Annex 2.

Annex 2.1. Report on DLD and SLM Assessment and Mapping of LUS Using of FAO LADA-WOCAT tools and DPSIR Analysis

DRAFT

REPORT

OF THE DLDD AND SLM ASSESSMENT AND MAPPING OF LUS USING THE LADA/WOCAT TOOLS AND DPSIR AHALYSIS AT NATIONAL AND SUBNATIONAL LEVEL

PART I: DLDD and SLM assessment using the LADA/WOCAT tools and DPSIR analysis at national, subnational and local level

Prepared by

Umid Abdullaev
DS-SLM National project Coordinator

Tatyana Khamzina,
SLM Mainstreaming/NTL

Tashkent-2017

CONTENT

Abbreviations **3**

Preface **4**

Introduction **4**

I.CURRENT STATUS OF DESERTIFICATION, LAND DEGRADATION AND DROUGHT **5**

1.1.Major Causes and Processes of DLDD in the country 5

1.1.1.The Natural Causes Of Land Degradation As A "Driving Forces" 5

1.1.2.Anthropogenic Causes Of Land Degradation 6

1.2. Components of Land Degradation 6

1.3. Distribution of Land Degradation in the Uzbekistan 7

II. SOIL SALINIZATION IN UZBEKISTAN **9**

2.1. Distribution of Salt Affected Soils 9

2.2. Secondary Salinization and Water logging of Irrigated Lands 9

2.3. Impact of Soil Salinization on Agricultural Productivity 10

III. DROUGHT **11**

3.1.Characteristics of Droughts 11

3.2.Effects of Drought on Livelihoods and Food Security 12

IV. ECONOMIC CONSEQUENCES OF LAND DEGRADATION **12**

V. ASSESSMENT OF DLDD AT SUBNATIONAL LEVEL **14**

5.1.Central Foothill Semi-desert Province (Jizzakh Region) 14

5.2.Southern Foothill Semi-desert Province (Kashkadarya Region) 15

VI. ASSESSMENT OF LAND DEGRADATION AT LOCAL LEVEL **17**

VII. ASSESSMENT OF SLM ACTIVITIES IN UZBEKISTAN **18**

Reference **21**

Annexes……

Abbreviations

ADB	Asian Development Bank
CACILM	Central Asian Countries Initiative for Land Management
CDW	Collector drainage water
DLDD	Desertification, land degradation, drought
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GEF WEMP	Project ГЭФ «Water and environment management Plan»
GIS/RS	Geographic information system/ Remote Sensing
GWT	Groundwater table ()
I&D	Irrigation and drainage
ICARDA	International Center for Agriculture Research in the Dry Areas
LADA	Land Degradation Assessment in dray Lands Project
MAWR	Ministry of Agriculture and Water Resources
NDVI	Normalized Difference Vegetation Index
NGO	Non-governmental organization
NFP	CACILM National Framework Programme (2006, 2009)
SLM	Sustainable Land Management
SLM-IS	SLM Information System, a component of CACILM multicountry project
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WB	World Bank
WB	World Bank
WOCAT	World Overview of Conservation Approaches and Technologies

Preface

This report had been prepared in accordance with the Methodological Logframe and Workplan of DS-SLM Project under the Module 2: National/Sub-national Level. The report is addressed on the assessment of current status of DLDD and SLM activities at national, sub-national and local levels (Part I), LUS mapping (Part II**)** and Soil Carbon mapping (Part III).

The assessment of DLDD and SLM is based on the collected information on natural resources and social-economic data, and on field survey and observation data, a review and evaluation the outputs, reports and lessons learned in the framework of CACILM-I and other SLM projects carried out over the past years, as well as expert knowledge elicited during field studies, using RS methods and LADA approach on «hotspot« analysis to assess and monitor of the current state of DLDD with focusing on salt affected soils. Meetings with local authorities, primary land users and discussions of existing problems made to assess the impact of natural and human factors on land use and natural resources.

Introduction

The Republic of Uzbekistan, a land-locked country remote from the sea, is located in the central part of the Eurasian continent in the Aral Sea basin (between 37° and 45° of northern latitude and 56° and 73° of eastern longitudes (Figure 1). The territory of Uzbekistan is divided into two parts: lowland part and mountain one. Majority of land in Uzbekistan consists of deserts, semi-deserts or grasslands as well as mountains in the eastern part of the country.

Figure 1. The Overall Location Map of Uzbekistan

Population of Uzbekistan is 32.5 million people, nearly half (49%) of it are rural inhabitants. Density of population is 54.6 person/km^2 (with maximum 575.4 person/km^2 in Fergana Valley).

Total land resources of the country are 44.4 million ha; 28.5 million ha from that (63% of total country area) are agricultural lands, 23.4 million ha (52%) from that are low productive pastures, and 4.2 million ha are irrigated lands (around 11%). The lands of forestry fund are about 2.7 million ha. Uzbekistan's climate is arid and continental Summers are long and hot, the maximum temperatures in July reach 45-46°C, the soil surface may be heated up to 60-70°C. Average rainfall varies from 100-200 mm/year (desert) to 200-80 mm/year (foothills and mountain areas).

The main water resources of Uzbekistan are the surface runoff, formed by the transboundary Amudarya and Syrdarya Rivers with their tributaries and also the Kashkadarya and Zarafshan rivers. The main flow of Amudarya and Syrdarya rivers are formed on the territory of Tajikistan and Kyrgyzstan respectively. The total surface runoff of these rivers is estimated as 126.9 km^3 for the years with 90% probability. The surface flow that formed in Uzbekistan area is 11, 5 km^3/year (around 18% from the total water demand).

Due to the natural geographic and climatic features, Uzbekistan is one of the most vulnerable country in the environmental sense, as it is located in the arid zone (aridity index varies from 0.05-0.20 to 0.65), influenced by air and soil drought and, accordingly, susceptible to degradation and desertification.

I. Current Status of Desertification, Land Degradation and Drought

Definitions, Methods and Approach

Land degradation is defined as the "temporary or sustained decline of soil fertility as a result of human activities" (UNEP, 1992). The term "desertification", which for the purposes of the United Nations Convention to Combat Desertification (UNCCD) means *"land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities"*.

The evaluation of desertification, land degradation and drought (DLDD) is based on the LADAWOCAT DESIRE methodology, in accordance with that a chain of causal links starting with '*driving forces*' (economic sectors, human activities) through '*pressures*' (emissions, waste) to '*states*' (physical, chemical and biological) and '*impacts*' on ecosystems, human health and functions, eventually leading to political '*responses*' (prioritization, target setting, indicators).

1.1. Major Causes and Processes of DLDD in the Country

1.1.1. The Natural Causes of Land Degradation as a "driving forces"

Due to the natural geographic and climatic features, Uzbekistan is one of the most vulnerable country in the environmental sense, as it is located in the arid zone (aridity index varies from 0.05-0.20 to 0.65), influenced by air and soil drought and, accordingly, susceptible to degradation and desertification.

In nature landscape of the republic the territory with relict salinisation is dominant. Eolian transfer of salts and its role in the balance of soil salinity are not considered here [Pankova E. Aidarov I., 1996]. Within Uzbekistan two landscape types are distinguished as based on manifestations of salt process: i) landscapes with relic soil salinity and ii) landscapes suffered from recent hydrogenic salt accumulation.

Depending on natural conditions automorphic soils are differed on the depth of salt horizon, salinisation degree and salt composition, but also has general features – these soils feel or very slow desalinization. Automorphic soils of high plateaus and relict plains have in their profiles traces of natural desalinization. Poorly drained plains feel ground salt accumulation in the places of recharging of deep geochemical flows.

Climate aridity, relief, hydro morphology and geological formations of the Pamir and Gissaro – Alay Mountains is the natural cause of relictive and modern hydrogen salt accumulation and rivers salinisation. Main resource of soil salinisation is the salt bearing in parent materials, mineralized ground waters, and surface waters quality and eoline salt removal. Natural condition of underground water inflow and outflow were used as an indicator of the natural causes of land degradation.

Condition of underground water inflow	*Degree of risk*
Guaranteed outflow and backing up and wedging out of ground waters in conditions of intensive water exchange	*no and rare*
Backing up and wedging out of ground waters in different conditions of water exchange	*moderate*
Difficult and extremely difficult of inflow and outflow of ground water	*high*

Source: Shreder V., 1970

1.1.2. Anthropogenic Causes of Land Degradation

Driving forces of the land degradation (according to LADAWOCAT DESIRE methodology) are the activities directed to satisfaction of society requirements. They are macroeconomic policy, land use development, increase in population, low-prosperity, land use conditions and land tenure, climatic changes, natural disasters and deficiency of water. Unbalanced are the factors of degradation development and of loss of productive functions of land. Below is the estimate of land use and land management in Uzbekistan

Poor Land Management

The main reasons for the deterioration of soil fertility are intensive development of agriculture with inadequate crop rotation, agro technology, low norms of organic fertilizers, which caused loss of humus of humus, exhaustion of the soil and its physical and chemical qualities, and general degradation of land. The newly developed agricultural land incorporated saline and low-productivity lands as part of the irrigation programs. It has resulted in degradation of natural regulating mechanisms, transformation of land from complex ecological system to substratum for transmission of mineral combinations to roots of plants that has resulted in decrease of efficiency of irrigated lands.

Water Mismanagement

The intensive development of irrigated agriculture in Uzbekistan resulted in the establishment of an extensive network of channels and structures designed for the collection and disposal of collector-drainage water (CDW). Disposal of CDW to the rivers has caused deterioration of the river water quality, reduction in yields of crops using the river as a source of irrigation water and deterioration of the ecological environment in lower reaches.

After the Soviet Union collapse, the irrigation sector has inherited huge network of reservoirs, dams, pumping stations, canals and other structures, but also great number of problems connected with all of them [I&D Strategy, 2001]. An insufficient of maintaining the drainage networks have resulted in increase of salt mobilization from deep aquifers. The mass of salts from upstream completely in the irrigated areas of downstream are accumulated. Water loss in the area between the canals of the central system and fields amounts to about 50-60% of the water supplied. Availability of water does not exceed 80%. Average water use efficiency is 0.37, ranging from 0.27 to 0.43. .

1.2. Components of Land Degradation

The greatest part of the land resources in Uzbekistan are subjected to degradation processes among which the wide spread categories are as follows: i) secondary salinization of irrigated lands; ii) under flooding and water logging of the irrigated lands; iii) loss of organic matter and increase of fertility decline soils; iv) wide spread occurrence of irrigation erosion of irrigated soils; v) wind erosion or deflation of desert lands; vi) soil pollutions; vii) aerosol transport of salt and dust from the dry bed of Aral Sea to irrigated area, etc. (Table 2.1).

Table 1.1. Main Indicators of Land Degradation and Desertification

Indicator	The extent and spread of degradation
Irrigated lands	
Secondary salinization	About 49% of area subject to salinization, of which more than 17.4% are classified as moderately or highly saline
Waterlogging	The areas with groundwater levels up to 2 m make up 30.8% of irrigated land
Water erosion	Water erosion occupies 8% of the total area of irrigated land, of which 2% are moderately and highly affected. Specific loss of the humus layer as a result of erosion vary in the range of 40-80 t/ha per season
Wind erosion	Over 2 million ha of irrigated land are affected by wind erosion

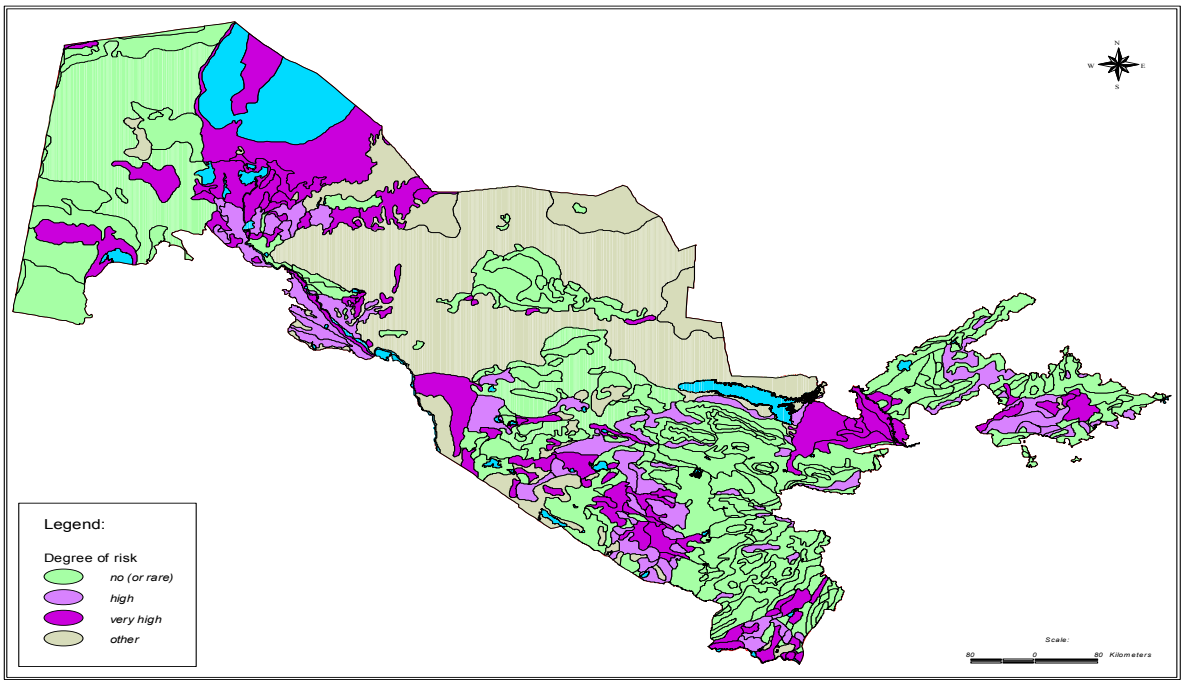
Indicator	The extent and spread of degradation
Soil compaction	Over 51% of the total irrigated area suffer from compaction and destructed structure.
Reduction of organic matter and soil microflora	Soil with a low fertility caused by the loss of organic matter by 30-40% and the loss of soil microflora, occupy more than 40% of the total area.
Fertility of irrigated land	Medium and low fertility soils make up 45% and 27% of the area, respectively.
Pasture and rainfed	
Overgrazing	Sandy desert Kyzyl Kum has seen a 4-fold reduction in species composition; 2-fold – for shrubs and dwarf shrubs; 2.5 times – for fodder plant species, Overall, about 10 million ha of pastures need radical improvement.
Deflation	More than 5 million ha of pastures are subject to sand deflation because of deforestation and the loss of more than 15% of valuable species. Mobility sand is an increased on more than 1 million ha
Deforestation	In recent years, in the desert-sand area large areas of trees and shrubs have been cut for the use of land for agriculture, more than 150 thousand ha of bush felled around the Bukhara oasis

1.3. Distribution of Land Degradation in the country

Desertification, land degradation and drought (DLDD) that have a negative impact on the standard of living, health, and the environment, occur everywhere. Figure 1.1 illustrates degree of natural risk of land degradation.

The GIS area of natural risk of land degradation in Uzbekistan is 16.4 million hectares (36%), of which 31% are prone to a high degree of degradation. The most vulnerable regions prone to environmental risk experiencing the superposition of natural and anthropogenic factors are located in the middle and lower reaches of the Amudarya and Syrdarya rivers, in the Aral Sea region and the Republic of Karakalpakstan, Khorezm, Bukhara, Navoiy and Kashkadarya regions

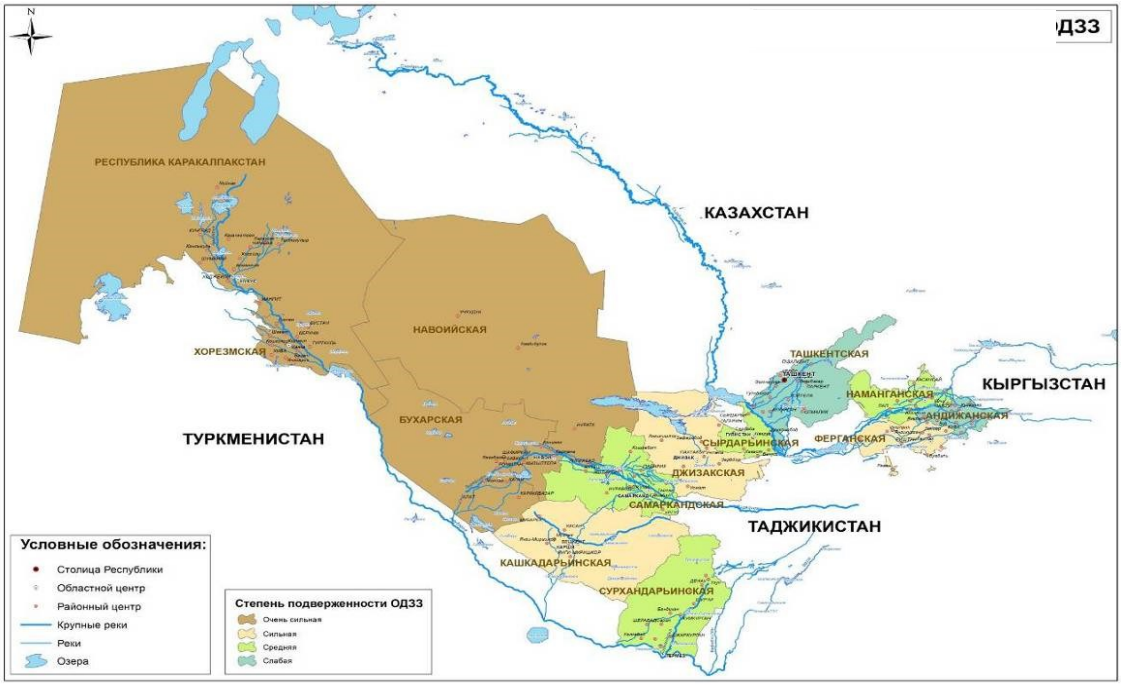
Figure 1.1. Natural Risk of Land Degradation in Uzbekistan



Source: G. Khasankhanova (2003). Land Degradation Assessment in dry lands (LADA). Technical Report. Republic of Uzbekistan

Degradation is the result of a complex interaction of biophysical, political, social, cultural and economic factors that is, being developed under the combined influence of nature and man. Spatial distribution of desertification by administrative regions of Uzbekistan is illustrated on Figure 1.2.

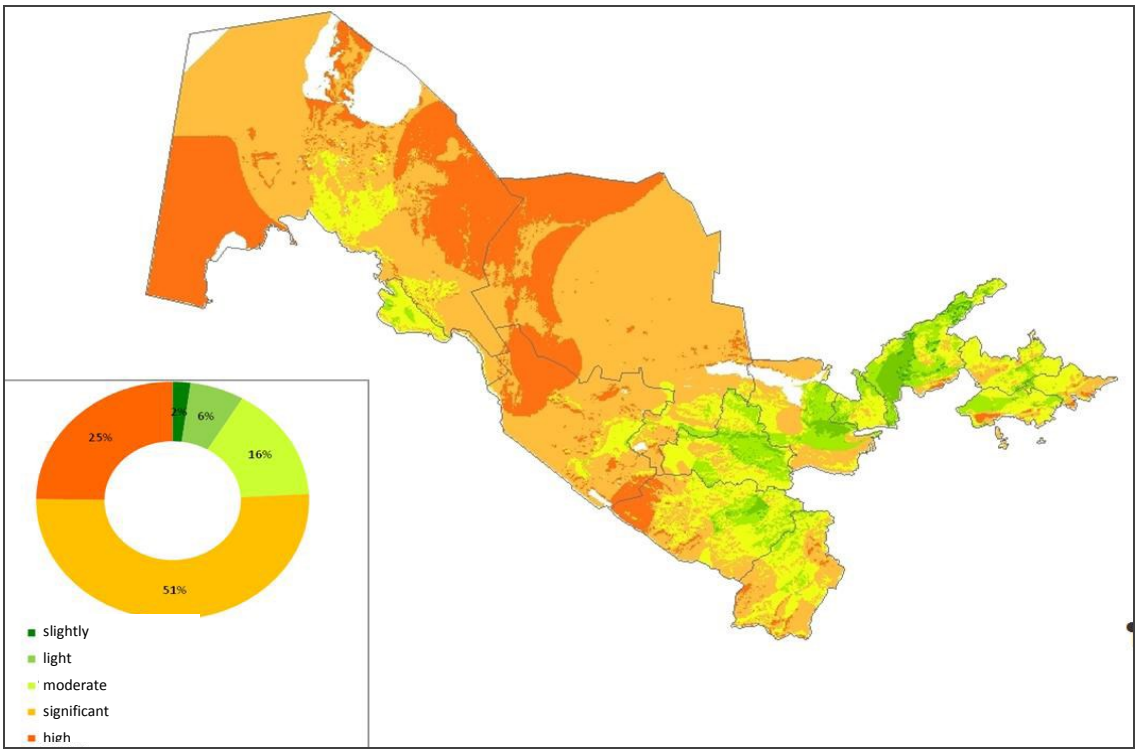
Figure 1.2. Map of Susceptibility to DLDD



Source: CACILM-I, UNAP, 2013

The vector map (Figure 1.3) of integral desertification of Uzbekistan include the following indicators: NDVI - soil cover, SPI - standardized precipitation index, AI - aridity index and soil salinity, soil erosion, soil organic carbon.

Figure 1.3. Map of Vulnerability to Desertification of Uzbekistan



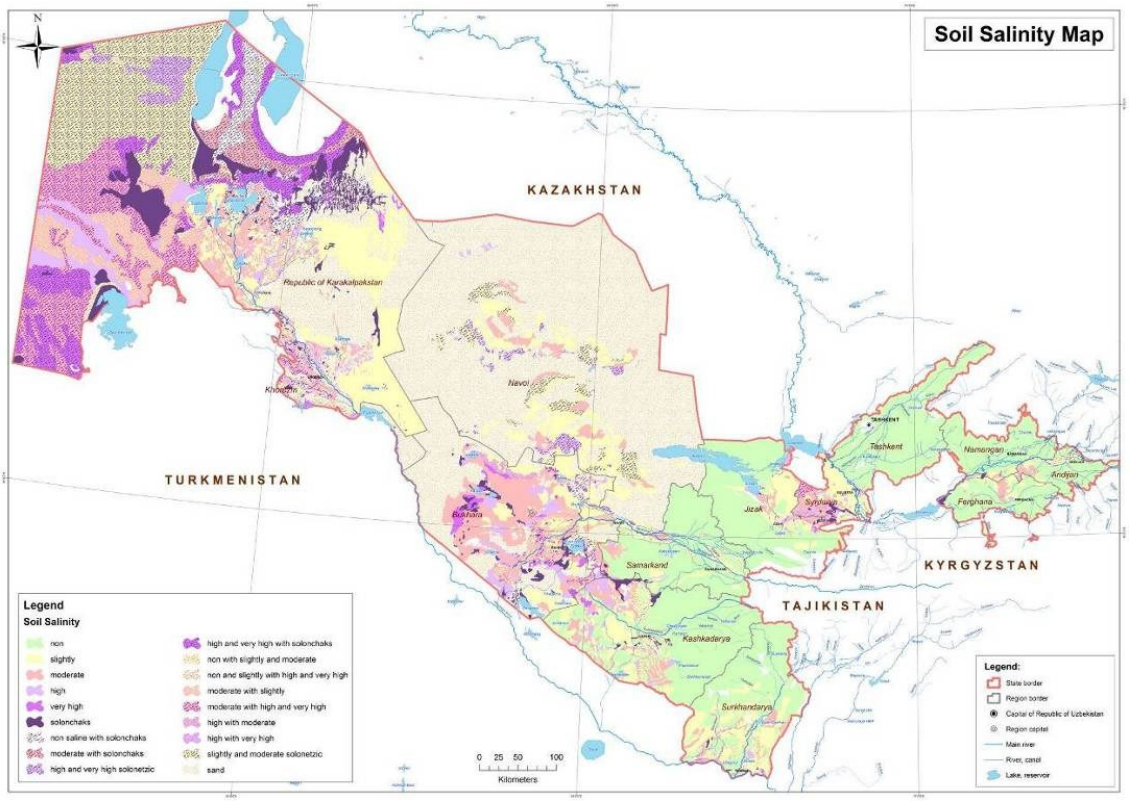
Source: Uzhydromet, 2015

II. Soil Salinization in Uzbekistan

2.1. Distribution of Salt Affected Soils

The vector map of soil salinity of Uzbekistan, with use of GIS/RS techniques was developed. The map illustrates spatial distribution of lands subject to various degree of salinization (Figure 2.1).

Figure 2.1. Soil Salinity Map



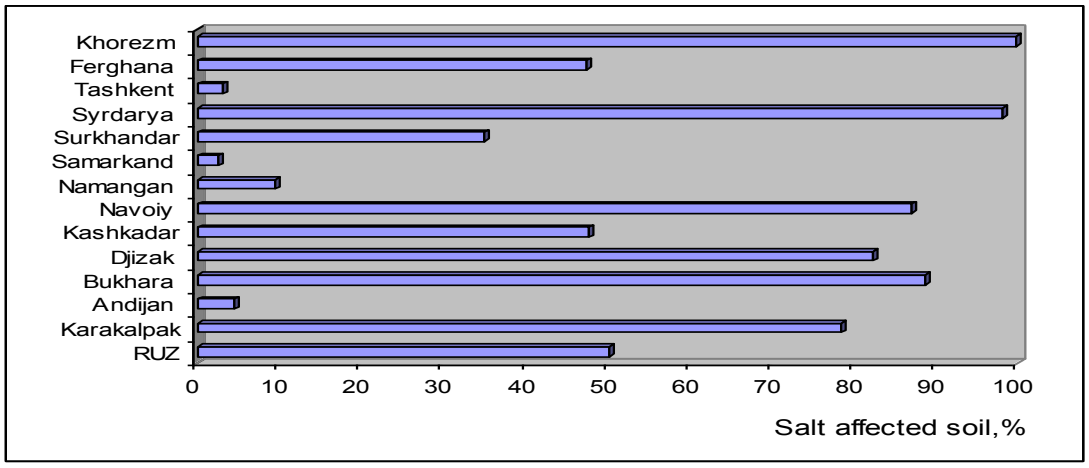
Source: *UGIP, 2015*

The total GIS area of salt affected soils in Uzbekistan is 21 507.67 ha. From this amount 10,469 million ha is characterized with high degree of soil salinisation, being enriched with water-soluble salts throughout the profile at a depth of 2 m. These soils are located mainly in the Syrdarya, Jizzakh and Central Fergana regions of Syrdarya River basin. Salt affected soils in the Amu-Darya basin are dominantly located in mean stream (Kashkadarya, Bukhara and Navoiy) and downstream area (Karakalpakstan and Khorezm).

2.2. Secondary Salinization and Water Logging of Irrigated lands

The most serious environmental threats in the country are secondary soil salinization and water logging of irrigated lands. The total area of irrigated lands is 4295. 3 thousand ha (9.7 % of the total area of the country). They are concentrated mainly in desert and semi-desert zones, where salinization is the inherent element of drylands. Secondary salinization occurs in the conditions of high groundwater table and poor drainage. Over-irrigation and high water loss from canals and irrigated fields produce fast rise of the groundwater table and salt accumulation in the rooting zone. At present, the areas of secondary salinization occupied 49 % of irrigated lands. The share of the salt affected soils by regions is illustrated in Figure 2.2.

Figure 2.2. The land areas, affected by secondary salinization in the regions (2015)



The analysis shows, that land secondary salinization is mainly concentrated in the Republic of Karakalpakstan, Khorezm, Syrdarya, Jizzakh, Navoiy and Bukhara regions where it covers from 50 up to 100 % of the existing irrigated areas. And the share of the land with a high and medium degree of salinization varies from 25 up to 60 %**.**

Various combinations and forms of secondary salinization in irrigated areas are spread. In ancient oases (Khorezm, Bukhara, etc.) there is clearly expressed continuous secondary salinization, as well as widely spread patchy (or small patchy) and seasonal salinization of irrigated land. In the new irrigation zones - Syrdarya, Jizzakh and Karshi steppes, there are early and intermediate stages of secondary salinization (from seasonal to constant patchy

Water logging due to high groundwater table occurrence is a serious problem of the irrigated land. At present, the areas with groundwater table (GWT) higher than 2 m occupy 27 % of, and in some areas - 60-70 %. The Republic of Karakalpakstan, Khorezm, Navoiy, Syrdarya, Ferghana and Andijan regions suffer from water logging in a greater degree

2.3. Impact of Soil Salinization on Agricultural Productivity

According to the ADB data (2005) the annual losses of agricultural production are estimated at USD 31 million and economic losses from the abandoned lands due to high salinity are estimated at USD 12 million. According to the GEF WEMP data in 2001, the total economic costs or losses are approximately USD 1380 million every year that is about 30% of the potential cost of production.

Annual economic losses of fallow lands, which is abandoned due to soil salinization, infrastructure damage, water shortage etc, are USD 58 million, out of that amount USD 15. 2 million (26%) fall onto Kashkadarya, and about USD 32.2 million (55,6%) – onto the Republic of Karakalpakstan, Bukhara, Navoiy, Syrdarya and Jizzakh regions. The remaining 19% of total fallow lands are distributed among the other regions of the country [CACILM, 2009].

As a whole, economic losses in the country are estimated approximately at USD 26 million. Moreover, the highest saline areas and loss of production of raw cotton and wheat are in Khorezm and the Republic of Karakalpakstan [IS-SLM Project, 2009].

III. Drought

3.1. Characteristics of Droughts

Drought is typical and frequently repeating phenomenon, correspondingly affecting all segments of population and dominating among other natural disasters in Uzbekistan. Three types of drought are typical for Uzbekistan: *meteorological, hydrological and soil drought.*
Drought phenomena differ from each other on three main characteristics: intensity, duration and spatial coverage (Table 3.1).

Table 3.1. Characteristics of Droughts by Intensity, Duration and Spatial Coverage

Spatial coverage	Intensity	Duration
Piedmont zone	very strong drought SPI < -50	1-3 times per 100 years
	drought with SPI < -20	3 times per 10 years
Deserts and semi-deserts zone	very strong drought SPI < -50	1 tim in 10 years
	drought with SPI < -20	3-4 times in 10 years

They accompany by high air temperatures with small precipitation rates. The temperature equal to and higher than 35°C is observed in the country, mainly, since the end of May till October, though in some years, especially in the south, the hot days start already in April, and sometimes even in March. The peak of hot days is in average in July, though in some years it is observed also in August. Soil drought is observed in the Kyzylkum desert and Central Fergana valley since the end of March or from the beginning of April. At the plain territories his process starts since the first decade of April, and in the eastern part of the country and in the piedmont zones in July.

Expected impacts of drought and climate change

Currently, Uzbekistan is experiencing a steady warming trend. Observations show an increase in the number of dry days in a large part of the territory of Uzbekistan. By 2030, the temperature in the north-west (Karakalpakstan, Khorezm and part of Navoiy region) is expected to increase by 2-3°C, in the north, the middle zone and in the east (Fergana Valley) – by 1.5-2.5°C. In the context of the expected warming, the rate of the shrinkage of the Aral Sea basin glaciers will probably total from 0.2% to 1% per year.

According to the Third National Communication of the Republic of Uzbekistan under the UN Framework Convention on Climate Change, by 2050 water resources of the Syrdarya river basin may decrease by 2-5%, the Amu Darya basin - by 10-15%. During extreme water shortage (an estimate for extremely warm and dry years), growing season stream flow in the river basins of Syrdarya and Amudarya may be reduced by 25-50%. The results of calculations using WEAP showed that the total water scarcity in Uzbekistan in 2030 will increase to 7 km^3, and in 2050 will reach 11-13 km^3. The expected reduction in water resources by 2050 will lead to increased water scarcity, which will be especially acute in dry years.

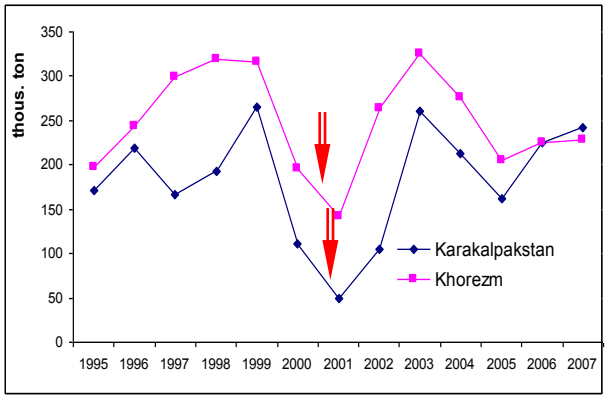
Estimates show that the expected major crops yield losses resulting from the scarcity of water could reach an average of 35-50% in 2050. Cotton crop losses only due to increased evaporation will vary from 4% (2030) to 10% (2050). Losses of winter wheat, rice and other food crops yields will range from 4% (2030) to 7-14% (2050). Due to the increase in air temperature, spring and summer vegetation of all kinds of plants in desert pastures will begin 5-10 days earlier; total evaporation will increase leading to a more rapid decline in soil moisture reserves and biomass.

3.2. Effects of Drought on Livelihoods and Food Security

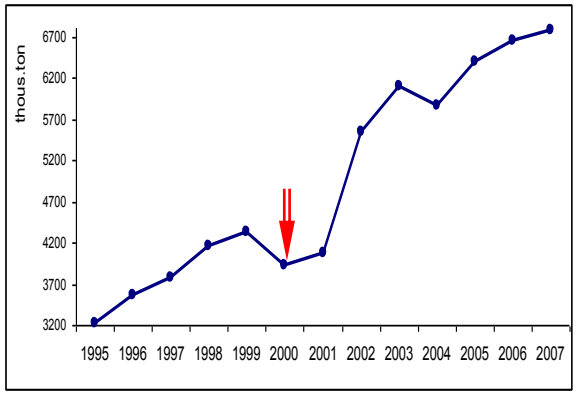
In Uzbekistan, drought is the dominant natural disaster. This weather phenomenon, large-scale and often repeated, affects virtually all segments of the population and has become reason for the reduction in food production, water pollution and economic damage.

The severe drought of 2000-2001 was the most large-scale and had a great negative effect: the loss of grain crops amounted to 14-17%, other crops – from 45 to 52% to 75% (in the lower reaches of Amu Darya) (Figure 3.1a,b). Losses caused by agricultural drought in 2000-2001 in Uzbekistan amounted to USD130 million, or 2.4% of the agricultural GDP.

Figure 3.1. Change of Cereal Crops Gross Harvesting in the Country for 1995-2007



a) The Amudarya downstream



b) As a whole for Uzbekistan

***Source**: CACILM-I, IS-SLM Project, 2009*

Percentage of population living in areas prone to drought is 76.3%, more than 90% of the crop is grown on irrigated lands. Insufficient water resources are a key constraint for Uzbekistan in the production of food, equivalent to, and sometimes even more critical than the shortage of land resources.

Due to the high dependence of the economy on irrigation and variability of water resources, climate change and more frequent droughts may result in (i) increased water scarcity; (ii) increased water use for irrigation; (iii) increased secondary salinization; (iii) reduction in the productivity of agricultural land, etc. In this context, mitigation measures and adaptation of agriculture and water resources to climate change using an integrated approach to addressing the problems of land degradation are particularly important.

IV. Economic Consequences of Land Degradation

To identify the most problematic areas, specialists carried out a comparative analysis of the degree of land degradation, socio-economic indicators and living standards of rural population in the administrative regions of Uzbekistan (Table. 4.1)

Table 4.1. Comparative Analysis of Land Degradation Degree and Rural Living Standards by the Regions

Oblast	Irrigated area, Thou ha	Rural, Thou. people	Land degradation, thou ha			Mineralization of irrigation water, g/l	Income per capita of rural, $US8	Poverty Level
			Water erosion	Soil salini-zation	Water logging			
Syrdarya River Basin								
Andijan	272	1710	14.2	12.3	133.3	0.59	380	30.3
Namangan	281	1352	54.52	27.0	77.5	0.40	330	30.3
Ferghana	359	2111	16.5	170.2	167.0	0.89	295	30.3
Syrdarya	293	473	0.7	287.4	129.2	1.13	622	37.0
Jizzakh	300	750	44.6	247.1	13.5	1.13	561	37.0
Tashkent	393	1523	138.6	11.6	71.1	0.62	652	16.6
Amudarya River Basin								
Surkhandarya	326	1587	37.4	113.6	3.3	0.66	356	26.4
Kashkadarya	512	1865	159.7	243.1	18.2	1.31	347	26.4
Bukhara	275	1095	-	244.3	81.3	0.94	496	24.7
Samarkand	376	2214	121.7	9.7	33.2	0.65	507	24.7
Navoiy	124	498	3.2	115.0	48.8	1.66	596	24.7
Khorezm	280	1156	-	276.6	240.9	1.6	423	27.8
Karakalpakstan	500	814	9. 4	396.9	3415.2	1.65	347	27.8

The population of all regions bears serious consequences of land degradation and desertification. But the extremely vulnerable are agricultural producers of mid- and downstream of the Amudarya River and the Syrdarya River: Karakalpakstan, Khorezm, Bukhara, Navoiy regions and Ferghana valley.

The depletion and land degradation cause irreversible damage to productive functions of natural ecosystems and lead to the great losses of agricultural crops potential yield. The losses of cotton yield in the farms of Syrdarya and Jizzakh regions due to salinization vary from 0,4-0,9 t/ha up to 1,05 t/ha, and in Kashkadarya and Surkhandarya they are estimated at 0,02-0,04 t/ha. The average yield of wheat on the saline lands in Syrdarya and Jizzakh regions does not exceed 1,2-1,5 t/ha [FAO, 2005].

V. Assessment of DLDD at Subnational Level

Assessment of DLDD at sub-national level implemented for two project agricultural production landscapes: (i) Irrigated lands in the Central foothill semi-desert province (Jizzakh region) and (ii) rainfed lands in the Southern foothill semi-desert province (Kashkadarya region).

5.1. Central Foothill Semi-desert Province (Jizzakh region)

The area of the Jizzakh region makes 2117 thousand hectares, 1249 thousand hectares of lands are used in agriculture. Arable lands include 260 thousand of irrigated arable land and 220 thousand hectares rainfed arable land.

A variety of climatic conditions promoted formation of various soil types. Following soils are distinguished among irrigated ones there: dark, typical and light sierozem soils, meadow-sierozem, sierozem-meadow, meadow-marsh that found in the belt of typical and light sierozem. Mountain brown, typical and light soils and gray sierozem, are used for rainfed agriculture.

The characteristic of the main soils degradation types is provided in Table 5.1, Figure 5.1-5.2.

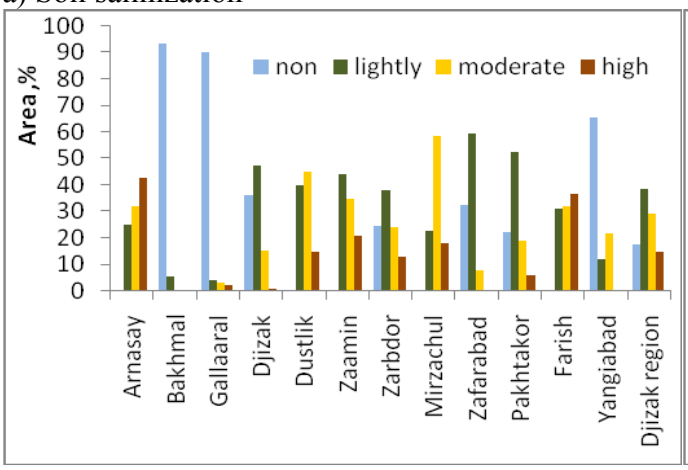
Table 5.1. Characteristic of soils degradation in the Jizzakh region

Soil type	Characteristic			
	Water Table, m	Humus content (%) in the 0-30 sm	Degree of soil salinization	Water erosion
Irrigated zone				
Light sierozem	>5-10	1.0-1.2	lightly-medium	no
Typical sierozem	>5-10	1.0-1.5	non-salinized	lightly
Dark sierozem	>5-10	1.4-3.0	non-salinized	no
Sierozem sierozem-meadow	3-5	0.7-1.0	lightly-medium/gyps	no
Meadow- sierozem	2-3	1.2-2.1	lightly-medium/gyps	no
Meadow	1-2	1.0-1.5	lightly-medium	no
Marsh-meadow	0,5-1,0	2.0-3.0	medium - strongly	no
Rainfed zone				
Light sierozem	>5-10	0.5-1.0	nonsaline	lightly-medium
Typical sierozem	>5-10	0.6-1.6	nonsaline	medium - lightly
Dark s sierozem	>5-10	0.8-2.2	nonsaline	medium - high
Brown sierozem	>10	2.8-3.2. <1.0	nonsaline	no, lightly- high

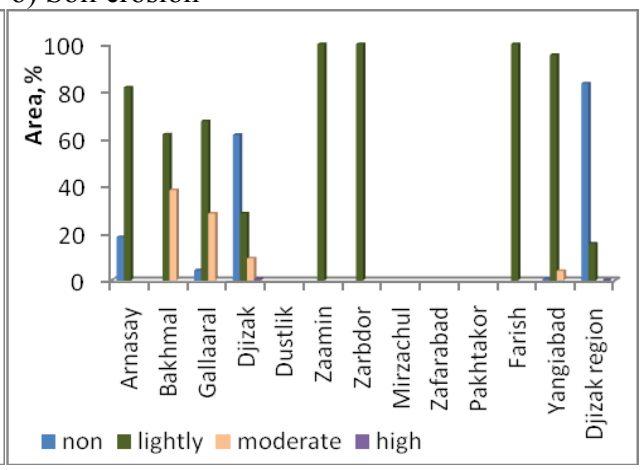
***Source**: Prepared by NPCU based on the available data of Soil science and agro-chemistry Institute, 2015*

Figure 5.1. Soil salinization and erosion of irrigated lands

а) Soil salinization



б) Soil erosion



The analysis shows that areas with high salinization cover the irrigated lands of Arnasay, Dustlik, and Mirzachul districts.

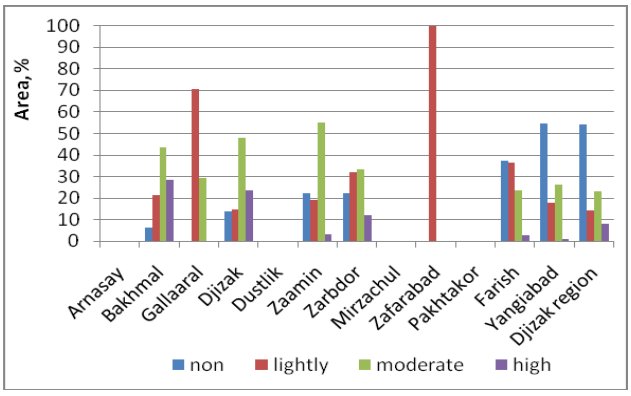


Figure 5.2. Soil erosion of rainfed lands

Rainfed lands are not subject to salinization, but suffer from erosion. From 40 up to 70% of lands of Bakhmal, Gallyaaral, Jizzakh and Zaamin districts are characterized as moderate and lightly eroded.

Content of humus in the arable horizon is differentiated depending on soil type, increasing from light sierozem soils up to dark sierozem. Notably, rainfed soils differ in lower content of humus, than irrigated ones. Content in the same type depends on degree of susceptibility to water erosion (washing out degree) - the washed-away soils contain less humus. In the marsh and meadow irrigated soils the content of humus is the highest and makes 2-3%, in the rainfed not eroded away soils - 2,8-3,2%.

5.2. Southern Foothill Semi-desert Province (Kashkadarya region)

Kashkadarya region occupies area 2857 ha. The territory is marked by well-defined vertical zonality. Most of western part is occupied by extensive spaces of plains which gradually pass into the foothills (adyrs) and mountains to the east and the northeast.

Sierozem soils (typical and light), meadow-sierozem, sierozem-meadow, and meadow soils are formed in the irrigated zone. Gray-brown- meadow, takyr-meadow and meadow soils were developed in desert zone. Dark sierozem, typical light and mountain brown soils are used in rainfed agriculture.

Agricultural lands occupy 2194 thousand hectares, 511 thousand hectares from them are irrigated lands, including irrigated arable lands - 422 thousand hectares. Rainfed arable lands generally needy rainfall include 257 thousand hectares. Pastures occupy 1460 thousand hectares.

In mountain, foothills and on the most part of piedmont plains ground waters underlay more deeply than 5-10 m in the end parts of piedmont sloping plains, inter-conical depressions, of lower

river terraces of Kashkadarya River medium flow - at depth of 1-5 m. The characteristic of the main types of irrigated soils and rainfed lands on degradation indicators is provided in Table 5.2.

Table 5.2. Characteristic of soils degradation in the Kashkadarya region

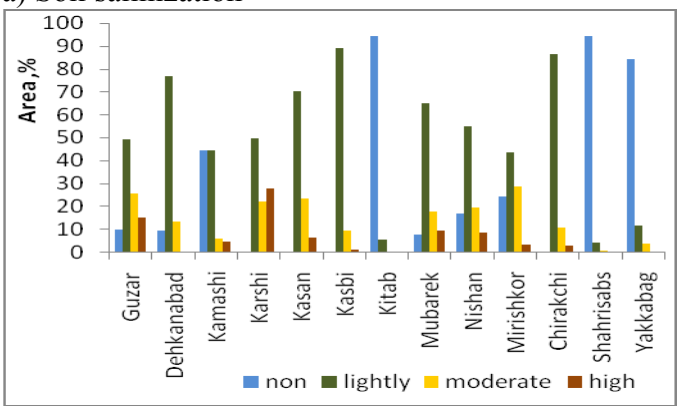
Soil type	Specification			
	GWT, m	Humus in the 0-30 см, %	GWT, m	Water erosion
Light sierozem				
Typical sierozem	>5-10	0.8-1.5	nonsaline	no
Sierozem -meadow	>5-10	0.9-1.6	nonsaline	lightly
Light sierozem	3-5	0.6-1.5	nonsaline and slightly-medium	no
Grey-brown- meadow	3-5	0.4-08	slightly-salinized, gyps.	no
Takyr- meadow	3-5	0.5-1.1	slightly-medium	no
Meadow	1-2	0.7-1.6	slightly-medium (strongly)	no
Rainfed zone				
Light sierozem	>5-10	0.5-1.2	non-salinized	
Typical sierozem	>5-10	1.0-2.1	gypsoferous	lightly-medium
Dark sierozem	>5-10	0.6-2.6	nonsaline	lightly;, medium-
Brown	>10	2.2-4.9; 1-2	nonsaline	no; lightly-high

Source reference: According to data from reports of Soil science and agro-chemistry Institute, 2015

Soil salinization and water / irrigational erosion. Territorial and quantitative distribution of soil salinization and soil erosion of irrigated and rainfed lands are shown in Figure 5.3-5.4

Picture 5.3. Soil salinization and erosion of irrigated lands

a) Soil salinization



b) Soil erosion

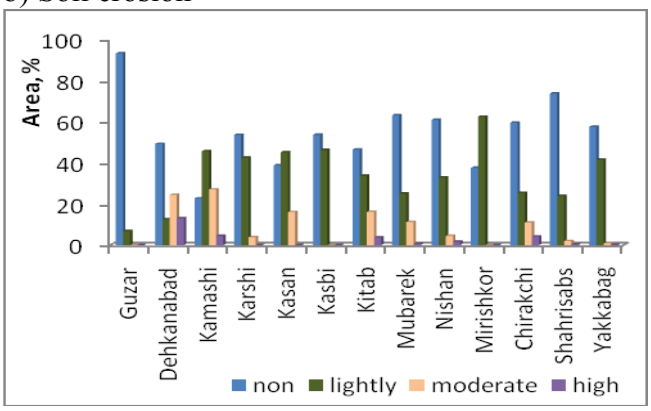
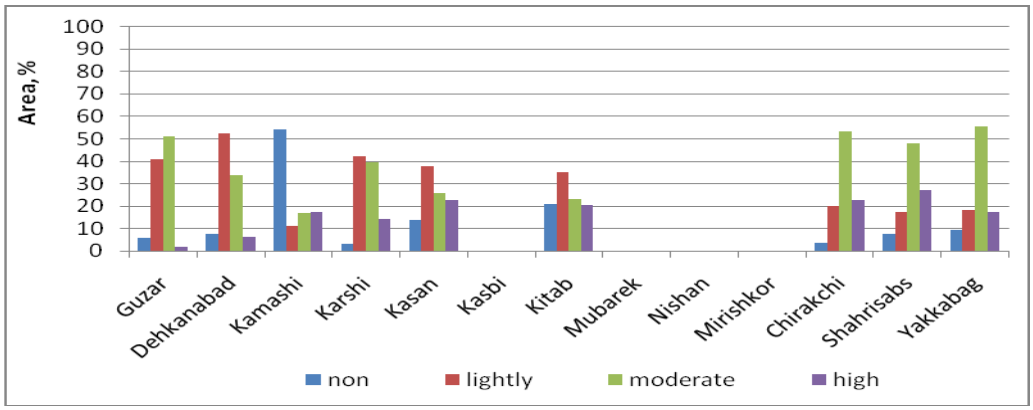


Figure 5.4. Soil erosion of rainfed lands



About 75% of the irrigated lands are subject to salinization from lightly to high degree. Most part of salinized lands is located in the areas with graded relief (Qarshi, Kasan, Mubarek, Nishan, Mirishkor). The irrigated foothill and rainfed areas (Guzar, Dekhkanabad, Yakkabag, Chirakchi, Shakhrisabs) are subject to water erosion. The areas of moderate and highly eroded lands at these places are 50-70%.

The humus content increases in the arable horizon from light to dark sierozem. The irrigated and rainfed sierozem contain approximately identical percent of humus (at most 1,2-1.5%). The observed highest content of humus is in not eroded away brown soils (4.9%) and eroded away ones differ in smaller contents (1-2%).

Lands of medium fertility occupy dominant position (50-80%) in the irrigated zone. Low fertility lands cover 55-95% of rainfed area. The lowest fertility belongs to the lands subject to degradation and salinization.

VI. Assessment of Land Degradation at Local Level

Zarbdar district

Zarbdar district occupies the space of 50.7 thousand hectares, 35825 hectares (70%) of which are agricultural lands and 9717 hectares aren't used in agriculture. The main role is played by the irrigated lands (34273 hectares) in agricultural production which include 33706 hectares (98,4%) of arable land, 391 hectares (1,1%) of wood plantings and 176 hectares (0.5%) of abandoned fields. The arable land makes 839 hectares (2.3%). Pastures are located on the area of 680 hectares The population is – more than 61900 people (density 1.22 persons/hectare).

Soil salinization covers 73% of the area under irrigation, and 37.5% of lands are subject in average and high degree. All irrigated lands are slightly eroded (Table 6.1).

Table 6.1. Degradation of the irrigated lands in Zarbdor district

Degree of degradation	Irrigated lands				Rainfed	
	soil salinization		soil erosion		soil erosion	
	thous. ha	%	thous. ha	%	thous. ha	%
No	9.0	24.8			0.18	22.3
Slightly	13.8	38.2	36.2	100	0.26	32.1
Medium	8.8	24.3			0.27	33.4
High	4.6	12.8			0.10	13.2

Fertility of the irrigated lands is differentiated as follows: low (21-40 points) – 24.1%, medium (41-60 points) – 62.2% and raised (61-70 points) – 13.7%

Kamashi district

Kamashi district area is 245.7 thousand hectares, 34.5 of them are the irrigated lands, which include 28.4 thousand hectares the irrigated arable land. Rainfed lands occupy 34,7 thousand hectares, haymakings and pastures – 113.5 thousand hectares. There are no big problems with salinization in the irrigated zone of Kamashi district. Non-saline and slightly saline lands occupy 89% of the territory, they aren't subject to water erosion, non-eroded and Slightly eroded lands occupy about 75% of lands. The factor reducing fertility of the rainfed of lands is the water erosion and it characterize soil losses, about 34% of lands are characterized as moderate and high erodet (Table 6.2).

Table 6.2. Degradation of irrigated lands in Kamashi district.

Degree of degradation	Irrigated lands				Rainfed	
	soil salinization		soil erosion		soil erosion	
	thous. ha	%	thous. ha	%	thous. ha	%
No	15.4	44.6	7.8	22.7	20.2	54.4
Slightly	15.4	44.6	15.8	45.7	6.3	11.2
Moderate	2.1	6.1	9.3	27.1	4.2	16.8
High	2.6	4.7	1.6	4.5	6.6	17.6

In accordance with the integrated indicator of lands quality – fertility, the irrigated areas are distributed as follows: medium fertility (41-60 points) is made by 57%, the increased fertility (61-70 points) is characteristic of 31% of the irrigated lands and only 12% occupy lands of low fertility (21-40 points).

VII. Assessment of SLM Activities in Uzbekistan

The Government or Uzbekistan has made great efforts to address the problems related to land degradation, drought and raise living standards of the population. Over the past years, significant progress has been achieved in improving the efficiency of land use, increasing soil fertility and introducing modern resource-saving technologies in agricultural production. Specific measures have been implemented in land reclamation, rehabilitation of irrigation and drainage networks, reduction of degradation of pastures, forest restoration and erosion prevention.

Recently, the President and the Cabinet of Ministers of the Republic of Uzbekistan signed a number of fundamental decrees and decisions to support the reform in agriculture and water sectors, strengthen institutional capacity, overcome the effects of water shortage and promote the sustainable management of water and land resources

As part of the Investment Programme, during the last 10 years, international financial institutions invested about one billion dollars in water sector for the reconstruction of irrigation and drainage systems, upgrading water facilities, improvement of irrigated lands, with special attention paid to the development of WUAs and institutional capacity-building. In 2012, 10 long-term projects involving foreign loans guaranteed by the Government were running in the agricultural sector. Most of them are aimed at improving the water supply system. Currently, Uzbekistan has completed and / or is implementing over 100 projects aimed at combating desertification, land degradation and drought. GEF Grants Small Programme (GSP), implemented with the support of UNDP has supported local communities and NGOs in the implementation of sustainable approaches of land use and the environmental protection.

The efficient water use programme is implemented through land reclamation and irrigation projects, in particular the modernization, renovation, increase of the efficiency of irrigation systems, the reduction of water losses in water facilities, the introduction of drip water saving technologies and other types of irrigation.

Wide experience in sustainable land use is accumulated, the best agro technologies and ways of land farming approved in Uzbekistan. Investment projects of GEF, FAO, UNDP, the WB, ADR, etc., the executed within CACILM, the program of Small Grants and National Institutes have shown a number of effective technologies for use of water and land resources in various agro ecological zones of the country.

Government documents and Decrees of the President (УП-4947 dated 07.02.2017, УП-5434 dated 04.08.2017, ПП-3405 dated 27.11.2017) aim at active introduction of modern resource-and water-conservation technologies supported by the Fund for Meliorative Improvement of Irrigated Lands, stimulation and privileges are provided to the land users introducing SLM technologies.

Use of modern and innovative approaches and technologies on a large scale depends on their availability to a wide range of farmers, dehkans and rural community, as well as key ministries, policy and decision makers and local governances, NGO and public societies.

Like the DS-SLM project, the country is currently testing and implementing the most effective technologies and practices to ensure their availability and use in farming practices in various agro-climatic zones of the country with the support of the World Bank, ADB, AF and other international organizations. The most effective technologies and approaches to SLM were integrated into the global WOCAT database (Table 7.1).

However, these practices have not yet been widely disseminated and expanded. As indicated above, this is due to various factors that depend on natural and economic conditions, complexity of terrain and landscapes, technical and institutional capacities and other.

Table 7.1. Approaches and Technologies of Uzbekistan Republic Integrated into WOCAT knowledge platform

Name of the technologies	Pictures from the technologies
1. Improvement of lands through development of pistachio varietal plantations Small Grants Program (SGP / GEF), 2009. http://cdewocat.unibe.ch/wocatQT/qt_summary.php?qt_id=614	 Adyr lands of Uzbekistan (Picture of A. Volkov,2009)  Pistachio plantations at adyrs (Picture of L. Nicolai, 2009)
2. Application of artesian mineralized waters for organization of irrigated cropping in Kyzylkum Karakul sheep farming and Desert Ecology SRI, Samarkand (Component "Researches" INCARDA, 2007-2009) http://cdewocat.unibe.ch/wocatQT/qt_summary.php?qt_id=616	 General view of artesian well and of halophytes field irrigated by the well (pictures of A. Rabbimov,2008)
3. Agroforestry of degraded lands UNESCO Project/ ZEF(Bonn), 2002-2012. http://cdewocat.unibe.ch/wocatQA/SummaryApproach.php?selected_id=386	 a) Initial condition of b) after 2 years c) After 7 years the demonstation plot. (Pictures of A. Khamzina, 2004-2011).
4. Pastures rotation in desert regions of Uzbekistan UNDP-GEF/Government of RUz "Achieving stability of the ecosystems at degraded lands in Karakalpakstan and Kyzylkum desert", (2008-2011) http://cdewocat.unibe.ch/wocatQT/qt_summary.php?qt_id=615	а)  б)  а) Survey of the watering wells, б) Herd of sheep at the embarked plot of the pasture (U. Nazarkulov, 2009-2011)

5. Farmers Field Schools in the irrigated zone FAO TCP/UZB/2903 Project Integrated management for sustainable use of salt-affected and gypsiferous soils (2002-2004) *http://cdewocat.unibe.ch/wocatQA/SummaryApproach.php?selected_id=393*	 Three stages FFS formation 1. Development of the training program; 2. Training of trainers for FFS; 3.Training of farmers
6. Communal forestry in Karakalpakstan. UNDP/GEF «Preservation of riparian woodlands and consolidation of systems of the protected areas at delta of Amudarya River in Karakalpakstan, 2007 *http://cdewocat.unibe.ch/wocatQA/SummaryApproach.php?selected_id=386*	 Rehabilitation of the degraded forest plots by local community (picture of B. Aybergenov, 2007)

These technologies can be used by farmers in relation to conditions and problems of the farms for prevention of degradation, adaptation to drought, salinization and negative impacts of climate change.

Reference

Babushkin L, *at el.* (1985). Agro-climatic conditions of agriculture of Uzbekistan. Mehnat, T.

Bazilievich N.I, Pankova E.I. (1972). Classification experience of soils on containing of toxic salts and ions, Bul, Soil institute after Dokuchaev V.V. 5 issue M.

Egorov V.(1954). Soil salinisation and their reclamation. M., pub A S USSR

K. Guganesharajah, J.F. Pavey,J. vanWonderen, G.M. Khasankhanova, D.J.Lyons, and B.J. Lloyd (2007).Simulation of Processes Involved in Soil Salinization to Guide Soil Remediation. Journal of Irrigation and Drainage Engineering, Volume 133, No 2, April 1, 2007. ASCE, ISSN 0733-9437/20007/2-131-139.

FAO. (1990). Management of gypsiferous soils. Soils Bulletin 62. FAO, Rome.

FAO/TCP/UZB/2801(A), (2003) FAO/TCP/UZB/2801(A) Project Results: Integrated Management for Sustainable Use of Salt-affected and Gypsiferous Soils in Uzbekistan. Paper presented at the Regional Workshop on Management and Rehabilitation of Salt Affected and Fertility Declined Soils for Sustainable Agriculture and Food Security, Tashkent, Uzbekistan

Umid Abdullaev, Gulchekhra Khasankhanova, et al.2013. Economic Valuation of Ecosystem Services to Support Sustainable Water and Land Management in Amudarya River Delta. Proceedings of the UNCCD Second Scientific Conference Extended Abstracts. 2013. Bonn, Germany, 5-8.

Ivanova E, Rozanov A. (1939) Classification of soil salinization, Soil science, № 7, 1939

Khasankhanova (2003), Land Degradation Assessment in drylands (LADA). Uzbekistan report, 2003.

Khasankhanova (1998), Problems of Salinisation of Irrigated Land. In: Problems of Desert Development, Ashgabad

Khasankhanova, Abdullaev, J.Pavey, at el (2001). Integrated Solutions for point and non-point pollution in the Amu Darya river basin, IWA 5th International Conference on Diffuse Pollution and Watershed Management, Milwaukee, Wisconsin, USA, 2001

Khasankhanova (2001). Degraded Soils in Uzbekistan: Extent, Present Use, and Management and Rehabilitation of Salt Affected Soils, FAO, SPUSH, Spain, Valencia.

Khasankhanova G (2003) Rehabilitation of Degraded Rangelands Based on RS/GIS Techniques: The Case Study North West of Kizilkum Desert in Uzbekistan. Volunteer paper at the VII-th International Rangeland Congress, August, 2003, Durban, South Africa.

Maja Schlüter, Gulchekhra Khasankhanova, Vladislav Talskikh, et al.(2013) Enhancing resilience to water flow uncertainty by integrating environmental flows into water management in the Amudarya River, Central Asia. ELSEVIER, Global and Planetary Change 110 (2013) 114–129;

Nabhan H, Khasankhanova, (2003). Brief Introduction to the Project TCP/UZB/2801 "Integrated Management for Sustainable Use of Salt-affected and Gypsiferous Soils": Objectives, expected outputs. Paper presented at the Regional Workshop on Management and Rehabilitation of Salt Affected and Fertility Declined Soils for Sustainable Agriculture and Food Security, Tashkent, Uzbekistan.

Khasankhanova G. Taryannikova R, (2011): Uzbekistan Sustainable Land Management in Practices// Combating Desertification and Land Degradation. Proven Practices from Asia and the Pacific. Edited by Yang Youlin, et al. Changwon, Republic of Korea;

Khasankhanova G, Khamzina T, et al. (2009): Using of LADA methodology for development of national SLM-Information System of Uzbekistan in assessment and mitigation of land degradation and climate change impact. UNCCD COP9 CST First Scientific Conference, Buenos Aires, Argentina;

Shreder V. at el. (1970). Calculation value of irrigation norms of agricultural crops in Syr-Darya and Amu-Darya river basins. Tashkent

Schlüter M, Khasankhanova G., Abdullaev U., Talskikh V., Taryannikova R., Joldasova I., Khamzina T., Ibragimov R., Pahl-Wostl C., 2007. Incorporating environmental flows into water management in the Amudarya river delta.// Proceedings of the International Conference on Adaptive & Integrated Water Management - Coping with complexity and uncertainty (CAIWA), 12-16th November, 2007, Basel, Switzerland. Electronic version (CD compilation);

Umarov M, (1976).Soils of Uzbekistan. Publisher «FAN» T.

Uzdaverloykha, (2002) Atlas of Land Resources of Uzbekistan, Geoinfocadastre, 2002

CACILM-1 (2009) Second Annual Report on the Status of Land Degradation. IS-SLM Report, 2009

Third National Communication of the Republic of Uzbekistan under the UN Framework Convention on Climate Change, 2015.