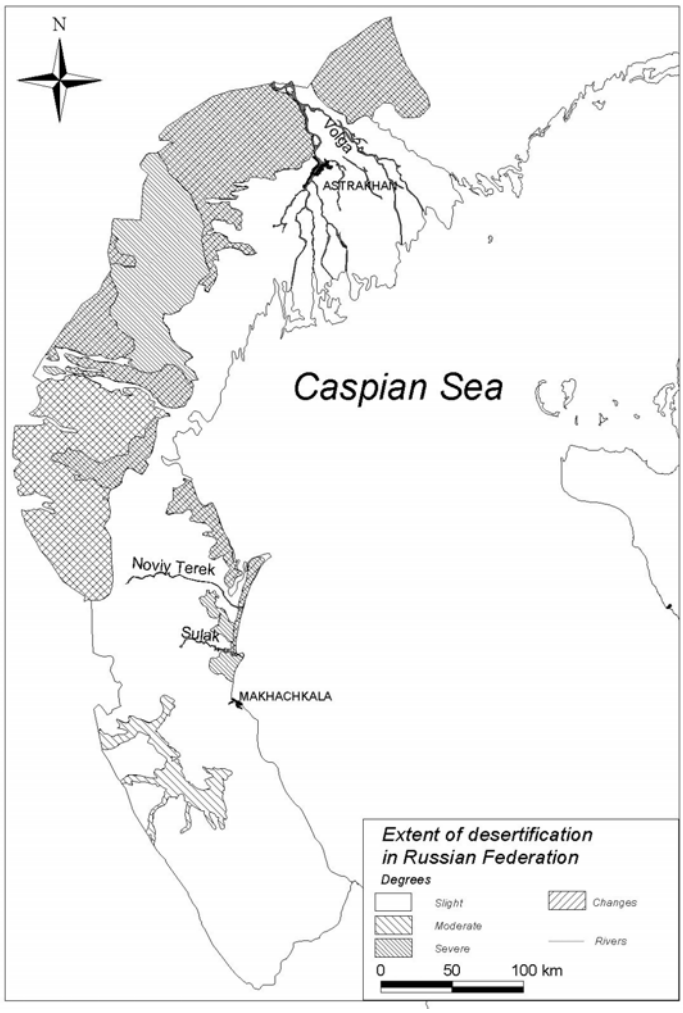
On the other side quasi-natural landscapes have been preserved in the foothills and hills of the northern Caucasus Mountains in the Daghestan Republic. Especially from the northern more humid ranges rivers like the Terek, Sulak and Samur flow from north to south. In the upper parts of the mountains there are still natural or quasi-natural forests, mostly coniferous. Around the mouth of the Sulak there are remains of a natural deciduous forest. Remains of very rare relics of natural plant groups of the *Girkan* type, with a high diversity of plants including liana species, occur. Although the climate is semi-arid the trees are supplied by the plentiful ground water on alluvial plains and marine terraces. Recently the human pressure from cutting trees and grazing has increased.

6.3. Extent of Desertification

6.3.1. Naturally Desertified Areas

The steppe and semi-desert areas surrounding the northern end of the Caspian Sea have suffered extreme droughts more often than usual in the last decade. These climatic causes have had a certain impact on the natural environment, especially on the volume and the composition of species of existing natural and cultivated plants. A further effect can be seen in the soil structure which is characterised by materials with a larger grain and therefore with a lower ability to preserve soil water. Xerophytes plant groups have increased.

Map 3 Extent of Desertification in the coastal zone of Russian Federation.



A second natural process, flooding and naturally induced salinisation, have had an influence on the desertification. This of course affected first of all the coastal areas but also due to the slow down drainage from river and streams further upstream. Sea lagoons behind the dunes and large areas with “new solonchaks” have developed. They are distributed mainly in the lowlands of the Terek, Sulak, Samur and Volga Rivers.

6.3.2. Man-made Desertification

The density of population in the Caspian coastal zone compared with other semi-arid and arid regions around the Caspian Sea is quite high (Daghestan Republic 43 inh./km^2, Astrakhan Oblast 23 inh./km^2 and in the Kalmykian Republic only 4 inh./km^2. But it must be added that most settlements in the Daghestan Republic are located on the coast and in the Astrakhan Oblast mainly within the Volga delta around the town Astrakhan. Here industry is productive. As a result, threats to the land can be observed. Consequences are the degradation of vegetation around settlements by cutting of fuel wood, overgrazing and different construction measures such as roads, railways, oil, gas and water pipelines but also contamination of some places with residues of oil.

In areas with a rural population beyond the Volga River delta different man-made types of desertification are found. These are mainly connected with agricultural practices, such as the

exceeding of a certain number of cattle and sheep, unsuitable irrigation methods, inappropriate cultivation of the soil.

Stress is caused to the coastal zone of the Russian Federation round the Caspian by wind erosion. This is due to the flat semi-desert and steppe land. Often strong western winds in summer and eastern winds in winter cause deflation processes if the vegetation cover has been destroyed. This can occur on arable land and especially in the degraded Black Lands area of the Kalmykian Republic. Over a wide area there is salinisation and flooding. This is why large areas of the middle and northern Russian coast (north of Makhachkala) are very flat. Degradation of vegetation is another type of desertification.

The main causes here are therefore the agricultural uses. We find the most serious situation concerning degradation in the Black Lands where the main cause is an inappropriate use of the pastures.

Recent changes during the last two decades had been made in the Black Lands around Komsomolskij (Kalmykian Republic) and in the foothills of the Daghestan Caucasus mountains both due to inappropriate agricultural use.

6.3.3. Conflict Areas in Environment And Human Activities

Black Lands

Cherniye Zemli or Black Lands is a steppe area covering about 3.5 million ha in eastern Kalmykia. Since 1958 the re-settlement of the Kalmykian nation[2] has strongly increased the environmental pressure on these steppe areas. Previously, sheep flocks never stayed there during summer but moved to distant pastures. Normally after autumn rains they returned. One reason for this landscape change was the abandonment of the traditional seasonal grazing patterns. In addition, sheep stocking numbers have been too high. In the early 1970's there were about 3 million head in 2,700 barns.

The area had been supplied with extensive irrigation from 600 artesian sources by 840 wells. 14 large cooperatives maintained the livestock. Eventually the pastures were four times overloaded. Nowadays in Lagan district 90% of the soils are salinised, causing severe vegetation degradation. Deflation has resulted in large areas being covered by sand dunes. Other areas are characterised by the change of the pasture vegetation structure to include grass types that cannot be eaten by sheep. Eventually the rural population out-migrated to other Kalmykian areas and the Black Lands are now poorly populated. The Black Lands have long been a protected state reserve: "Cherniye Zemli Zapovednik" to protect typical steppe conditions with vegetation and animals close to the Caspian. It is also one of the original habitats of the endemic and protected Saiga antelope, which is currently endangered.

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[2] Under Stalin in 1943 about 120.000 Kalmykians, mainly women and children, were deported for political reasons to Siberia and northern Kazakhstan. Many of them died on the road and in these areas. Khrustchov at the 20th Congress of the Communistic Party of the Soviet Union in 1957 rejected this decision. About 70.000 Kalmykians re-settled in 1958 in their previous living places. Now the Kalmykian Republic has about 300.000 inhabitants, including about half from other ethnic groups.

Daghestan Coast

The population density of Dagestan is 42.5 inhabitants/km^2 and the density of settlements, technical and industrial infrastructure is high. During the sea level rise from 1979 until 1995 about 150,000 ha along the coast was flooded, and the March 1995 surge (1.7m deep) caused considerable damage.

The drainage system no longer functions, affecting arable land and pastures along the coast and salinisation has begun in these areas. Salinisation also damages houses and other constructions. About 200 houses in Makhachkala, Derbent and Lagan have been destroyed and 800 families displaced.

6.4. Potable Water Supply

The water resources situation in each of the three administrative areas on the coast of the Russian Federation is quite different:

Only surface water is used in Astrakhan Oblast. The agricultural sector is important and uses 89% of the 95.35 million m^3/yr total consumption, 1.7% is used for drinking water and less than 1% for industrial purposes. Even though the communal water supply halved between 1999 and 2000, the per capita consumption of 1,270 l/head/day is still extremely high.

In the Lagansk rayon of Kalmykia there are three distinct water supply zones. In all three zones only surface water is important. There are groundwater deposits but they are highly mineralised. The most populous zone is Lagan town, which is supplied from the Caspian Main Canal, originating on the Bakhtemir River (using the reservoir “Krasinskoe”). The canal and water supply system has a capacity of 3,200 m^3/d, enough to provide the 12,700 inhabitants (1999) with 253 l/head/day. However, the water treatment plant does not function properly since the March 1995 surge flood, and the daily average drinking water supply is only 30-50 l/head/day, which is much less than the norm of 165l/d. Water quality is also poor (heavy metals, non-metal elements, organic matter from nitrogen chemicals, chloral-organic pesticides) especially during the summer.

The zone adjacent to Astrakhan Oblast (northern Lagan Rayon) receives water through a 120 km long canal from the Volga River.

The third zone is the most southern. Some groundwater resources are used, but the zone is mainly provided with potable water from surface water sources through a pipeline along the main railway line delivering surface water from the Terek River (Kizjlar, Daghestan Republic).

In the Daghestan Republic 71% of the potable water comes from ground water, resulting in:

- More assured supply and less pollution in comparison to surface sources; and
- Independence from seasonality.

A large depression of the Caucasus Mountains to the north, with thick porous layers, forms the aquifers that could supply 2.0 million m^3/d, although only 0.9 million m^3/d are currently exploited.

The problem in this zone is the recent pollution of groundwater by oil, industries and sewage. The Derbent deposits especially are endangered in periods of high demand, when the Tarum and Kizjlar groundwater deposits are polluted by arsenic, magnesia, and phenol. About 30% of groundwaters do not meet state water quality requirements. The quality of surface water from the Terek, Sulak, and Samur rivers has also decreased through pollution with hydrocarbons (especially Terek River), phenol and copper (Samur River).

Chapter 7. Turkmenistan

7.1. Natural Conditions For Desertification

The climate of the Caspian coastal area of all Turkmenistan is arid although there is an increase in average yearly rainfall mainly from north to south. The annual precipitation around the large Kara Bogas Gol bay in the northern part of Turkmenistan is given as 95 mm. Around Turkmenbashi the rainfall reduces to 73 mm/year, but increases in the southern Turkmenistan region to 196 mm in Esenguly. The whole Balkan Velayat therefore is characterised by natural deserts on different geological situations such as

- Primary rocks on the Ustjurt plateau surrounding the Kara Bogas Gol bay, in the Bolshoi and Malij Balkan Mountains, and the area around Krasnovodsk Bay up to the Kara Bogas Gol bay
- Sand massifs such as the huge ones stretching from Belek in a long, wide belt (20-30 km, sometimes 50 km) south along the coast to Bugdalij, Gumdag and to Garadepe; another area is the Kara Bogas Gol spit south of Bekdash
- Clay plains from the former Caspian Sea bottom 100 and more kilometres from the present coast line, especially between western Kopet Dag Mountains, and the Malij and Bolshoi Balkan Mountains
- Sea lagoons especially around the Krasnovodsk Bay and in the south large depressions and the characteristic solonchaks.

Other desertification factors are high summer air temperatures and summer droughts. Due to the coastal position there are often strong winds from the Caspian Sea but also hot dry winds coming from the east. Those eastern winds mainly during the summer period often cause sand and dust storms. The flat area, the large sand massifs and clay sediments contribute to the problem. In winter months there are often fogs.

A natural factor increasing the salinisation was the flooding and the rise in the groundwater table from 1979-1995: Former areas of salinisation have been totally inundated. New large areas of salinisation have developed. This problem for Turkmenistan is not of huge economic importance, as on the western Turkmenistan coast there is no arable land that could be degraded. Naturally the salinisation of large areas with the formation of new solonchaks has reduced the area for livestock.

7.2. Areas With Quasi Natural Deserts

Deserts characterise all Turkmenistan coastal zones due to the arid climate. The desertification status map (see map 8) demonstrates that large areas (percentage of total area) are still quite natural such as

- Kara Bogas Gol bay northern and some southern areas
- Tekedji and Goimat Dag Mountains (northeastern investigation area)
- Dardja Peninsula
- Northern Esenguly Etrab (beginning southwest of Gumdag village up to Garadepe).

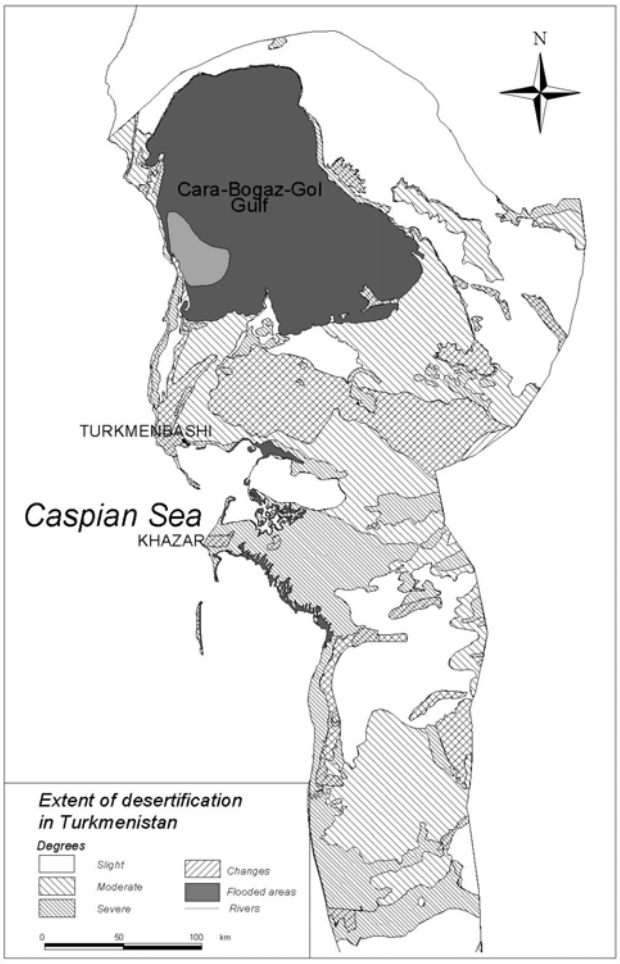
The reasons for those large areas are the very low pressure from human activity due to the demographic situation. Almost nobody lives in the northern Kara Bogas Gol bay area. The Kara Bogas Gol has, because of the high salt content, no importance for fisheries. The main reason for the low population number and population density and thus the low pressure on the environment is the lack of deposits compared to other western Turkmenistan areas.

7.3. Extent of Desertification

7.3.1. Naturally Desertified Areas

Large areas were affected by flooding of the Caspian Sea water during the transgression from 1979 till 1995. Large areas were flooded : the depressions called Balkanski Solonchak up to a distance of 35 km inland, Kelkor Solonchak up to 5 km and in the Atrek delta up to 7 km from the coastal line. The effect was not only the flooding of large coastal areas – especially in the southern almost flat Esenguly area – but also a strong salinisation of the soils adjacent to the new coastline.

Map 4 Extent of Desertification in the coastal zone of Turkmenistan



Large depressions were affected. “New solonchaks” (soils with a very high content of salt) have developed since this process started. The most important areas of severe and very severe salinisation are

- Coastal strip north of Turkmenbashi
- Balkanksi Solonchak enlargement in an eastern direction
- Kelkor Solonchak with northern (Balkanabad, former Nebit Dag), eastern and southern enlargement
- Esenguly Etrab coastal strip.

Other natural desertification factors are the frequent strong winds that, coupled with the relief of the land, cause soil deflation. Especially large flat areas, such as the former Sea clay bottom east of Balkanabad (Khazar) and solonchaks, are affected.

Main types of desertification in Turkmenistan are flooding, such as during the past inundation (see flooded areas in map 8.), and the related salinisation (extending from middle

Turkmenistan along the coastline to the south). Owing to high evaporation existing ground water areas are salinated. Another important factor is the characteristically strong winds in the coastal area and the corridor between the Bolshoi Balkan Mountains in the north and the Kopet Dag Mountains in the south. The Balkan Velayat experiences an average of 280 days of sand and dust storms per year.

While the main causes of desertification are partly of natural origin, such as salinisation and deflation, they are also in part man-made, and these human activities are on the increase. Highest ranking of these are all activities in the oil and gas sector, especially in the middle Caspian coast of Turkmenistan. Another cause is agriculture: an increase in desertification processes has been investigated on the large plateau south of the Kara Bogas Gol bay, where livestock has had a serious impact on the terrain.

7.3.2. Man-Made Desertification

Human activities prove to be a major factor of current desertification in the coastal zone of Turkmenistan, although the pressure from population is not so great. There is a natural fact that has to be considered: From the climatic situation this area is in origin a natural desert. These ecosystems are especially sensitive to all human activities. The vegetation and soil cover therefore can be degraded very fast. Even the limited threats from the low number and density of population in the Balkan Velayat where the population is mainly living in towns such as Turkmenbashi, Balkanabad (Nebit Dag) and Khazar (Cheleken) and Bekdash have often severely influenced the land. The degradation of vegetation and soils especially around those towns and settlements has been ongoing for a long period. Always in historical time the desert has been exploited as pasture for camels, sheep and goats. Especially around water wells and takyrs collecting rain water the vegetation cover is often strongly degraded.

Another impact is the degradation of vegetation by cutting wood for fuel. We observe this mainly around small rural settlements far from the large gas pipelines. In cases where the people in those villages have no access to permanent gas supply they collect wood from bushes, such as Saxaul, for fuel wood.

Man-made processes are affecting large areas of western Turkmenistan region. The Map Extent of Desertification" illustrates the affected areas. The main factor involved in man-made desertification is the oil and gas industry, with its various impacts on land degradation. The effect of vigorous oil and gas research and production is especially noticeable in the Balkan Velayat region. Although this industry has been active in Turkmenistan for over a hundred years, new exploitation since 1991(year of independence) is having an increased effect. The research and the production under on-shore conditions are mainly concentrated in one large coastal belt, beginning at the established areas around Khazar (former Cheleken) and Balkanabad (former Nebit Dag), through Gumdag up to the newer zone of exploitation around Ekerem-Garadepe in the south, where more widespread impacts on the environment are to be seen.

Strong desertification was beginning between the 40ies and the 60ties of the last century. There are two impacts: The first one is the degradation of vegetation and soil by transportation processes around the drilling wells, tanks, along pipelines for gas and water,

around the residential places for the oil workers. The second impact is caused by leakages from oil. This mainly occurred at old oil deposits and pumps. For a long time oil has been running into the soil and had often infiltrated ground water, as in the Khazar (former Cheleken) area. But there are also some places with large oil lakes or saltwater lakes with oil on the surface. The leakages are mainly caused by oil pipelines, sometimes by drilling processes, like Ekerem (southern Turkmenistan). The new exploitation is performed by joint ventures with international companies such as Mobil Oil, Dragon Oil, Petronas, and the Argentinean company Britas (who have left Turkmenistan); in the Ekerem-Garadepe they mainly are working on offshore deposits and therefore have only small effects via transportation needs at some ports along the coast.

A peculiar situation is found in the Kara Bogas Bay in northern Turkmenistan. The bay previously dried out after the dam was built south of Bekdash. For many years sulphur was mined in large opencast mines. The Bay was flooded again with the rising sea water level of the Caspian Sea and the deliberate breaching of Bekdash dam. Another sulphur-sodium technology was and, partly, is still being applied: The water from the Kara Bogas Gol bay is led by water pipelines into large depressions north of Bekdash. The natural evaporation helps to dry out the salt. The salt has to be brought on lorries to the Bekdash factory. The consequences are the very severe degradation of all vegetation and soils by a thick salt dust layer in a large area north of Bekdash.

Despite the low population transportation lines – one railway line and some more roads – cross western Turkmenistan. Alongside those lines, for various reasons, a corridor of some hundred meters is always cleared. The related processes are mainly a degradation of vegetation.

7.3.3. Conflicts Areas Of Environment And Human Activities

Bereket-Turkmenbashi Transportation Corridor

The main road and railway from Ashgabad and Bereket over Balkanabad to the Caspian coast in Turkmenbashi forms a transport corridor that exerts pressure on the environment. settlements are concentrated along the route in an area that is generally very lightly populated. The road itself is often over-sanded. Because of the increase in traffic, desertification has increased during the last 15 years. Improvement of living conditions of the population in coastal areas, demanding more goods and services from central Turkmenistan and an increase in recreation and leisure will increase the pressure on this corridor (the government plans to greatly increase the number of hotel and sanatoria places in Turkmenbashi).

Khazar-Gumdag-Ekerem: Oil Contamination

Around the oil and gas exploration and production fields of Khazar Peninsula (Cheleken), Balkanabad, Gumdag, 26 Baku Commissars, and Ekerem the environment is strongly contaminated and many depressions are filled with oil. Especially over the last 15 years there has been considerable oil exploration, requiring many kilometres of new roads. The traffic on roads and over the landscape has considerably degraded the area.

Bekdash: Salt Mining

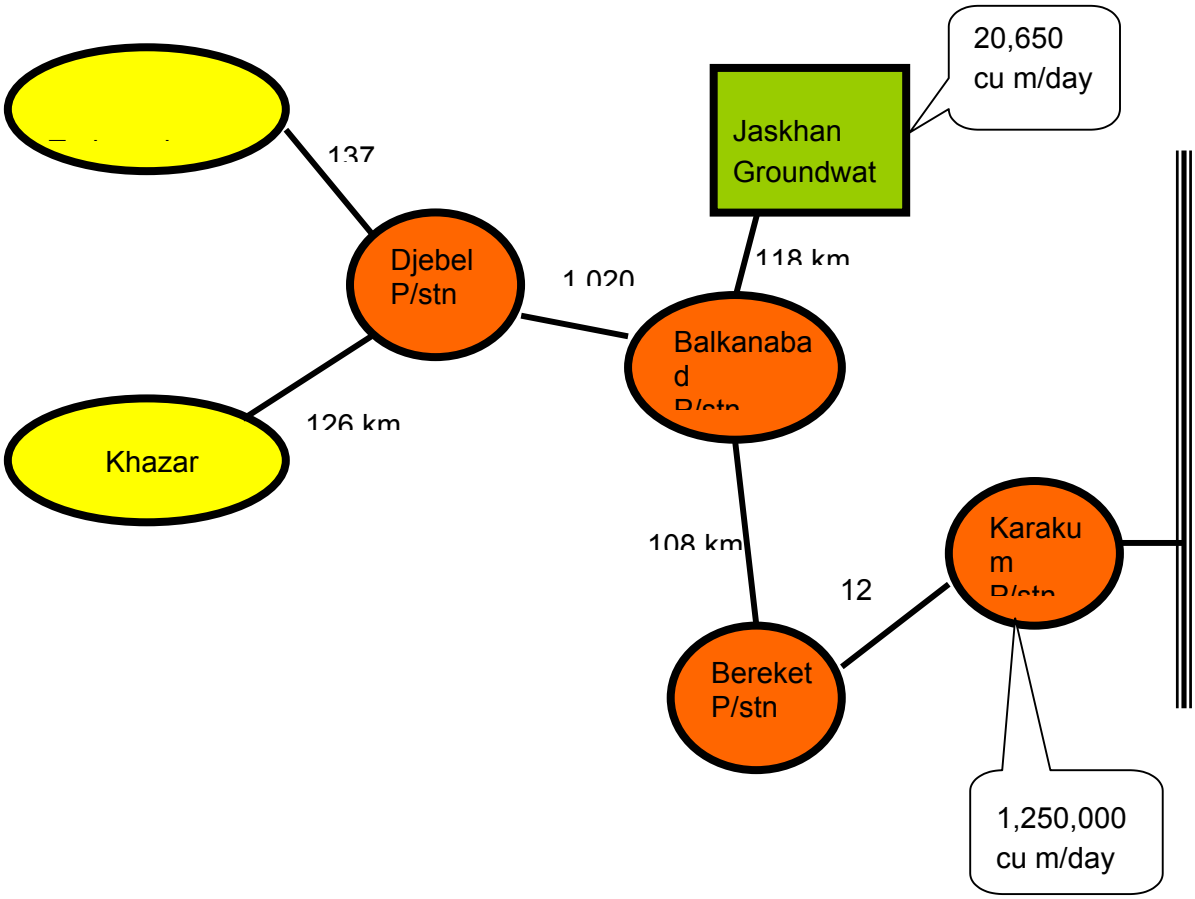
The Bekdash sulphur-sodium factory has considerably reduced its production since 1990. As a result, the population of Bekdash, which relies almost exclusively on the factory for its livelihood, is under severe economic pressure. At the same time, living conditions are harsh because of the complete lack of any fresh water source (water is trucked in) and the considerable degradation of the landscape by the salt production, and people are leaving the area.

7.4. Potable Water Supply

There is a large deficit of water resources in western Turkmenistan because of the very dry climate, and most groundwater (80%) is not potable because of its high salt content. Almost all potable water as well as water for industry and agriculture in Balkan Velayat is thus transferred from other regions. The only domestic sources are:

- Small groundwater lenses utilised by wells for villages
- Distillation plants producing potable water from seawater (such as in Esenguly. established 2001)
- Atrek surface water (although recently the river has not reached the coastal province of Turkmenistan).

The schematic plan shows the sources and water distribution from the Kara Kum canal (using surface water from Amu Darya River) and the main ground water deposits from the



Jaskhan lens in the Uzboj valley north of Bereket (Gazandshik).

The towns and settlements receive 40 million m^3 per year from the central water supply. The average water supply in Balkan Velayat (2000), is only 86 l/head/day, compared with the norm of 250 l/head/day. Some regional disproportions within this region should be noted: whereas in Turkmenbashi the rate of consumption is 86 l/head/day, in Esenguly, the most southern coastal settlement near to the border to Iran, water from a new desalination plant delivers 173 l/head/day, the highest in the western part of Turkmenistan. Previously, water was delivered by tanker, which is still a common practise in other settlements.

The northwestern areas of the Balkan Velayat are supplied from water pipelines from the Kara Kum canal. Existing small ground water lenses with saline water are used for livestock watering and water is traditionally collected in depressions called “takyrs”.

The future water policy in the Balkan Velayat is to:

- Establish desalination plants in Bekdash and Ekerem;
- Agree water sharing of the Atrek River between Iran and Turkmenistan;
- Increase groundwater supplies from Jaskhan lens from 20,650 to 70,000 m^3/d; and
- Exploit new groundwater lenses in Kuuli Majak (north of Turkmenbashi), Cilmamed Kum (north of Balkan Mountains), and Cerkesli (north of Bereket).

Chapter 8. Measures to Combat Desertification

8.1.1. Contamination & Landscape Destruction by Oil Exploitation

Contamination by the oil industry is unnecessary. The report “Environmental Management in the Caspian Oil Industry” shows how the contamination from exploration and production is completely avoidable. Accidental spills from properly-arranged installations should be of minor importance compared with the massive contamination by the Soviet installations. Further contamination by these old installations and destruction by driving over fragile landscapes should be avoided by introducing a new ethos of safety and environmental management. The HSE departments of the oil companies need to be restructured and considerable training is needed at all levels of the organisations.

Cleaning-up the oil polluted lands is a major task. In some areas, oil can be recovered form lagoons and heavily-polluted soils. The first attempts to do this are underway, but the areas where it can be done profitably will be small, not least because of the extensive metal and concrete waste that must be moved. In other areas, the remaining oil reserves could be exploited by modern directional drilling. A project proposal has been prepared to redevelop the Bibi Heybat field in Baku. The proposal bases the cost of rehabilitating the contaminated site on the receipts from new oil production, using the more efficient techniques of the international industry. A profit sharing agreement would be required that establishes an environmental fund and at the same time carefully defines the environmental responsibilities (for the historic pollution) of the international partner company. The proposal has been accepted by the President of the Azerbaijan State Oil Company and is further described in the report “Support to the PIPP”. Such a project would be a pilot for many similar projects in the coastal oil fields.

Re-cultivation of the Absheron peninsula and similar areas should address the re-establishment of typical and traditional vegetation of this region such as Pine (“Eldar”), pistachio, almond, olive and fig trees.

Areas along the coast of Kazakhstan, well fields are less dense than in Azerbaijan but there is an additional risk from storm surges washing pollutants into the sea. A plan is needed to clean up areas that are at high risk and protect valuable installations. It must be recognised that large areas cannot be protected and their land use should be determined accordingly.

The environment should be protected from new oil developments by:

- Including in PSA contracts EIA regulations concerning minimisation of the areas of land occupied for:
  - Drilling and all works around the well heads
  - Residential areas for oil industry workers
  - Locations of tanks and materials storage
- Including in contracts EIA regulations concerning aggregation of roads and pipelines into narrow corridors to reduce the degradation of unique landscapes.

8.1.2. Land Degradation through Salinisation and Flooding

Measures to combat land degradation of agricultural regions such as the lower Kura delta are also technically simple, although they depend on introducing better agricultural practises to large numbers of people. Land reform also has quite an impact on the situation. Throughout the CIS countries, agricultural reform and improvements in irrigation and drainage practices are gradually being introduced.

The areas inundated by sea level rise provide a different problem. Families have abandoned their houses, fields and orchards. Proper planning of the coastal zones is required that takes into account the periodic changes in sea level, and those already displaced should be resettled with adequate infrastructure at a suitable elevation above the sea.

8.1.3. Deforestation and Gully Erosion

The land use of areas that have already been deforested such as in eastern Mazandaran province should be planned, based on the natural conditions such as slopes, exposure to rainfall and soil structure. Investigations are required to plan the best land use for the area. The development of a fully closed vegetation cover with meadows and pastures is the only really effective method. Thus properly managed livestock would be the most appropriate method of protecting the landscape against water erosion. Reducing erosion will also minimise the volume of river sediment in the middle and lower river valleys.

Further deforestation should also be avoided. Measures taken should raise the income levels of the population responsible for deforestation, including increasing the productivity of existing arable land.

8.1.4. Overgrazing and Pasture Destruction

Recovery of overgrazed pastures such as the Black Lands should be attained through:

- Seeding with perennial grasses
- Providing shelter belts of appropriated bushes to protect against oversanding of settlements
- Supporting the development of primary pastures
- Developing forest-pastures
- Limiting animal stocking levels to ensure at least 25-35 % of the yearly root growth
- Reconstruction of irrigation and drainage systems
- Limitation of heavy transport on the pastures
- Permanent supply of all settlements with gas or oil in order to avoid cutting of fuel wood.

8.1.5. Protection of Natural Deserts

Natural desert habitats close to the gas and oil exploration area of Khazar-Gumdag-Ekerem, should be protected because of the roads crossing the area and small settlements that are associated with the development. Highest priority is the area south of Gumdag (northern

Esenguly rayon, Turkmenistan). Protecting habitats also allows protection of endangered species such as some snakes (cobra), tortoises, birds, insects and plants.

The areas in the far north of Balkan Velayat are potentially not so endangered because they are far from settlements, population density is low, and there are few roads.

8.1.6. Transport Corridors

Corridors such as that from Bereket (former Gazandshik) to Turkmenbashi should receive a high attention. Better planning is needed to concentrate the strung-out settlements into small towns:

- Confine the spread of settlements to protect surrounding landscapes;
- Focus attention on improving the standards in towns by providing good quality accomodation;
- Improve the water supply to establish green zones in and around the settlements; and
- Support public participation to improve the ecological situation in settlements.

Transportation facilities should be dealt with by:

- Improving the main road information to drivers of the dangers from oversanding;
- Aggregation of road, railway, gas, oil and water pipelines into a narrow corridor to avoid further impact on adjacent areas;
- Clearance of iron, concrete, and asphalt waste;
- Planting trees, bush and grass in the most endangered places on a 100 m corridor on both sides; and
- Constructing rest places at intervals to avoid further degradation by people parking and on the verges.

8.1.7. Bekdash Salt Mining

The degraded area around the sulphur-sodium salt factory is quite small in comparison to other desertified areas. However it is unlikely that funds can be found for rehabilitation of the area and activities should concentrate on improving the areas immediately around the residential blocks.

Chapter 9. Institutional Strengthening

9.1. Action Plan to Combat Desertification

9.1.1. Objectives

The main tool to combat increasing desertification should be a procedure introduced into the local and regional planning process termed the “Desertification Action Plan”. The goal of the Action Plan would be to identify the causes of desertification in each seriously affected area and devise the measures necessary to protect infrastructure and the rural population, while also protecting the environment. The objectives of the Desertification Action Plan should be:

- Making a detailed assessment of the current state of desertification;
- Assessing impacts on nature, the population and economy;
- Prediction of important future natural phenomena and human activities linked to changes of the environment;
- The consideration of recommendations to improve human activities and the environment; and
- Regional measures to combat desertification.

9.1.2. Local Authority as the Planning Agency

The principal actor should be the local authority, because desertification first and foremost affects nature locally and local activities. A plan is needed for the whole administrative area, based on detailed investigation and evaluation of the natural and human environment. The Plan should be discussed with and developed with the local population. Finally, in accordance with the particular laws and regulations pertaining, the Plan should be approved by the local authority, after which it should be modified if necessary and approved by the Ministry of Nature Protection. The Action Plan should have a fixed duration, for example five years.

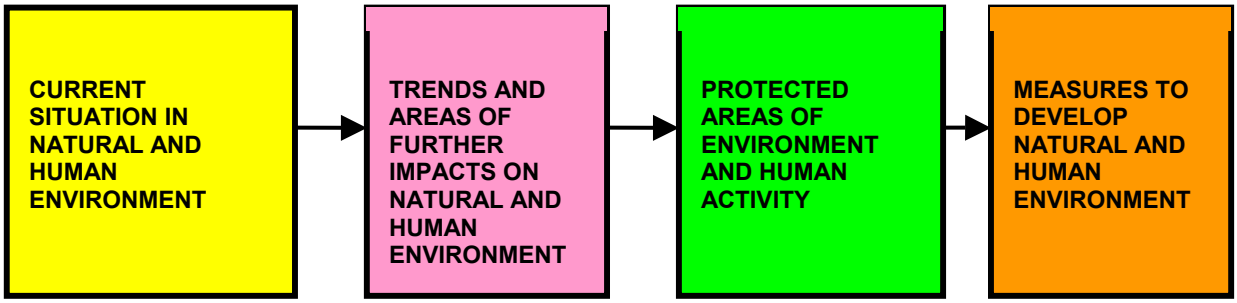
The local authority needs scientific-technical support to enable it to carry out the investigations and monitoring. Support can be provided by the existing desertification institutions such as the National Institute for Desert, Flora and Fauna, Ashgabad and the four desertification groups in Baku, Tehran, Almaty and Elista.

9.1.3. Public Participation

The primary root cause of landscape degradation or desertification is human activity. The whole planning process thus needs public participation and acceptance. The draft Action Plan should be published and discussed with public agencies and it should be implemented by a permanent body.

9.1.4. Structure of the Plan

The detailed assessment of the current state of nature and population should be carried out using thematic maps of geology, vegetation, population, and transport, together with detailed ground investigations.



A forecast should be prepared as to the likely further degradation over the next 10 years. The Action Plan should be prepared to tackle all aspects of local planning affecting the landscape and affected by it, including nature conservation, water resources management, and architecture. Protected areas should be defined to conserve high value habitats.

On a time frame of ten years, planned measures to improve industry, agriculture, transport, gas and oil installations, water supply, and settlements should be set out. The locations and the spatial area of impact should be estimated.

9.1.5. Protected Areas

Places of high value from different standpoints should be identified for inclusion in the Plan including:

- Existing natural protected areas;
- Habitats with a high importance in the national and local context (such as coastal swamps, high dunes, typical natural or quasi-natural deserts and takyrs);
- Structures from national or local architectural importance; and
- Recreation areas, such as beaches and sanatoria.

9.1.6. Measures to Conserve the Environment

The most important issue of the planning process is to define the actions to combat desertification, to improve the natural and human environment. The starting point is the current state of the environment and the underlying main environmental risks and causes of change.

Mapping and description of the issues provided in the Desertification Action Plan should include:

- Measures for roads and railway lines against oversanding (by forestation, oil spraying, or shelter walls)
- Measures for settlements and surrounding arable lands against oversanding (with participation of rural population)
- Measures against further flooding
- Measures to improve drinking water quality
- Measures to minimise air pollution
- Measures to improve irrigation

9.2. Legal Support to Combat Desertification

9.2.1. Analysis of Legislation

Generally environmental legislation is poorly developed in the Caspian region in comparison with European countries. Those responsible in local government and science have not only gaps in their knowledge of legislation but contempt for legal matters. Legal documents are not consulted, and the legal consequences of actions are not considered. This comment is particularly appropriate regarding desertification.

Despite the fact that all Caspian littoral countries have signed the United Nations Convention to Combat Desertification, except in the Russian Federation, legislation has not been developed regarding desertification. No Caspian state has a law or other legal document addressing the protection of nature or the population against desertification.

The term “desertification” can only be found in Turkmenistan within the “Law on Nature”. In other countries the term “land degradation” is mentioned in acts covering land resources, water resources and/or forest resources. There are other links to degradation in the general laws on nature and the environment. Most of the Caspian countries have developed general “Laws on Land” which include requirements concerning:

- Rehabilitation of degraded land;
- Re-cultivation and amelioration of land; and
- Rules for water and forest improvements.

General requirements are provided for preventive measures to avoid environmental threats and throughout the region Environmental Impact Assessment rules and procedures address measures to avoid land degradation.

The Caspian countries have well-developed legislation regarding “use of natural resources” or “land use” but the lack of a definition of desertification or land degradation makes it difficult to develop a common understanding.

Although desertification has severe impacts on the rural socio-economic situation, these impacts are not defined in law. There are no protection measures or legal means of implementation of regulations to provide compensation or receive state support after droughts that result in a serious decrease in agricultural yield or for resettlement.

There are no juridical rights of persons suffering from desertification or land degradation.

9.2.2. Recommendations for Improvements of Legislation

The following measures are recommended improve the legal and administrative base for combating desertification:

- Legal acts to define desertification or land degradation should be developed and included into the Laws on Environment, including:
  - Criteria that accept desertification as an legal fact;
  - Definition of the impacts of desertification on the population;

  - Measures to restore damages to infrastructure;
  - Protection of the most endangered high-value desert landscapes; and
  - Rehabilitation of destroyed or degraded areas.
- Amendment of legislative documents on forestry, water resources and land to include environmental concerns (laws are almost entirely focused on increasing productivity);
- Strengthening legal mechanisms such as:
  - Compilation of EIA procedures for those activities that induce desertification;
  - Development of criteria for those activities and constructions to be recorded;
  - Development of planning procedures (national, regional, local).
- Improvement of the governmental structures to increase their responsibility;
- Implementation of a desertification monitoring programme;
- Encouragement of the population to participate in all relevant desertification matters through the media, public awareness and non-governmental organisations; and
- Improvement of social and financial support for affected individuals.