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# A SOCIAL-ECONOMIC DEVELOPMENT STRATEGY FOR UZBEKISTAN: IMPROVEMENT OF THE SALINED LANDS



April - 2017



## INDUSTRIAL LIVESTOCK PRODUCTION BASED ON BIOSALINE AGRICULTURE



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## **Executive Summary**

The Hydropolitics Association's experts visited to Kazakhstan, Kyrgyzstan and Tajikistan to investigate water management problems related with climate change and transboundary waters in last 5 years. After these technical visits, some books, reports and articles on transboundary water issues in the Central Asia have been published by these experts.

This time, we as Hydropolitics Association decided to study about water problems in Central Asia focusing more practical problems like salined agricultural lands problem that lowland countries are generally faced in the region.

Increasing agricultural land salinization can be identified as the most important issue among the priority areas related with water, food, energy, and environment in Uzbekistan. Therefore it can be noted that "salinization of a country's agricultural land" should be taken into account as the most important threat for the food security and sustainable development of the country.

Uzbekistan is in the progress of developing. But the country is in a challenge to agricultural land salinity problem. 60% of the population of the country still live in rural area and highly depend on agricultural sector.

Different alternatives to tackle salinity problems in salined agricultural lands are under consideration in the Central Asia as well as in the Uzbekistan. Among the alternatives, reclamation approaches to treating saline soils involve leaching (flushing) of the soil with clean/relatively pure water. Sufficient water must be applied to dissolve the excess salts that have accumulated and cause them to percolate/flow out of the soil profile, particularly the root zone. To accomplish this leaching of salts, adequate drainage is requisite.

This alternative is not easily applicable in the region because of water shortage and high initial cost of drainage systems.

In other words, soil protective technologies and methods for soil water-salt regime regulation under conditions of shallow groundwater level, reducing water consumption and harmful effects of salts are expensive and difficult solutions.

Therefore salt tolerant plants may bring more applicable solution in the salted agricultural lands. Salt-tolerant species are able to grow in saline soils. Therefore growing non-conventional salt-tolerant crops and developing intensive animal farming and livestock industry in related with expanding salined land agriculture would be an efficient solution for the region.

A very intensive biosaline agricultural production in the context of growing food for Livestock Industry which results in the development of large-scale livestock farm and related industry is a recommendable solution. Main emphasis of the work to contribute to this paradigm would be through the realization of the following outputs:

- Institutional capacities strengthened for coping with salted soil with the introduction of an appropriate framework, focusing on growing suitable crops to industrial livestock production.
- Improving an appropriate development strategy with water and land resources
- Institutional capacities strengthened on irrigation modernization for improved irrigation water delivery services

Raising awareness about dramatically increasing soil salinization and support a socio-economic development plan based on the sustainable use of the salined land resources and improve Livestock production in livestock farms and livestock industry.

Intensive animal farming and industrial livestock production based on the biosaline agriculture in Uzbekistan will be an innovative development strategy that brings several benefits to the country as well as the Central Asia.

## **ABSTRACT**

Uzbekistan is divided into 12 oblasts or provinces and the autonomous Karakalpakstan Republic. Agriculture accounts for 26 percent of the country's GDP. The total land area of Uzbekistan amounts to 44.9 million ha, of which 23.5 million ha are in pasture. A total of 4.3 million ha are irrigated, of which 3.3 million ha are irrigated arable land and one million ha irrigated pasture.

There is a rainfed arable area of 0.8 million ha. Yields in the rainfed area are low but the area makes an important contribution to national grain production.

Prior to independence the monoculture of cotton led to problems of land degradation. Especially soil salinization. Cotton production has since fallen and there has been a substantial expansion in the grain area and production. This has permitted a large reduction in grain imports. The country is divided into three climatic zones, northern, central and southern.

Since independence, a new agricultural structure has been put into place. Prior to independence the monoculture of cotton has led to serious problems of land degradation in Uzbekistan and to the environmental catastrophe of the Aral Sea. Since independence, priority has been given to the diversification of agricultural production and self-sufficiency in cereals has now been achieved. Farming, although not land ownership, has been privatized. This study describes the agro-ecological and farming conditions of the country, cropping, and a development strategy of Uzbekistan economy improving by salined lands

About half (about 2.1 million ha) of the irrigated area in Uzbekistan is affected by secondary salinization. This can be taken as a serious issue in terms of food security and development in Uzbekistan. Therefore an innovative approach is needed to tackle land salinization.

Intensive animal farming and industrial livestock production based on the biosaline agriculture in Uzbekistan will be an innovative development strategy that brings several benefits to the country .



## SECTION I

### 1.1.UZBEKISTAN IN BRIEF

#### 1.1.1.Situation Analysis

The Republic of Uzbekistan located in the centre of Central Asia and occupies 447.4 thousand km<sup>2</sup>. Uzbekistan is one of the largest Central Asian states with a population of more than 30 million people. Thus it is the most populous country in Central Asia. Population dynamics, including growth rates, age structure, migration and more, strongly influence the country's social and economic development strategies<sup>1</sup>. Uzbekistan has a harsh continental climate with large daily and seasonal changes in temperature. In spite of its drylands characteristics, Uzbekistan's major economic activity is agriculture. Agriculture is also a great consumer of the natural resources, and it accounts for 92% of Uzbekistan's 56 billion cubic meters total water use withdrawal Total agricultural land occupies 25.2 million hectares<sup>2</sup>. This includes 23.4 million hectares that can be considered poor or low-productive pastureland, and 4.3 million hectares of irrigated land (7).

About 44% of the total irrigated area is in the Syr Darya basin and 56% in the Amu Darya basin; these two major river systems basins, the Amu Darya basin and the Syr Darya basin, both of which flow into the Aral Sea basin<sup>3</sup>. In particular, having a dry, continental climate, agricultural output is almost fully dependent on irrigation. Cotton and wheat are the two main crops that are grown at present on 42.2% and 41% of irrigated land respectively. However, there is a shift towards wheat production; this shift appeared to have reduced the total quantity of irrigation water consumed. Despite a subdued performance in the broader Europe and Central Asia (ECA) region, Uzbekistan continues to grow strongly. Slightly below the 8.2 percent growth rate registered in 2012.

Real GDP growth averaged 8.3 percent per annum between 2008 and 2012, which makes Uzbekistan one of the fastest growing economies in the region and the middle income countries during this period. GDP growth was 8 percent in 2013, and was reflected in growth across all sectors, with construction, services, and agriculture the most dynamic (agriculture by 6.8 per cent). The agricultural sector is one of the important sectors of the Uzbekistan's economy and contributed 16.8 percent of the annual GDP and 24.7 percent of employment in 2012.

More importantly, about 60 percent of the population live in rural areas and depend on agriculture and related activities for their livelihoods. The Government strongly supports agriculture sector and farmers' activities with incentives, including tax exemptions; in particular, farms, vineyards and gardens are exempted from tax for 2 and 3 years' periods, respectively. Overall, there are over 70 thousand farms in the country, with an area of 5.9

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<sup>1</sup> <http://www.unfpa.uz/en/whatwedo/population/>

<sup>2</sup> National report on "Land Resources of the Republic of Uzbekistan", The State Committee of the Republic of Uzbekistan on Land Resources, Geodesy, Cartography and State Cadastre. Tashkent-2013

<sup>3</sup> 3 Irrigation in Central Asia in Figures – AQUASTAT Survey 2012 ( FAO Water Report No: 39)

million hectares operating under long-term leasing conditions. The average area of each farm amounts to 80.7 hectares. The Decree of the Republic of Uzbekistan from 21 May, 2012 on the “Programme of Modernization of Agricultural Production, and Technical and Technological Improvement of Agricultural Sector for 2012-2016” has prompted the provision of the agricultural sector with modern technologies as well as practically introduced over 60 types of conserving, highly productive and multi-functional agricultural technologies in the country(7).

This, in turn, has reduced the costs of production and lowered the prices for food products as well as, at the same time, yielded higher profits. The initiative of the President of the Republic of Uzbekistan has further given significant attention to the improvement of land and water resources management, including drainage and irrigation schemes and hundreds of projects are being implemented in this direction, which in turn is contributing to increase of productivity by some 3-5 percent. The priority areas of the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan as indicated in several platforms are:

1. Diversification and intensification of farming systems in conventionally irrigated areas of Uzbekistan as well as intensive gardening, fruits and vegetables production, including for export markets
2. Capacity building of sector specialists about international experiences in integrated Pest Management, Conservation Agriculture, and other good agriculture practice of crop protection techniques especially for grains and for cotton
3. Development of livestock production and diseases combating
4. Sustainable development and better management of natural resources such as forests, land and water resources
5. Capacity development, technical assistance and introduction of modern technologies in specific subsectors, such as: - inland fisheries and aquaculture - forestry, medical herb harvesting - poultry production, and - beekeeping.

The main objectives of agricultural policy in Uzbekistan are to

- a) maximize and stabilize export revenues from agricultural outputs,
- b) achieve food security and self-sufficiency in wheat production,
- c) support the development of the agriculture sector and
- d) improve rural standards of living. Combating wind erosion, land degradation, improvement of ameliorative condition of land, irrigation and water management are the priority areas of further agricultural development in the country(7).

Water management and the modernization of the irrigation system will command special attention by the Government. Rural development is a policy priority adopted by the President’s Decree in April 2013 to improve the standard of living of rural population through infrastructure growth and creation of jobs. Food security is a major concern of the government

and this context Uzbekistan appreciates the role of FAO. Increasing support is needed in the areas of: animal health emergency support; veterinary service strengthening and related capacity development. The Government's industrialization policies contribute to changes in the structure of Uzbekistan's economy, and have embarked on a series of programs to modernize and diversify the economy, including exports, and increase the role of the private sector(7).

## 1.2.TOTAL LAND AREA IN UZBEKISTAN

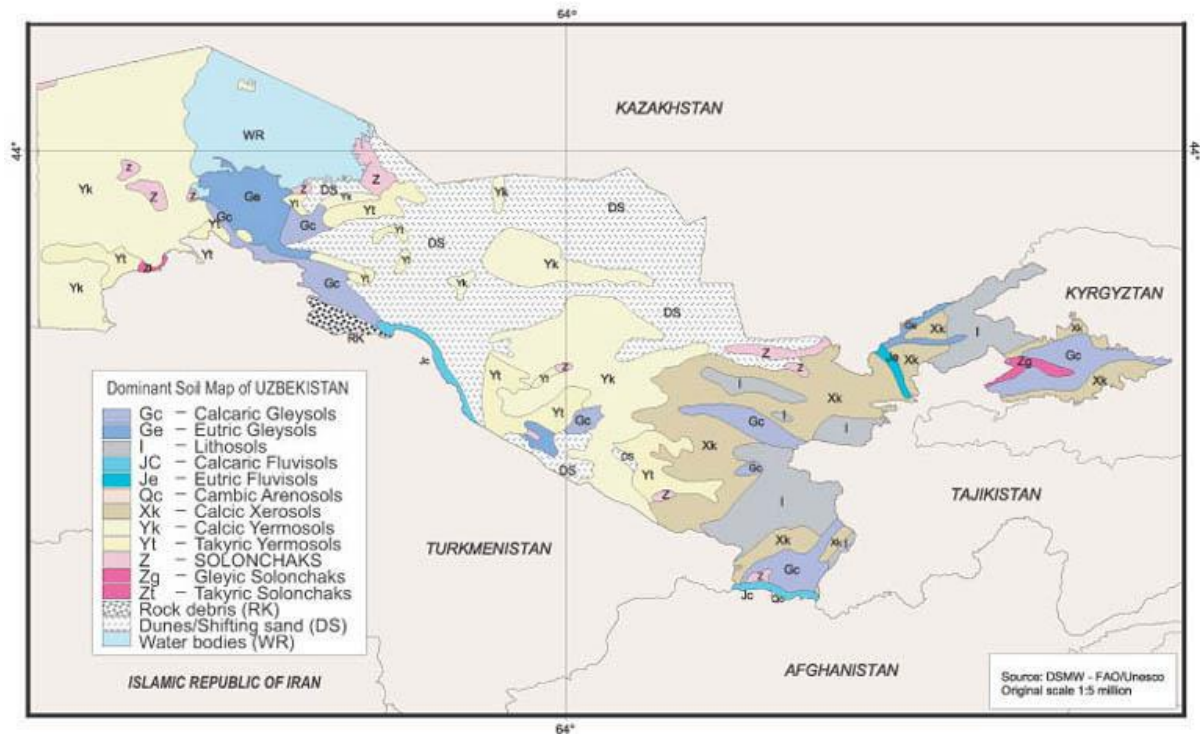


Figure 1.Dominant Soil Map of Uzbekistan

The total land area of Uzbekistan amounts to 44.9 million ha of which 4.3 million ha are irrigated, 3.3 million ha being irrigated arable land (Table 1) and one million ha being irrigated pasture. The irrigated land is of paramount significance for the agriculture and economy of the country. The permanent pasture area amounts to 23.5 million ha accounting for over 80 percent of all agricultural land(6).

Dominant soil map of Uzbekistan is given in Figure 1.As shown in this figure large amount of Uzbekistan land is rock debris.

**Table 1**  
**Distribution of irrigated arable land in Uzbekistan ('000 ha)**

Zone	Average 1996 to 1998	Average 2000 to 2002	Difference
Karakalpakstan Republic	427	419	-8
Oblasts			
Andijian	203	198	-5
Bukhara	201	200	-1
Djizak	253	258	5
Kashkadarya	418	417	-1
Navoiy	92	92	0
Namangan	199	198	-1
Samarkand	263	262	-1
Surkhandarya	250	244	-6
Sirdarya	260	256	-4
Tashkent	297	299	2
Fergana	257	256	-1
Khorezm	218	212	-6
Tashkent city	0	0,5	0,5
Total	3 338	3 311	-27

Source: State Committee for Land Resources (SCLR), 2002.

In Uzbekistan, the rainfed area covers more than 747 thousand ha with rainfall exceeding 200 mm per year, yielding between 0.8 and 2.0 tonnes of grain per hectare. However, in view of their extent, these areas play an important role in grain production (Figure 2).

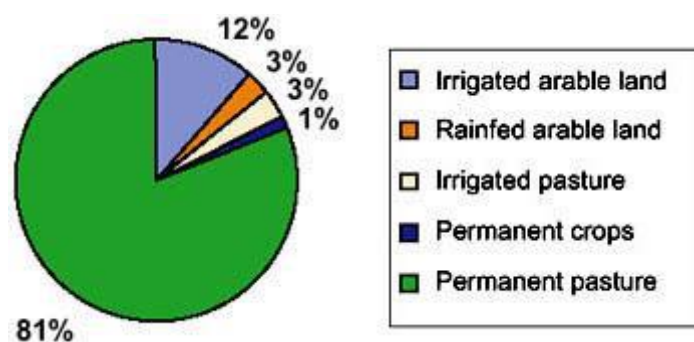


Figure 2. Agricultural area in Uzbekistan



www.alamy.com - BPAW9K

Picture 1. Cotton production in Uzbekistan

Cotton production (Picture 1) has fallen. Prior to independence the monoculture of the crop has led to problems of land degradation, especially from salinization and waterlogging. However, cereal production has increased substantially (Figure 3). During the past three years alone, the area under cereals, especially wheat, has been extended by more than 300 thousand ha, to reach more than one million ha in 2001. Cereal production has reached 3.5 million tonnes and the importation of the food grain has been reduced more than six-fold (6).

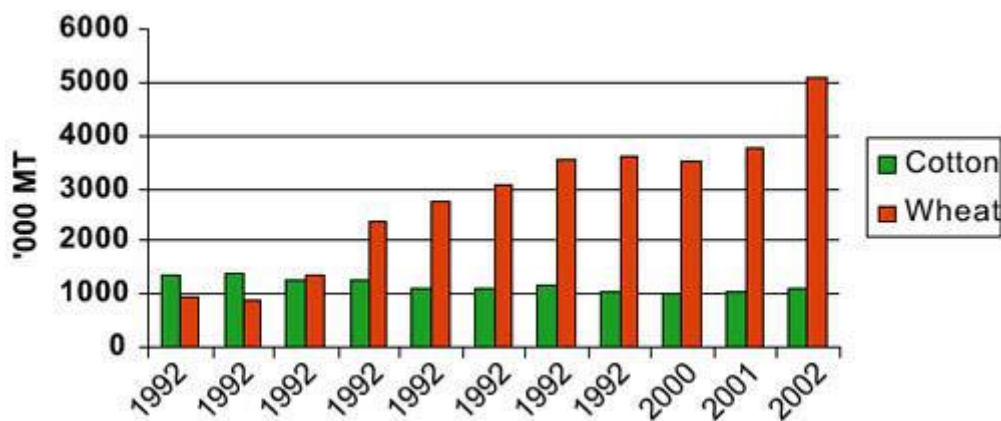


Figure 3: Cotton and wheat production, 1992 to 2002

The average crop production capacity of pastureland is only 0.2 tonnes cereal equivalent per ha but this land provides 60 percent of livestock forage.

The agricultural areas are situated in the basin of the Aral Sea and on the extensive plains and foothills. Most of the land is exceptionally well suited to mechanical cultivation and the prevailing temperatures permit the cultivation of a large variety of vegetables, fruits and berries, cereals and cash crops, including medium-fibre cotton. In the south the valuable fine-fibre varieties of cotton are grown.

Each year 25 000 ha of new irrigated land is brought into cultivation and more than 45 000 ha of old irrigated arable land reclaimed(6).

### 1. 3. THE AGRICULTURAL SECTOR IN UZBEKISTAN

Uzbekistan’s economy depends heavily on agriculture, which accounted for 28 percent of GDP and employed 40 percent of the labour force in 2005. Arable land only comprises 11 percent of the territory. With such a small percentage of land available for farming, the inadequate management of soils and years of irrigated agriculture intensification, without regard to the consumption of water or other natural resources, have had adverse environmental effects such as severe salinization, erosion and waterlogging of agricultural soils, which have reduced the land’s productivity. Two crops have strategic significance for Uzbekistan: wheat for domestic consumption and cotton for export. Cotton accounts for 40 percent of the gross value of agricultural production. Subsidiary crops include alfalfa, rice, sorghum, maize, bakhcha (a fruit, like a melon).

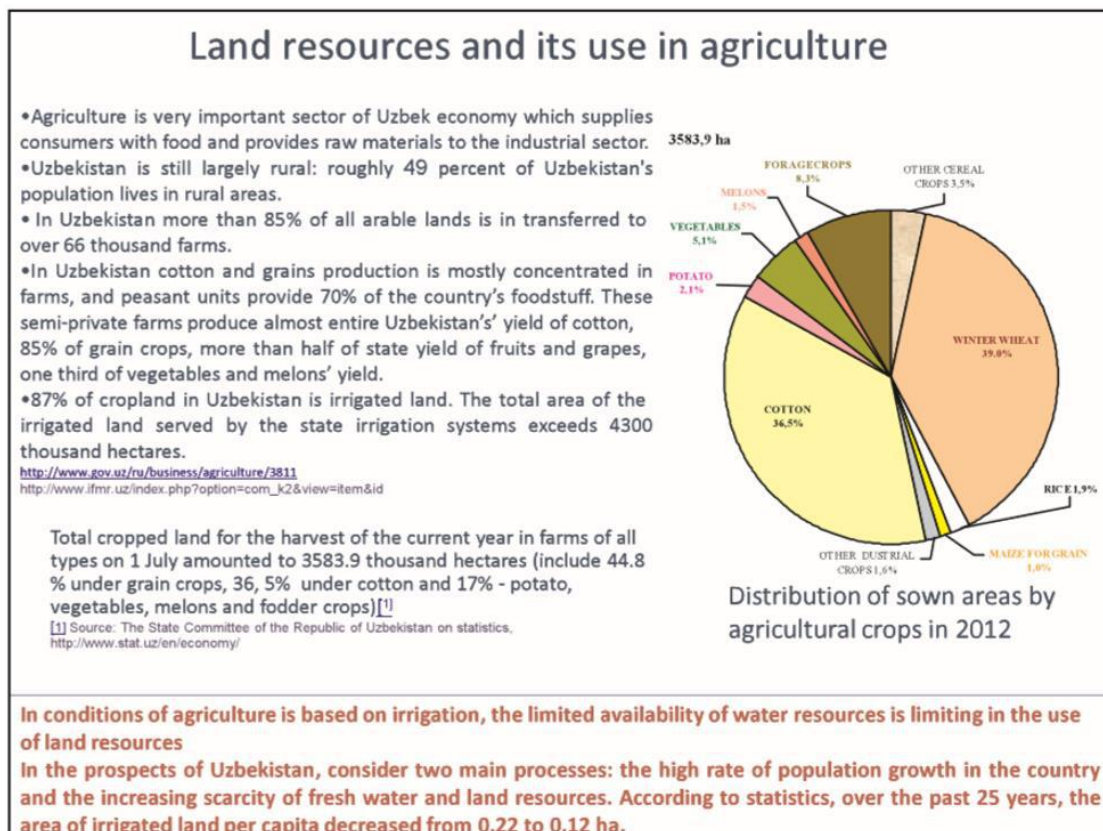


Figure.4. Land Resources and it’s use in Agriculture (9).

Land resources and its use in Agriculture is given in Figure 4. As shown in this figure 36,5% of sown areas consist of cotton production.

Many cotton and wheat varieties have been developed through plant breeding to suit agro-climatic conditions in Uzbekistan. However, agricultural practices and policies in Uzbekistan need to be improved and modernized. Yields of irrigated cotton and especially wheat are low by world standards. There are several reasons for low productivity, including obsolete farm equipment and tillage practices; lack of availability and timely application of agricultural inputs; increasing soil salinity; an unsustainable cotton-wheat crop rotation; poor weed control; a still imperfectly developed and structured shirkat (cooperative farm) system; and a lack of research and knowledge on alternative crop rotations.

According to the FAO Report published in 2009, Agricultural problems in Uzbekistan has been indicated as follows;

Desertification processes connected with wind and water erosion and secondary salinity, Increasing saline areas, Declining soil fertility, Lack of appropriate crop rotation, Poor weed control, Lack of infrastructure, Inefficient and obsolete agricultural practices Lack of experience and knowledge Outdated farm equipment Lack of availability or untimely application of agricultural inputs Inefficiency of the shirkat (cooperative farm) system (FAO 2009).

Although they are all very important problems for agricultural sector in the Uzbekistan, one of them is very crucial for the future of country that is “ Increasing salined agricultural lands” (Photo4, Photo 5).



Picture 2. Salt-affected soils in Uzbekistan Photo by Kristina Toderich.



Picture 3. Salt -affected soil

#### **1.4.TREND OF IRRIGATED LANDS SALINIZATION**

Uzbekistan has an extreme continental climate with hot, dry summers, cold, unstable weather in winter, and a wide range of variation in seasonal and daily temperatures. The desert and steppes are characterized by short winters with thin and unstable snow cover, and hot, dry dusty summers. Agriculture is dependent on irrigation and concentrated in the river valleys. Drought conditions in Uzbekistan since 1999 have affected the flow of the rivers feeding into the Aral Sea Basin.



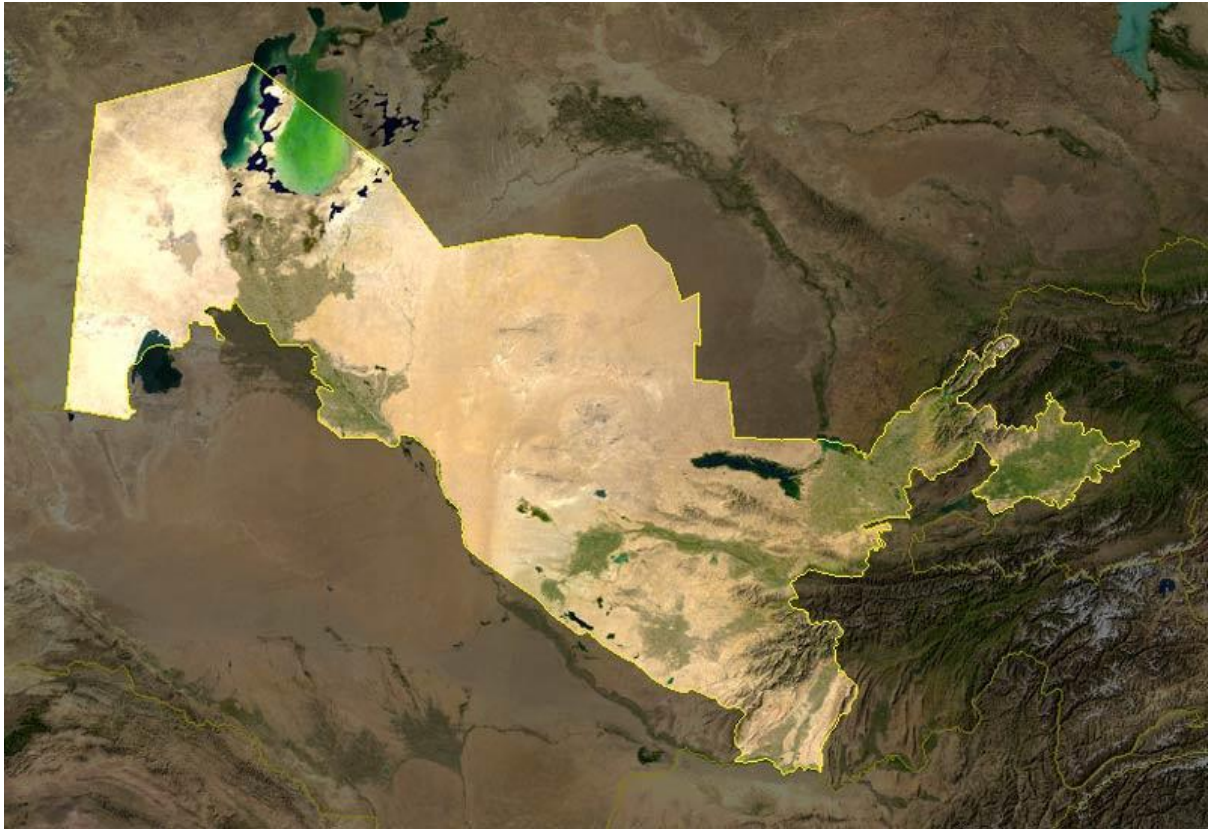


Figure 5. Uzbekistan from space

The effect of the reduced flows was aggravated by inadequate water management, in particular along the Amu Darya, which provided irrigation water to about 500 000 ha of land in Karakalpakstan in the past. Now, the irrigated area has decreased due to water shortage.

About half (about 2.1 million ha) of the irrigated area in Uzbekistan is affected by secondary salinization:

31 % is slightly saline,

18 % moderately saline,

4.5 % strongly saline.

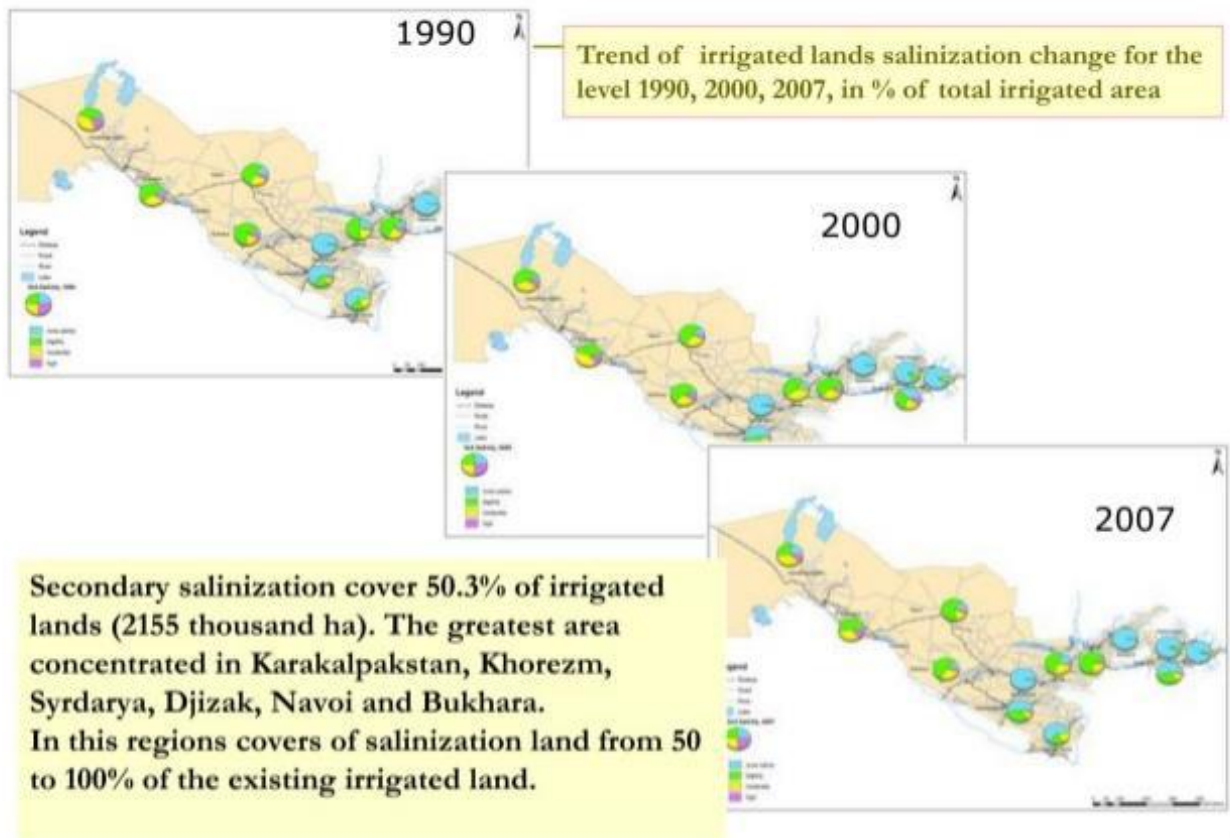


Figure 6. Trends of irrigated lands salinization change (15).



Figure 7. Regions of the Uzbekistan



Picture 4. Strongly salined land



Picture 5. Moderately salined land

#### **1.4.1 Karakalpakstan- Substantial increase in salinity**

The geographic location of Karakalpakstan (Figure 7), at the tail-end of the river but also downstream from several hydro-electric and irrigation schemes. There has been a substantial increase in the area of soils affected by salinity in recent years (Picture 4, Picture 5).

##### **In Karakalpakstan, almost all of the irrigated area is affected by salinity:**

In the era of the Soviet Union, Karakalpakstan (KK) specialized in rice production and was one of the main rice-producing regions in the country. After independence, it continued to be Uzbekistan's largest rice-producing region. Because of this, Karakalpakstan received a high water allocation, 12 000 m<sup>3</sup> /ha annually. However, shortage of irrigation water experienced for many years has affected the agricultural production in KK. Since 1991, the productivity of agriculture has decreased by 40–50 percent. Three successive years of drought (1999–2001) inflicted serious damage on the agricultural sector. Gross production of the three main crops – rice, cotton and wheat– fell by 75, 11 and 52 percent respectively, between 2000 and 2001 (FAO 2009).

Furthermore, due to the increasing soil salinity, the region loses billions of Uzbek Soums every year. Under the Soviet regime, cotton was the main agricultural crop in Chimbay district, with about 60 percent of the total irrigated area under cotton cultivation. Other crops such as rice, alfalfa, and maize were grown on the remaining 40 percent. Some farmers grew rice and sunflowers, but there was no double cropping practice. Rice and cotton dominate the agricultural production in Chimbay and require much more water than other crops (FAO 2009).

The salinity evaluation was made for crops with strong salt tolerance; the consequences would be more severe for crops with weak and medium salt tolerance. In the Amu Darya river delta, southern Aral Sea Basin, most of the soils can be divided into soils associated with and affected by the floodplain of the river.

These include slightly to moderately saline wetlands formed by clayey hydromorphic meadow and bog soils. These soils were in limited agricultural use. Other soils, south-east of Nukus, in a narrow strip along the river, are non-saline or slightly saline hydromorphic meadow and bog soils formed on alluvium. To this group of soils also belong hydromorphic meadow soils that are mildly to strongly saline and can be termed Solonchaks. Many of these soils are covered by a 1–2 cm thick salt crust. The Solonchaks developed on sediments of variable texture, deposited from the Aral Sea water after being introduced by the two major systems (FAO 2009).

These are young soils with undeveloped profiles and slight organic matter accumulation. A second group of soils are Takyr soils, distinguished by their hard, polygonally cracked surface. Chimbay district, in the northern zone of Karakalpakstan, has a severe continental climate with hot summers and cold winters.

Summer temperatures often exceed 45°C; the average winter temperature in January is about -8°C, with absolute minimum as low as -40°C. Water resources are in short supply in most of Chimbay district. According to the data of the Karakalpak Research Institute of Crop and Land Management (KRICLM) located in Chimbay, the long-term average annual precipitation is 110 mm, distributed as 18mm in autumn (September- November), 60 mm in winter (December-March), 24 mm in spring (April-May) and 8 mm in summer (June-August).

The three canals supplying Chimbay district, Mayjap, Shokharik and Aytgejap, originate from the large Kyzketken canal of the Amu Darya. Groundwater resources are polluted by untreated sewage water and by drainage water, which contains high levels of agrochemicals and minerals(FAO 2009).

#### **1.4.2.Tashkent**

Tashkent region is located in north-east Uzbekistan which is surrounded by the West Tyan Shan mountain chain in the north-east and east. Most of the region is a valley south and south-west of Tashkent city towards the Syr Darya river. The climate of the region is sharp continental, with mild winters and long dry summers. The average monthly temperature is -1 to -2 °C in January and about +27 °C in June. Plain areas receive about 250 mm annual precipitation, and have a vegetation period of about 210 days. The soils of Tashkent region are mainly seryozem (grey loamy) and represent the majority of arable lands. The soils are composed of gleysols and meadow soils, nonsaline or of low salinity, with good hydro-physical properties. The cotton monoculture cropping system is causing environmental degradation including declining soil fertility, low quality irrigation water, shifts in the water table and rising salinity; monoculture has also contributed to the increased resistance of many pests to pesticides(FAO 2009).



**Figure 8 .Uzbekistan**

### 1.5.AGRICULTURAL STRUCTURE IN UZBEKISTAN

In Uzbekistan there are 1 389 collective (kolkhoz) farms, 872 cooperative farms, 21 675 dekhan or family-owned farms and 1 895 private farms. Agriculture accounts for 19 percent of the country's GDP and employs more than a third of the population (Figure 9, Figure 10)(6).

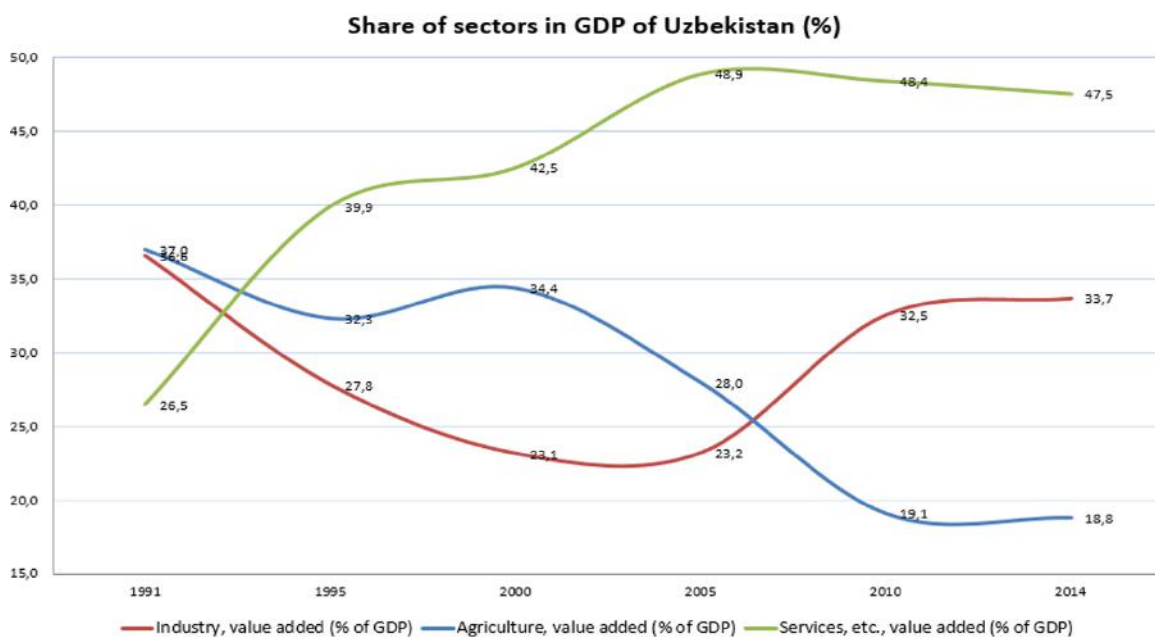


Figure 9... Share of sectors in GDP of Uzbekistan (World Bank 2015)

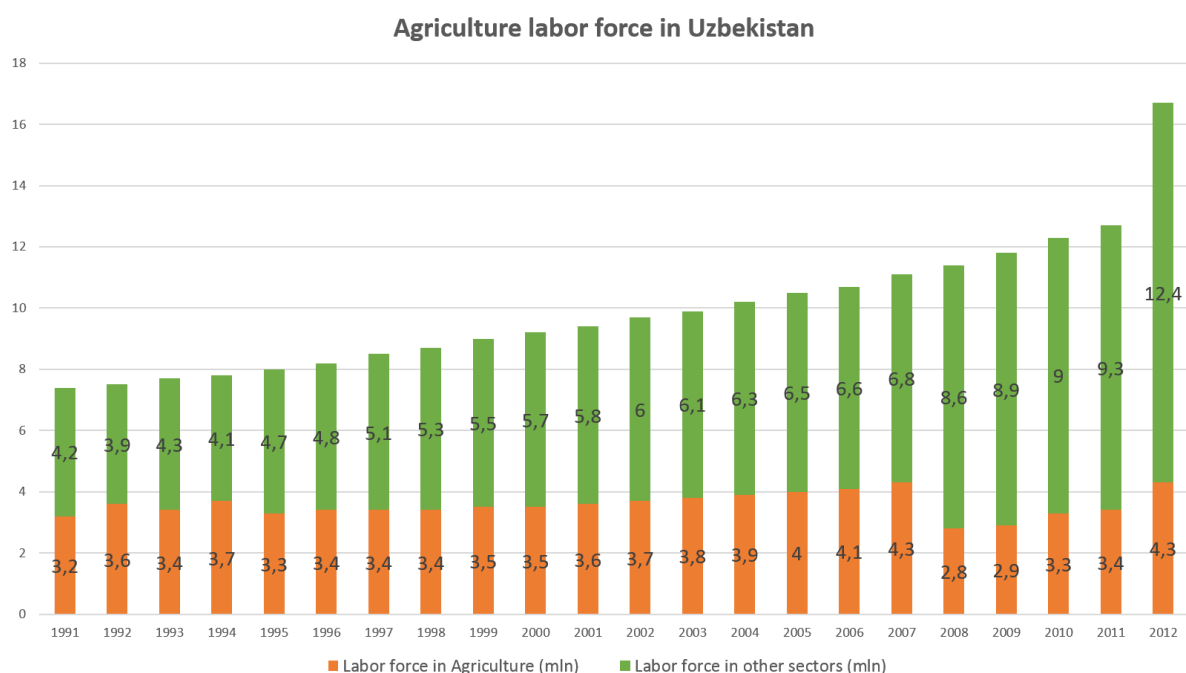


Figure 10. Agriculture labor force in Uzbekistan ( World Bank 2014).

Since the independence of Uzbekistan, a number of laws and decrees have been issued in order to establish a legal framework for the establishment of mixed economy enterprises, businesses, farms and private domestic plots. The farms include 'shirkat' cooperative farms and 'dekhan' family farms. The land is on long-term lease from the state. The 'dekhan' farms account for more than 60 percent of agricultural production. Land allocation to farmers is shown in Table 2.

**Table 2. Land allocated to farmers ('000 ha) (17)**

Zone	Allocated	Owner occupied		Rented	
		Total area	Irrigated	Total area	Irrigated
Karakalpakstan Republic	26	0	0	26	19
Oblasts					
Andijan	9	0.2	0.2	9	8
Bukhara	31	29	4	2	1
Djizak	50	36	24	14	7
Kashkadarya	36	18	13	18	14
Navoiy	88	75	3	12	3
Namangan	14	9	8	5	5
Samarkand	46	10	7	36	12
Surkhandarya	30	23	15	7	5
Sirdarya	14	1	1	13	11
Tashkent	31	24	14	7	5

Fergana	15	1	1	15	15
Khorezm	6	5	4	0.4	0.4
Total	396	231	94	164	105

The social structure of agriculture has changed fundamentally. Today the public sector accounts for less than 2 percent of the total. The economic independence of agricultural enterprises has been extended. There have been several other structural changes in agriculture. For example, the cotton monopoly inherited from the former centrally controlled Soviet system and so-called all-union division of labor, have been abolished. During the Soviet period, Uzbekistan was mostly oriented towards the production of cotton for the textile and military industries of the Soviet Union. After independence Uzbekistan reduced cotton production by expanding production of grain, vegetables and other crops, which previously did not satisfy domestic requirements(6).

### 1.5.1. Livestock Farms

By 2001, 8 259 farms had been established on an area of 190 000 ha (Table 3).

**Table 3 .Types and numbers of private farms (17)**

Type of farm	Number of farms	Approximate area	Number
Cotton	5 687	Over 100 ha	182
Grain	1218	100 ha	57
Livestock	511	60 to 80 ha	145
Horticulture	572	40 to 60 ha	776
Vine (grape)	32	20 to 40 ha	1 993
Vegetable	438	10 to 20 ha	3 472
Melon	23	1 to 5 ha	1 634
Total	8 481		8 259

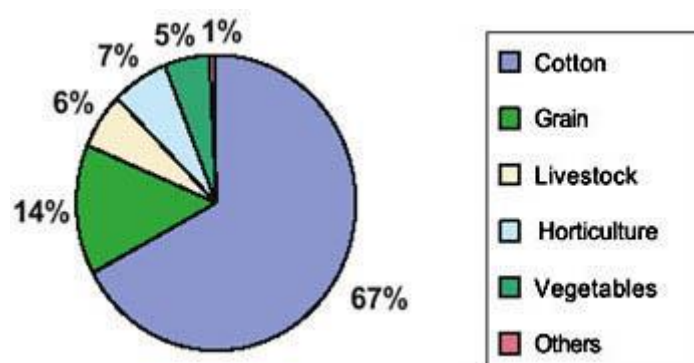


Figure 11: Number of different types of farms



## 1.5.2. LAND QUALITY IN UZBEKISTAN

The main factor in the qualitative assessment of land is its fertility and this is determined by 'bonitation'. The 'bonitation' of land is the comparative assessment of the land quality, and productivity with a representative level of agricultural activity. Bonitation involves an analysis of the soil properties, both natural and human-induced, that determine its crop carrying capacity, both its natural productive capacity and that obtained through agricultural activities.

The bonitation carried out in the period 1989 to 1990 for irrigated land has a 100-degree scale. The highest score is attributed to soils with the highest fertility, or 40 centners of cotton per hectare. A yielding capacity of 0.4 centners/hectare gives a value of one. Table 4 classifies the land according to these assessments.

The categories of land suitable for irrigation (Table 5) are defined as:

- i. Very good land capable of producing 81-100 percent of the potential yield
- ii. Good land capable of producing 61-80 percent of the potential yield
- iii. Moderate quality land capable of producing 41-60 percent of potential yield
- iv. and iv. Poor land capable of producing 40 percent of potential yield

**Table 4 Land suitable for irrigation ('000 ha) (17)**

Zone	Total area	Total area suitable for irrigation	Present irrigated area
Karakalpakstan Republic	16 659	1 540	502
Oblasts			
Andijan	423	70	282
Bukhara	14 335	1 700	347
Djizak	2 049	560	288
Kashkadarya	2 858	1 320	470
Namangan	744	90	273
Samarkand	2 467	870	407
Surkhandarya	2 010	170	315
Sirdarya	500	150	300
Tashkent	1 558	170	401
Fergana	676	150	355
Khorezm	605	240	262
Total	44 884	7 030	4 202

## SOIL TYPES IN UZBEKISTAN

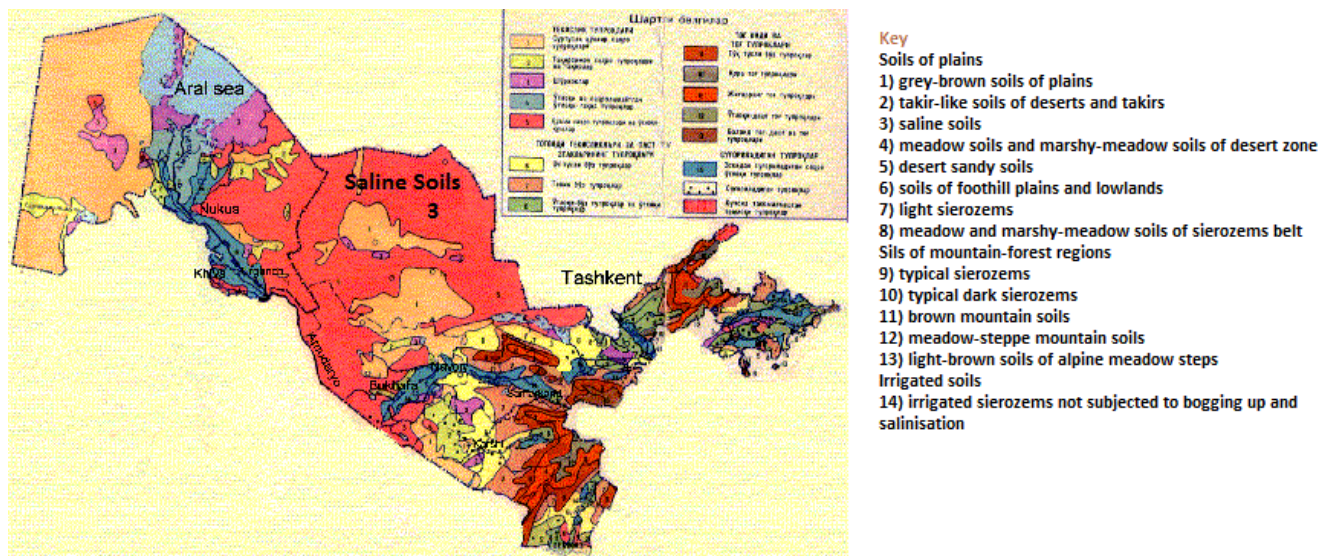


Figure 12. Soil Type in Uzbekistan

The genesis of the soil forming rocks in Uzbekistan is very varied. This, combined with the complexity of the litological structure of the soils, the different hydro-geological conditions, an arid continental climate and the vegetation has led to the formation of many different soils. In Uzbekistan, the soils are of high-altitude belts and desert zones (Table 5).

**Table 5. Types and subtypes of soil in Uzbekistan (18)**

Soil	'000 ha	Percentage
Light-brown, meadow desert, high mountain	54	1.2
Brown and dark brown, mountain-wood, middle mountain	166	3.7
Dark sierozem	105	2.4
Typical sierozem	305	6.8
Light sierozem	259	5.8
Meadow-sierozem and sierozem-meadow	780	1.8
Meadow of sierozem belt	67	1.5
Marshy-meadow sierozem	7	0.2
Sub-total	1 041	23.4
Grey - brown	1 103	24.8
Desert sandy	137	3.1
Dry lands	178	4.0
Meadow and dry-meadow	46	1.0
Desert zone meadow	179	4.1
Desert zone marshy meadow	5	0.1
Saline, alkali soils	127	2.9
Sand	1210	27.2
Others land (rocks, wetland etc.)	416	9.4

Sub-total	3 402	76.6
All land	4 442	100

Types of soils in rainfed agricultural areas in Uzbekistan is given in Table 6. As it is seen in this table totally rainfed area is only about 970 000 ha in every soil types.

**Table 6. Types of soils in rainfed agricultural areas in Uzbekistan (18).**

<b>Zones &amp; soil types</b>	<b>Total area '000 ha</b>	<b>Percent of total</b>	<b>Typical annual rainfall (mm)</b>
<b>Totally rainfed</b>			
Brown, leached soils	318	9	500 to 900
Dark sierozems	145	4	350 to 500
Well drained, dark sierozems	507	15	350 to 500
Total	970	28	
<b>Partially dry</b>			
Typical sierozems	793	23	280 to 350
Well drained, typical sierozems	816	24	280 to 350
Total	1 609	47	
<b>Wholly dry</b>			
Light sierozems	836	25	280 to 350
<b>Total rainfed</b>	<b>3 415</b>	<b>100</b>	

Main problems of soil in Uzbekistan has explained by Dr.Yulia Shirkova (9) as it is shown in Figure 13.

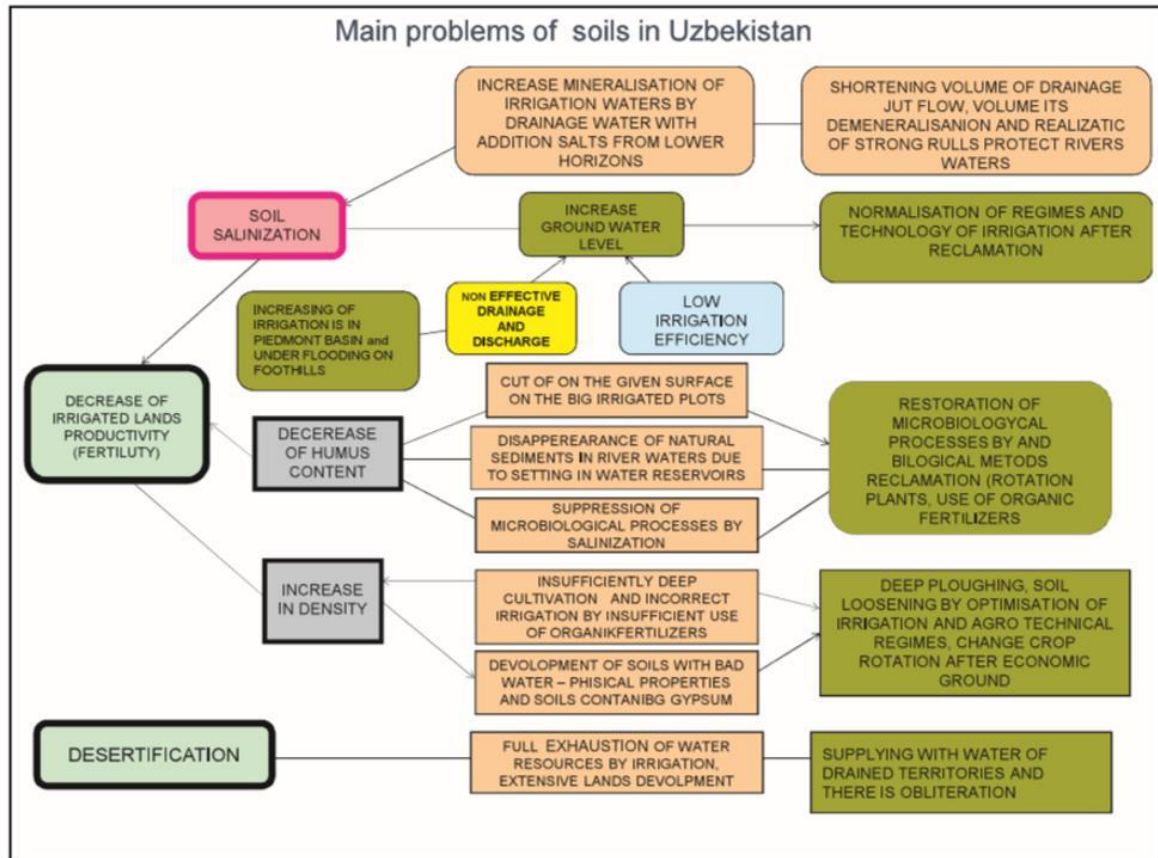


Figure 13. Main problems of soils in Uzbekistan (9).

## SECTION II

### 2.1.SALINIZATION OF SOILS IN THE UZBEKISTAN

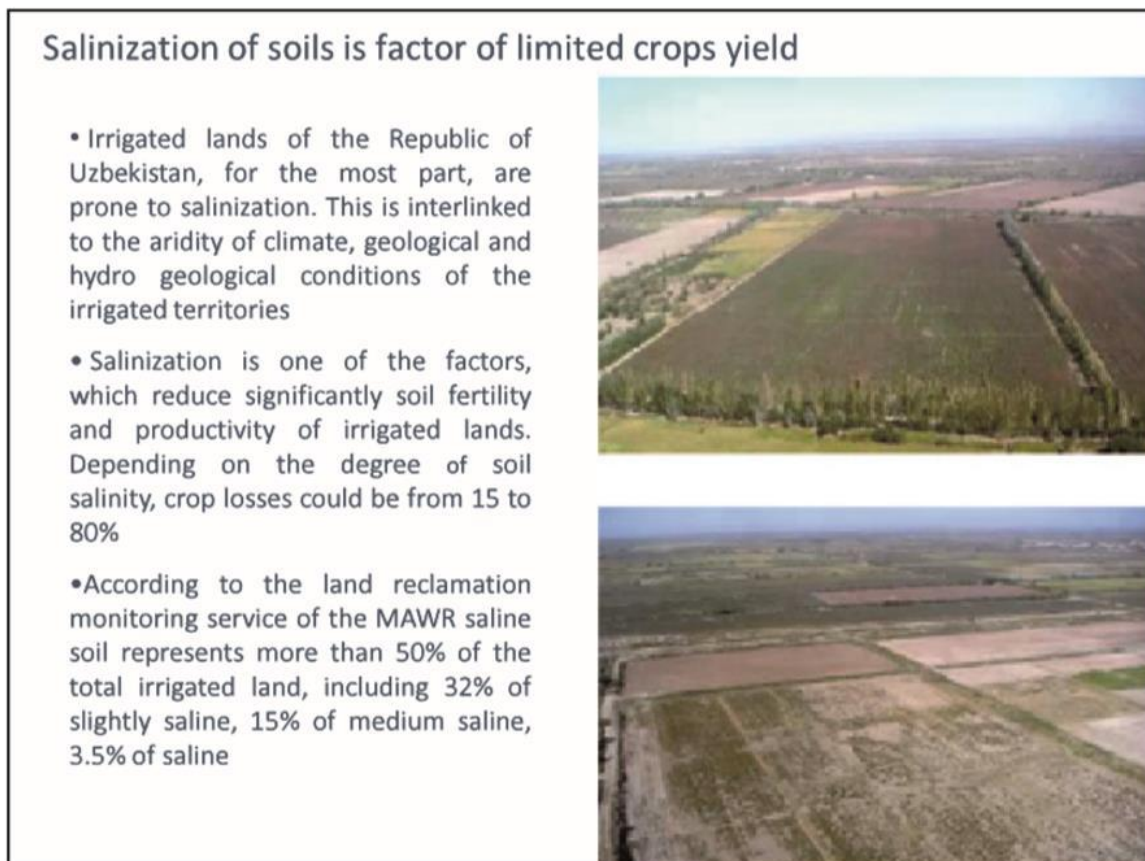


Figure.14. Salinization of soil (9)

During literature survey for this study, we realized that Dr. Yulia Shirokova<sup>4</sup> has been one of the most interested, eager and knowledgeable researcher on salinity of irrigated lands of Uzbekistan and its causes and consequences. Therefore, thanking to her, mostly we referenced her studies in this report (Figure 14).

The territory of Uzbekistan is a combination of flat and mountain terrain. More than 2/3 of the territory is covered by plains (Turan plain, Fergana Valley, Valley of the rivers Amudarya, Syrdarya and Zarafshan rivers and their tributaries), and 1/3 made up of mountains and foothills

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<sup>4</sup> Yulia Shirokova received her Ph.D. in agriculture from the Central Asian Scientific Research Institute for Irrigation (SANIIRI) (in Uzbekistan) after successfully defending her thesis, "Using drainage water to leach saline soils." Her scientific interests include improving the monitoring and desalinization of saline-irrigated soils. She has worked as a deputy director of scientific research. She is currently head of the Soil Research and Ameliorative Processes Laboratory at Uzbekistan's Scientific Research Institute of Irrigation and Water Problems

(spurs of Tyan-Shan, Gissar-Alay). The highest point of Uzbekistan's mountains is 4,643 meters asl, the lowest point, in Aral Sea area, is 53 m. The climate of Uzbekistan is sharply continental. The growing of agricultural crops is impossible, without artificial irrigation since the ratio of precipitation to potential evaporation is around 0.1-0.3 and less (9).

According to the Ministry of Agriculture and Water Resources (MAWR) irrigated land occupies 4,200 thousand hectares. According to the State Committee of the Republic of Uzbekistan on statistics, in 2012, the total cropped land in Uzbekistan amounted to 3583.9 thousand hectares (include 44.8% under grain crops, 36.5% under cotton and 17% —potato, vegetables, melons and fodder crops) (as for July 1, 2012) (9). High and very high permeable land accounts for 24 % of irrigation area in Uzbekistan ( Figure 15)

### 2.1.1.Salinization :

Irrigated lands of the Republic of Uzbekistan are mostly prone to salinization. This is interlinked to the aridity of climate, geological and hydrogeological conditions of the irrigated territories. Salinization is one of the factors, which reduce soil fertility and productivity of irrigated lands significantly. Depending on the degree of soil salinity, crop losses could be from 15 to 80%. *According to the land reclamation monitoring service of the MAWR saline soil represents more than 50% of the total irrigated land*, including 32% of slightly saline, 15% of medium saline, 3.5% of saline (9).(Figure 16).

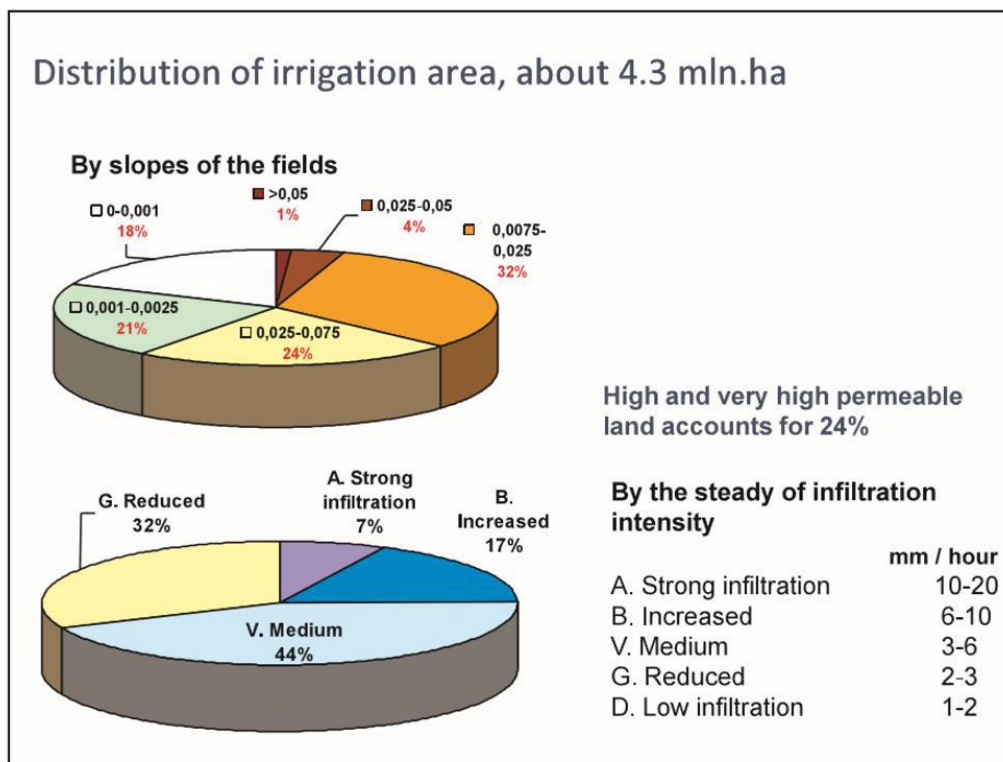


Figure 15.Distrubution of irrigation area with different infiltration rate in the Uzbekistan (9).

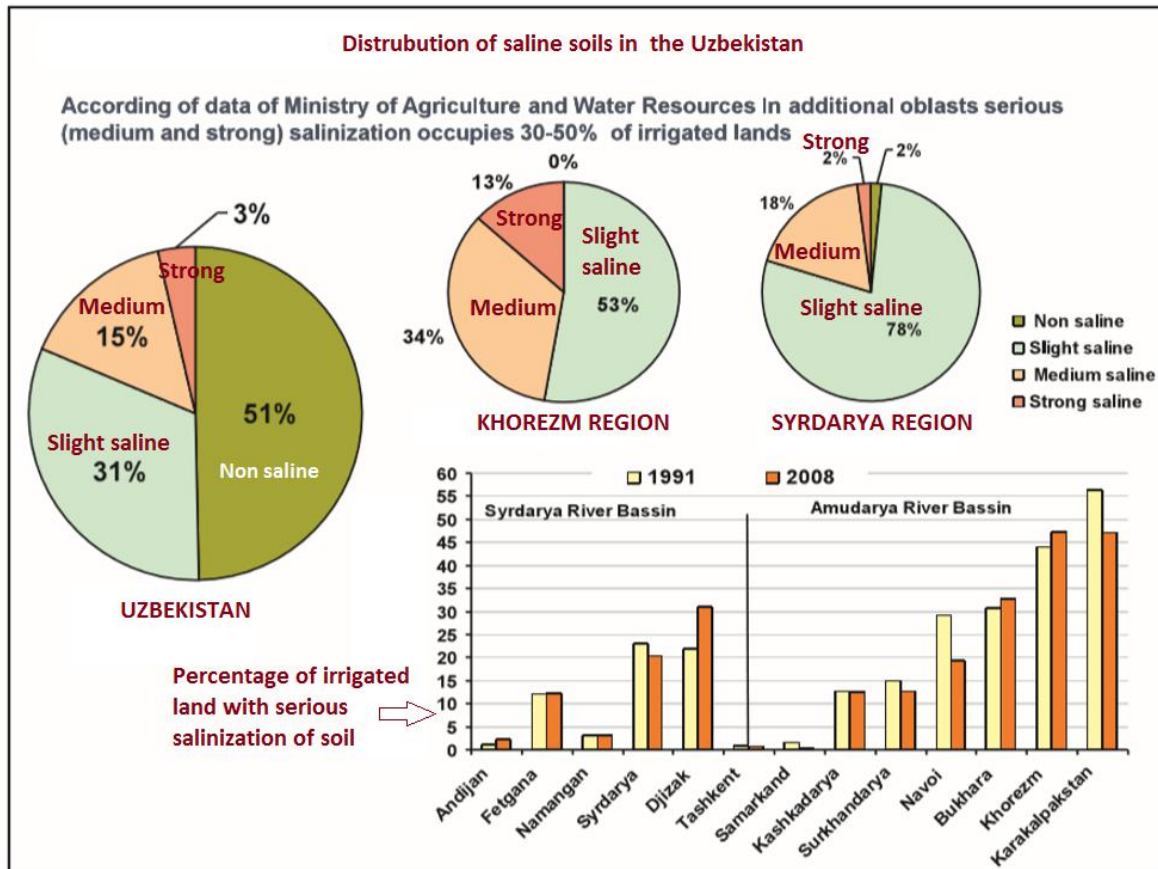


Figure 16. Distribution of saline soils in the Uzbekistan (9).

The main crops grown in Uzbekistan (cotton and wheat) are resistant to salt. Nevertheless, soil salinization is not a crucial factor for reducing yield of winter wheat considering relatively moist soil due to precipitation in winter. However, cotton, which is sown in spring, needs good soil moisture with a minimum of its salinity for ensuring of good growth and development of young plants(9) (10).

Therefore important agricultural approaches for cotton fields are increasing moisture reserves due to special irrigation as well as leaching salts from the land before planting. Uzbekistan's soil is also very diverse due to differences in genetic, geological, hydrological and anthropogenically-historical nature.

Mostly genetically fertile are foothill land and land of ancient irrigation. Depending on the zonal location, soils have different quality and uniformity of texture and fertility. There is also the notion of limitation of irrigation. In the arid climate of Uzbekistan are irrigated soils poor in humus and have high anthropogenic load. Such soil is prone to salinization, wind and irrigation erosion(9).

### **2.1.2. Cause and Consequences**

According to the Committee on Land Resources of the Republic of Uzbekistan, 24% of irrigated land in Uzbekistan has low productivity. Main part of Uzbekistan's water resources (80-90%) is use for irrigated agriculture's needs. Therefore main problems of rational use of water resources in Uzbekistan are connected with the efficiency of irrigation systems and water use in the fields. Technology of crop irrigation by furrows, prevailing at current, leads to filtering water into groundwater and, as a consequence, waterlogging and salinization. Irrigation of land situated in automorphic conditions ordinarily lead to a flooding of downstream-located land. Irrigated water lost from the canals by filtering is partially used on fields, partially irretrievably lost for evaporation (from bands of exclusion along the canals and fields). In addition, these water losses create an artificial pressure of groundwater what contributes to the development of waterlogging and salinity processes ("pushing" brines from deep aquifers to surface soils); To encourage farmers to water and resource saving, introduction of methods of reducing water consumption in agriculture, including advanced irrigation technologies (drip irrigation, sprinkler irrigation, which has so far not developed widely) is needed(9).

### **2.1.3.Measures taken**

The Government of the Republic pays great attention to the problems of streamlining of water distribution, rehabilitation of irrigation and drainage systems in irrigated lands. There are a number of laws and presidential decrees and orders of Cabinet of Ministers successfully implemented by the MAWR. These are a law "On water and water use", regulation "On limited water use", a number of decisions on restructuring of agricultural sector such as e.g. establishment of farms, organization of water management based on basin principle, establishment of water user associations(9).

A special role is played by the Government in the reclamation work by creating the special Reclamation Fund for an improvement of reclamation condition of irrigated lands through reconstruction and repair of large and small drainage systems. Already this year about 77 million US Dollar were spent on land reclamation of more than 1, 2 thousand hectares of cropland(9).

Uzbekistan tried to do a lot for improvement ameliorative situation on farmers' lands, and accepted laws for efficient water usage.

Uzbekistan has also wide range monitoring of salinity and ground water level system for more effective solution about rehabilitation of collector-drainage systems. In country also has a special fund control money for and organization to clean collector-drainage systems. The Uzbekistan government spend US\$ 70 million for these goals in 2012.(9).

### **2.1.4 International Cooperation**

Partnership for international cooperation allows to bring new ideas and experiences from other countries, to raise qualitatively level of scientific research through exchange. An example of successful project implementation and fruitful cooperation with scientific institutions in



Uzbekistan is a project on “Measures against farmland damage from salinization in Uzbekistan” implemented by the Japan International Research Center for Agricultural Sciences (JIRCAS).

The results of the project implemented in the Syrdarya region aimed at adaptation of farmers to more efficient use of water in their fields by known (simple) methods of land reclamation by high-precision land leveling, small repairs of drainage on the field and others. Due to project activities farmers’ awareness was raised on major resource-saving agricultural technics(9).

But soil protective technologies and methods for soil water-salt regime regulation under conditions of shallow groundwater level, reducing water consumption and harmful effects of salts are expensive and difficult solutions.

Therefore protection measures before salinization must be first priority. After salinization of soil(Picture 6) ,natural measures like growing suitable crops for salined soil rehabilitation is also recommended even if it takes longer time.



Picture 6. Salted agricultural land in Uzbekistan

## **2.2.GREAT EFFORT MADE BY CGIAR PROGRAMME ON DRY LANDS**

The CGIAR Regional Program for Central Asia and the Caucasus has a long history of successful collaboration with national research organizations in Uzbekistan, dating back to 1998. Strong bilateral relations have been built over the years by, among others.

CGIAR Regional Program for Central Asia and the Caucasus (CAC), initiated in 1998, operates as a consortium of the Centers of the Consultative Group for International Agricultural Research (CGIAR), led by the International Center for Agricultural Research in the Dry Areas (ICARDA). For many years the program has been successful in collaborating with local and international research institutions, public organizations, universities, farmers' associations and other groups of partners. (3).



Picture 7. Salted agricultural land in Uzbekistan

### **2.2.1.Seminer to discuss and review the Consortium's joint research activities**

In this programme one of the seminar held at Tashkent State Agrarian University on 17 December 2014 brought together more than 75 people from the Ministry of Agriculture and Water Resources and various national research institutions to discuss and review the Consortium's joint research activities with national partners in Uzbekistan.

During a series of presentations, scientists briefed participants on their work in the country and prospects for collaboration. During Question and Answers session, salinity and land degradation remained a major concern. Some 800,000 ha of the irrigated croplands are

estimated to be subject to serious soil erosion in Uzbekistan. As Dr Nasrullo Bobokulov, director of the Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts, said during the seminar, more effort should be put into tackling salinity and land degradation.(Picture 7).

He also suggested research should focus more extensively on arid and semi-arid areas as they make up a large percentage of the country's territory(3).

It is also important to develop and cultivate plants tolerant of salinity. Prof Igor Belolipov, of Tashkent State Agrarian University, noted that it is necessary to save, breed and cultivate fruit varieties, in particular apple, adapted to salt-affected areas (Picture 8).

Mr Rashid Azimov, of Bioversity International, pointed out that considerable work had been carried out to this effect under the project 'In situ/on-farm conservation and use of agricultural biodiversity (horticultural crops and wild fruit species) in Central Asia'. For example, a salinity-resistant form of apple called 'Khazarasp' is now kept at a demonstration site in Khonka district of Khorezm Region. Mr Azimov added that propagation of different apple varieties is also done on a farm in Bostanliq district, Tashkent Region. In a similar vein, Dr Ram Sharma, of ICARDA, said that a new variety of winter wheat called 'Davlatli' had recently been submitted to the State Variety Testing Commission in Turkmenistan, which boasts resistance to salinity, frost, heat and drought. Dr Sharma suggested that the variety could also be grown in Uzbekistan, in particular in Bukhara and Syrdarya regions where salinity is high. He added that salinity is getting more attention also in view of climate change predictions, and new varieties are being developed with tolerance to this stress(3).



Picture 8. Agricultural land affected by soil salinity



Picture 9. Strongly salted agricultural land



Picture 10. Salted agricultural land

Increasing salted agricultural land (Picture 9, Picture 10) forced to Uzbekistan to take some measures considering different alternatives such as biosaline agriculture.

During last 3 years, some international seminars, conferences, workshops organised by ICBA, ICARDA in Uzbekistan are explained below;

Although these organisations seem to be very valuable to be informed about biosaline agriculture but it doesn't lead to develop actionable knowledge and development of a large scale pilot project in salted soils in Uzbekistan.

### **2.2.2. 'Problems and achievements of biosaline agriculture in Uzbekistan'**

Some 60 participants including Members of Parliament of Uzbekistan (Oliy Majlis), scientists, journalists, and representatives of environmental and health NGOs, and international organizations gathered in Tashkent, Uzbekistan, on 24 June 2013 at the seminar under the title 'Problems and achievements of biosaline agriculture in Uzbekistan', organized by the Ecological Movement of Uzbekistan, the International Center for Biosaline Agriculture (ICBA) and the International Center for Agricultural Research in the Dry Areas (ICARDA).

### **2.2.3. International Conference on Eurasian Food Security and Nutrition Network and Eurasian Soil Partnership**

Held on 29 February to 2 March 2016 in Bishkek, Kyrgyzstan, the *International Conference on Eurasian Food Security and Nutrition Network and Eurasian Soil Partnership* brought together stakeholders from all 8 countries of the CAC region, as well as other parts of the world. During the conference Dr. Kamel Shideed, Assistant Director General for International Cooperation and Communications of ICARDA, led a plenary session on the "Role of international organizations in promoting agricultural research, food and nutrition security in the Central Asia and the Caucasus"(4).

Making a presentation on "ICARDA in Central Asia and the Caucasus: History of Collaboration and Achievements", Dr. Shideed emphasized the high importance of fostering current and future cooperation towards sustainable agricultural research in the region.

Complementing achievements and newly launched projects, International Water Management Institute (IWMI) in partnership with GIZ and Council for Research and Economics in Agriculture (CREA) will be implementing European Union Programme "*Sustainable management of water resources in rural areas in Uzbekistan*" for the period 2016-2020. In the context of changing climate, the project aims at improvement of water supply and efficiency of water management at national, basin and farm levels(4).

Another project - "*Use of Non-Conventional Agricultural Water Resources to Strengthen Water and Food Security in the Transboundary Watersheds of the Amu Darya River Basin*" - launched by International Centre for Biosaline Agriculture (ICBA), applies an integrated approach to transboundary watershed management in the environmentally vulnerable sub-basins of the Amu Darya River basin to address water resources availability, water quality deterioration, land degradation and ecosystem loss. Project activities will be implemented in Uzbekistan and Tajikistan. In February, the project was presented at the National Academy of Sciences workshop in Washington DC, USA(4).

## Workshop on “Innovations for Improving Drylands in Central Asia”



Picture 11.A workshop on “Innovations for Improving Drylands in Central Asia” organized by ICARDA held on December 14-15, 2016 in Tashkent, Uzbekistan.

The workshop was organized under the Collaborative Research and Capacity Building Program for the Development of Sustainable and Resilient Agricultural Production Systems and the Conditions of Changing Climate in Central Asia (CRP-DS) headed by the CGIAR Regional Program for Sustainable Agricultural Development in Central Asia and Caucasus led by ICARDA (Picture 11)(5).

The event brought together representatives of Ministry of Agriculture and Water Resources in Uzbekistan (MAWR) and National Agricultural Research Systems (NARS) from five countries of Central Asia, donor organizations, members of the international agricultural research centers and others involved in current projects related to agricultural development in the region(5).

This workshop has been supported by the Eurasian Center for Food Security under funding by the Russian Federation. The main agenda of the event was to present technologies and approaches developed for improving drylands over the past four years in Central Asia, share the knowledge on dryland systems developed collaboratively by International and National Agriculture Research Centers in partnership with NARS, funded by other donors, find out ways to move innovations to the field for end-users, determine further needs to address the present and emerging environmental challenges to food security and identify funding opportunities for further work(5).

## SECTION III

### A NEW DEVELOPMENT STRATEGY PROPOSAL

#### 3.1.BIOSALINE AGRICULTURE BASED INDUSTRIAL LIVESTOCK PRODUCTION

##### Non-conventional salt-tolerant crops to tackle salinity problem in Uzbekistan

##### Biosaline agriculture

Biosaline agriculture is a relatively new way of dealing with salinity in agriculture. It develops cropping systems for saline environments, using the capacity of certain plants to grow under saline conditions in combination with the use of saline soil- and water-resources and improved soil and water management.

Biosaline technology is based on two major components: the knowledge of salt tolerant plants and halophytes in various saline environments and how to improve their productivity via plant breeding and agronomics. The knowledge of salinity management in various saline environments including infrastructure for irrigation and drainage adapted to the needs of specific salt tolerant and halophytic crops.

In order to achieve a salined soil management is a hard task as shown in Figure 17.

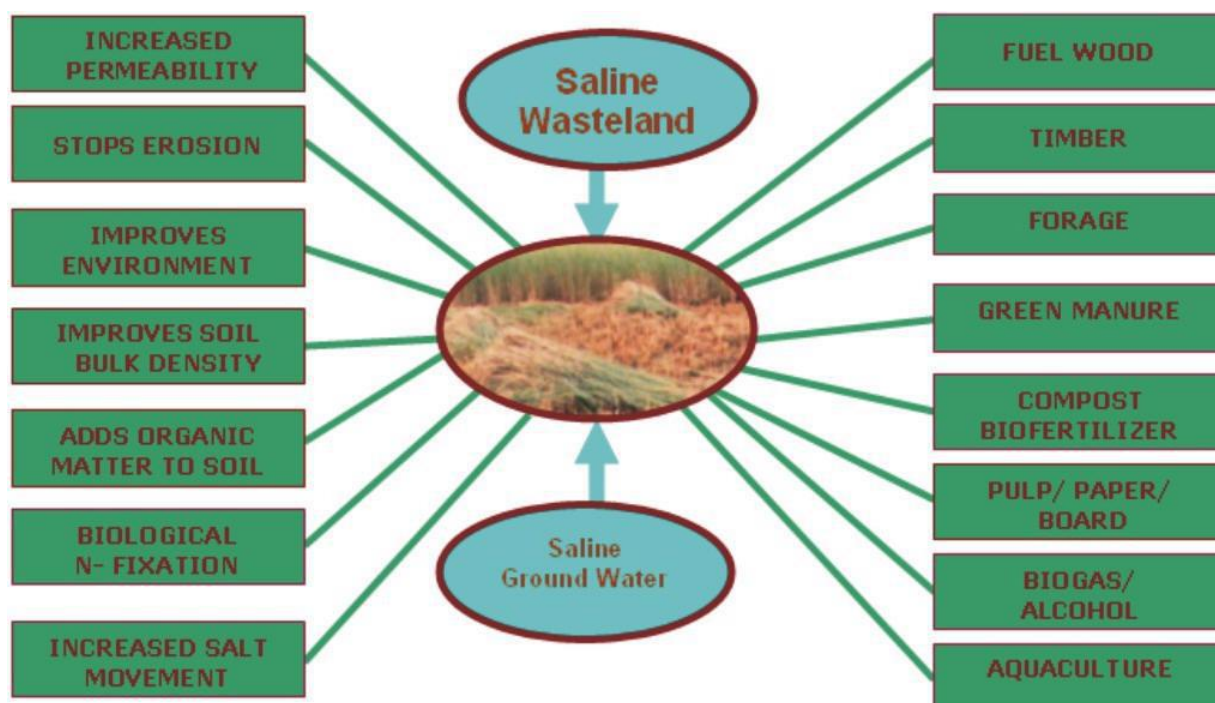
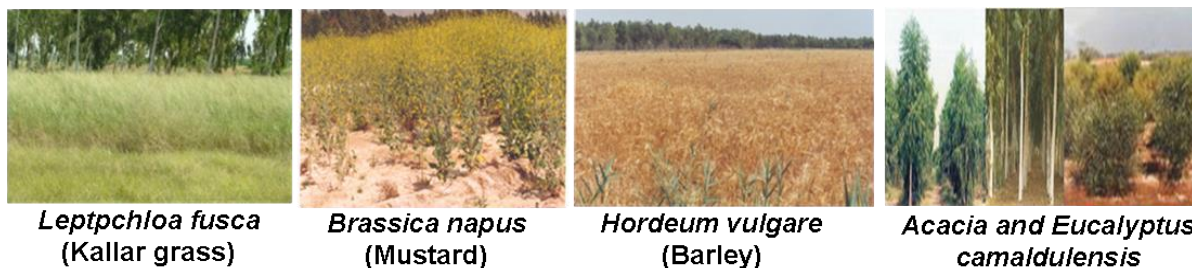


Figure. 17. Salined Soil Management

To demonstrate the feasibility of Biosaline Agriculture Technology in areas facing salinity problem, the first Biosaline Research Station (BSRS-I) of NIAB was established on 150 acres of highly salt-affected land at Rakh Dera Chal near Lahore and field scale activities were continued for about 25 years on different aspects of productive use of saline land and brackish groundwater

### Salt Tolerant Plants



Picture 12. Some salt tolerant plants

Series of field experiments on wheat have been conducted at BSRS, Pakka Anna using salt tolerant Plant (Picture 12)Growth Promoting Rhizobacteria (PGPR). These microorganisms improve plant growth employing a variety of growth promoting mechanisms including nutrient up-take, root growth, proliferation and biocontrol activities.

Salinity significantly reduced wheat yield up to 60% in both pot and field experiments. However, salt tolerant PGPR strain (SAL-15) inoculation enhanced 37% yield by alleviating the toxic effects

### 3.1.1.Agriculture in Saline and Marginal Environments

International Center for Biosaline Agriculture (ICBA)

International Center for Biosaline Agriculture – ICBA is an international, non-profit organization that aims to strengthen agricultural productivity in marginal and saline environments through identifying, testing and facilitating access to sustainable solutions for food, nutrition and income security.

ICBA’s work reaches many countries around the world, including the Gulf Cooperation Council countries, the Middle East and North Africa, Central Asia and the Caucasus, South and South East Asia, and Sub- Saharan Africa.ICBA’s research center is located in Qatar (Picture 13)





Picture 13. ICBA Research Center – Qatar.

Saline and marginal environments, characterized by lack of water and high levels of soil and water salinity, are not suited to traditional agriculture. Yet some 1.4 billion people make a living from farming in these environments. Most are subsistence farmers who face the constant risk of losing much or all of their harvests to salinity and drought. As a result, poverty and malnutrition are endemic (12)

In 2015, the IDB-funded project on Integrated Crop and Seed Production Systems in Sub-Saharan Africa (SSA) came to a successful conclusion as it demonstrated to farmers in Burkina Faso, Senegal, Nigeria, Mauritania, and Mali how to increase overall farm productivity through irrigation technologies and management practices(12) (Picture 14).

Researchers continued studies into soil improvement in marginal sandy lands. As part of a joint project with Tadweer, a waste treatment plant in the UAE, the researchers studied how organic (compost) and inorganic (Zeolite) amendments help to enhance water and nutrient retention capacity of sandy soils. They carried out a series of experiments to test how compost and Zeolite increased growth of barley under greenhouse conditions where the yields doubled and water use decreased when compost was used at the rate of 30 tonnes per ha (12).



Picture 14. Effective irrigation system boosts crop yields in Senegal.

In a separate series of experiments, scientists investigated how the use of microorganisms can boost the effect of organic amendments like compost in UAE soil conditions. Complementing organic amendments with effective microorganisms has been found to improve considerably soil quality, leading to increased organic matter and microbial activity. The research team found that using the Bontera™ microbial soil enhancer to grow quinoa in greenhouse and field conditions helped to increase yields by as much as 30 percent and make a saving of 25 percent on chemical fertilizers.

Research on using biochar from date palm waste as a soil amendment showed that it has a positive impact on soil health by increasing soil carbon, nutrient and water-holding capacity. Their research also showed that scaling up the application of biochar using date palm waste has high potential for increasing crop production in marginal environments, and reducing the date palm waste which can help protect the environment (12).

### **Key achievements of the Integrated Crop and Seed Production Systems in Sub-Saharan Africa Project (12):**

- A comprehensive database was developed on water resources, irrigation technologies, crops and baseline socio-economic conditions of the farming communities for each country.
- Different irrigation technologies for water distribution (i.e. canals and pipes), and irrigation methods (i.e. furrow, basin, drip and sprinkler, Californian system) were demonstrated and tested for their efficacy under local conditions. The Californian system proved most successful.
- Demonstration fields were planted with Irish potatoes in Mali, Nigeria and Gambia instead of traditional onion and tomato.
- Two seed production units were established: one onion seed production unit in Nigeria and a potato seed production unit in Gambia.

- 240 farmers, extension workers and local irrigation technicians attended technical training sessions, and more than 800 participated in field days.



Picture 15. Several year of collaborative research has resulted in the release of the new high-yielding sorghum variety “Keshen” at the National Center for Biotechnology of **Kazakistan**.

### 3.1.2. Resilient salt-tolerant crops for climate-smart agriculture

Dispersed throughout marginal lands across the globe is a range of native and underutilized species of plants that tolerate and even thrive in saline environments (Picture 15). The thrust of ICBA’s applied research programs is focused on identifying, assessing, screening and introducing new genotypes of nutritious, stresstolerant and water-use efficient crop species that can help sustain agricultural productivity in salt-affected areas(13).



Picture 16. Some salt tolerant plants

ICBA's program in Central Asia saw the release of new promising local varieties of pearl millet "Tamuz" and of sorghum "Keshen". This is in addition to the pearl millet variety "Hashaki 1" released in 2013.

These new varieties are resistant to both biotic and abiotic stresses and were developed from the ICBA-ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) breeding material. Efforts were also concentrated on multiplying seeds of the selected genotypes of the crops suitable for the marginal environments of the Aral and Caspian Sea Basin. By the end of 2014, three farmer/community-based seed multiplication units on salt-tolerant cereals, legumes and forage perennial plants were set up(13). (Picture 16).

### 3.1.3. Researchs in Central Asia

Researchers began collaborative work to develop a manual on seed morphology and biology of seed germination of halophytes in Central Asia. Within the UAE, ICBA scientists tested new plant species to evaluate their performance and yield under various salinity levels. These species included amaranth, oat, sesbania, mustard and citrullus.

Amaranth, a highly nutritive leafy vegetable, proved to be a promising crop. Oat and sesbania demonstrated moderate tolerance to salinity(13).

Trials on mustard helped to identify three accessions of mustard with high tolerance to salinity.

During the past year, 84 new accessions of germplasm were acquired by ICBA's genetic resources team. Furthermore, seeds of 150 salt-tolerant germplasm accessions of barley, triticale, sorghum, pearl millet, cowpea and quinoa were multiplied and disseminated to research partners in 12 countries(13).



Picture 17. Marginal lands affected by salinity can be put to use if non-conventional salt-tolerant crops are introduced into agricultural production, scientists believe. Photo by Kristina Toderich.

- Irrigated lands of the Republic of Uzbekistan, for the most part, are prone to salinization
- This is interlinked to the aridity of climate, geological and hydrogeological conditions of the irrigated territories.
- According to the land reclamation monitoring service of the MAWR, soil salined from slightly to totally represent more than 50% of the total irrigated land.
- Salinity is one of the factors, which reduced significantly soil fertility and productivity of irrigated lands.
- About half (about 2.1 million ha) of the irrigated area in Uzbekistan is affected by secondary salinization:
- According to statistics over the past 25 years, the area of irrigated land per capita decreased from 0,22 to 0,12 ha.(9).
- Transboundary water issues, drought, climate change extension of rapid soil salinization in the agricultural lands threaten food security and economy of the Uzbekistan
- This is an alarming fact for future of the country that requires innovative and actionable approach and a new development strategy to be implemented in soon.
- Sustainable management of salt-affected and marginal lands in Uzbekistan for agricultural purposes can help to find new avenues of agricultural production
- Uzbekistan urgently needs to grow non-conventional salt-tolerant crops starting from the most suitable salined land to tackle salinity problems and feed livestock production and industry.
- Irrigated salined lands should be used for biosaline agriculture to grow up animal feeds to support livestock production and integrated food production industry.
- Uzbekistan is in the progress of developing its livestock industry as well as modern integrated plants in this sector.
- Taking into account of the threats, an urgent priority should be given to agriculture oriented industry on the basis of an innovative biosaline agriculture policy.

### **3.2.CURRENT LIVESTOCK INDUSTRY IN UZBEKISTAN**

Protein-rich foodstuffs, including dairy and meat products, are important in ensuring food availability. Livestock production is one of the leading agricultural sectors of Uzbekistan.

According to the Food Industry Association, there are 1,312 meat and milk processing enterprises in Uzbekistan. 48 of them are members of the Association. Almost all companies are operated by imported equipment, which has enabled them to run technological cycles in accordance with international requirements ranging from procurement of raw materials to packaging finished products. Expansion of the product range has become an important trend(11).

Land quotation system for cotton and wheat production and setting of the mandatory state production quotas for these crops, restrict easy land reallocation in favour of other crops, including feed crops. Even livestock breeding farms have to sow most of their irrigated arable land with cotton and winter wheat (Figure 3.5) that contradicts the national legislation stipulating targeted land use in livestock breeding farms. Thus, only one third of the available arable land is used for feed production<sup>5</sup>

The Uzbekistan chose a policy of increasing the capacity of the meat and dairy industry in terms of integrated processing of raw materials and manufacture of the whole range of products, including the production of semi-finished foods and products with high degree of processing. The strategy was supported by the resolution of the state's leader of January 26, 2009 'On additional measures to expand the food production and enrich the domestic market. Since then, the industrial processing and production of finished meat and dairy products has been carried out exclusively by legal entities(11).

The sustainable growth of production and consumption of meat and milk is conditioned both by an increase in population income and supply, also owing to the state support of the livestock sector. The idea of government resolutions of 2006 and 2008 in the field of animal husbandry is reduction of price for meat and milk requires an increase of the supply. With this purpose, the villagers engaged in cattle breeding at personal subsidiaries and farms, were legally provided with the right of receiving pensions upon reaching the retirement age. Low-income families have been supported through allocation of free cows by sponsors and entrepreneurs.

According to official data, animal husbandry in Uzbekistan has been growing by the average of 5-7% year, and, as reported by the State Statistics Committee, the cattle stock has reached 10.99 million heads. The production of livestock foods in 2014 totaled to 15.1 trillion soums, all categories of farms produced 1.9 million tons of live weight meat. Milk production exceeded 8.4 million tons. The major cattle stock, as the statistical analysis shows, is concentrated in farms - 93.9%. According to the Mahalla Republican Foundation, more than four million families have private economies on 495,000 hectares of land, keeping about 8 million head of cattle, including over 4 million of dairy cows(11).

Realizing importance of ensuring sustainable livestock production development and urgency of the existing problems, the Government of Uzbekistan is undertaking a series of measures on reforming the sector.

### **3.2.1. Lack of pastures.**

The situation with pastures is rather complex. Around 92% of all pastures in the country were under the management of the MAWR in 1991. Gradually, their area shrank by 40% due to intensive and unlimited grazing, abolishment of pasture rotation and lack of their reclamaion practices. Some part of the degraded pastures was transferred to the State Land Reserve, and some part to the Forest Fund(8).

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<sup>5</sup> 36.6% of arable land is sown with feed crops; herewith 16% of the arable area is not used.

Nowadays, there are almost 13 million ha of pastures available for the national livestock breeding. Most of them are located in the Republic of Karakalpakstan, Bukhara and Navoi regions, where the most remote grazing livestock breeding is practiced (sheep breeding)(8).

It should also be accounted that haylage provision (natural grass) for cattle is accompanied with some difficulties. As a rule, the farms specialized in cattle breeding, are located in plain irrigated areas, while haylage collection is to be done in the steppe and foothill regions that supposes travelling, feed collection and its transportation to considerable distances that calls off labour resources; requires transportation; and makes feeds more expensive. Besides, haylage provision made by special feed collecting teams in the steppe and foothill regions is not systematically arranged and does not ensure needed volumes(8).

Table 7. Grazing land shortage (% to cattle breeding farms) (8).

Type of farming	Proportion of households experiencing lack of pastures	Causes of pasture shortage		
		no areas for pastures	pastures are overgrazed	pastures are water logged/saline
Dehkan	84.9	20.9	71.7	8.5
Private	61	14.7	54	4.6

*Source: Results of survey conducted by the TAHLIL Centre for Social Research, September, 2007*

All regions, which have been surveyed in 2007, feel acute shortage of pastures. This was mentioned by 85% of the respondent dehkans- and by 62% of the respondent farmers (Table 7). The existing pastures are overgrazed, on farmer land plots as well. More than a half of cattle breeding farmers stressed lack of community pastures for grazing. Lack of own feed resources makes cattle breeders buy feeds elsewhere(8).

### 3.2.2..Livestock Productivity

Starting since 1991, cattle herd number has increased by almost 1.5 times that subsequently resulted in meat and milk production growth and augmentation of livestock product share in the gross agricultural product of Uzbekistan(8).

Still, the livestock productivity is at a rather low level in the country as compared not only to the most advanced meat and milk producing countries, but also to the most number of the FSU states(8). Further, it is important to emphasize the most important issues faced by the livestock sector's development of Uzbekistan(8).

Insufficient quality of feed resources is the main reason of low animal productivity. In addition to that this issue cannot be addressed unless the areas under feed crops are expanded and hence the existing practice of land distribution and land use is changed(8).

The Government should pay special attention to the issues of feed market, establishment of the free market for agricultural raw materials and to encourage research and development in the area of high productive feed plant breeding.

Finally, it is important to consider the issue of providing incentives for establishment of specialized firms to deal with feed production in salined soils for livestock sector.

It is not feasible to produce all kinds of feeds for farmers without subsidation. It is more expedient to delegate this to the specialized farms located in salined irrigation areas using biosaline agricultural technics.

### 3.3. DEVELOPMENT STRATEGY IMPROVING BY SALINED LANDS

Salinity and land degradation remain a major concern in Uzbekistan. This problem is especially acute in the Aral Sea Basin. For example, the livelihoods of these households in the 40 let Karakalpakstan settlement are being seriously affected by salinity and land degradation.

We aim to introduce alternative crops and cropping systems suitable for large amount of salined land to develop intensive animal farming and industrial livestock production

#### 3.3.1. Land Distribution Dynamics In Uzbekistan

Agriculture employs three main production factors: natural resources (land, water for irrigation), capital (fixed assets) and labour (employees of agricultural enterprises). Undoubtedly, land is the most critical resource in Uzbekistan

According to the *Goscomcadastre* data, agricultural producers use more than 17 million ha of agricultural land (8). Overall, the land is distributed between pastures and arable lands (Figure 18).

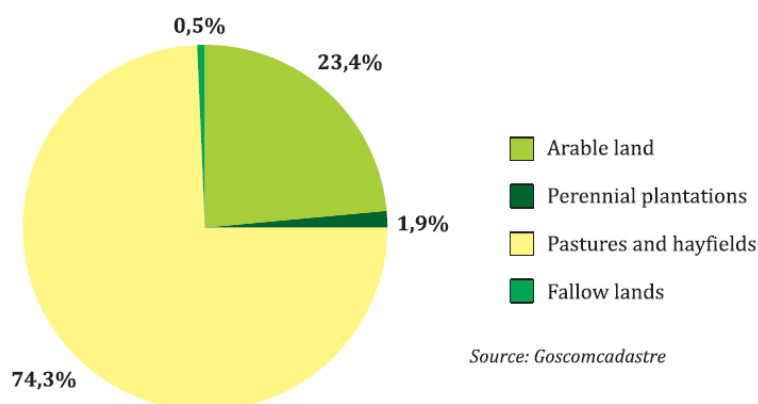


Figure 18. Agricultural land distribution in 2006, % (8).



### 3.3.2. Decreasing Agricultural Land and Pasture Land

Figure 19 shows land use changes in selected rural areas since 1991. Particularly, the agricultural area has decreased by 33%. This was caused mainly by decrease in pastures (approximately by 40%) as a result of low land productivity and transfer of low-productive and degraded pastures to the State Reserve and Forest Fund (8).

Declining pasture quality was caused by increase in cattle herd number, primarily private one, and unsystematic pasture use and overgrazing, as well as inobservance of pasture rotation. The ratio of arable lands has changed over the period insignificantly (8).

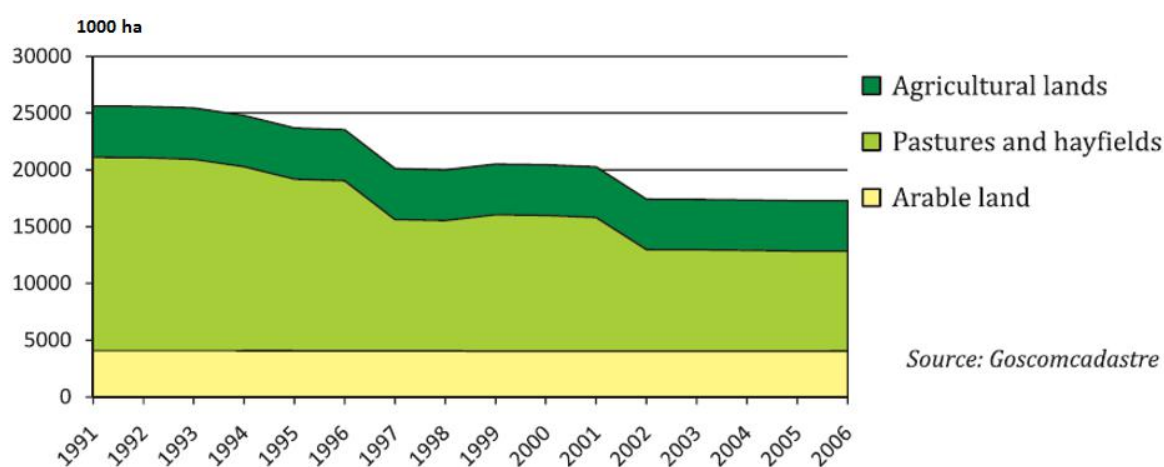


Figure 19. Dynamics of agricultural land distribution in Uzbekistan (8).

### 3.4. SALINE LAND and LIVESTOCK INDUSTRY INTERRELATION FOR DEVELOPMENT

Taking into account of vast amount of naturally saline land not to be used for agriculture in Uzbekistan, it is worth while to develop these saline lands for alternative livestock farming. The livestock industry played an important role in Uzbekistan economic development.

#### 3.4.1. A new policy proposal to “Newly established Development Strategy Center”

Several public and state organizations have initiated the establishment of the “Development strategy” center, intended to coordinate the implementation of the Strategy on five priority directions of development of the Republic of Uzbekistan in 2017-2021, as well as the State

program “Year of dialogue with people and human interests”. The establishment of the Centre was approved by the presidential decree.

The Centre aims to consolidate efforts for effective organization of expert and public discussions, in-depth study and implementation of measures stipulated by the Strategy, as well as the active involvement of representatives of civil society institutions, experts and scientists in the processes of democratization and modernization of the country.

Its tasks include information and analytical support activities under the Strategy, studying the best foreign experience, etc.

The center will also put forward sound proposals for effective implementation of the Action Strategy, including the preparation of drafts and other acts, stipulated by the State program and establish cooperation with international organizations, scientific-research, informational-analytical and educational institutions.










The funding sources of the Center are funds of technical support, grants from international and domestic organizations, NGOs, funds of ministries and agencies to conduct studies and analyses, and others.

It is worthwhile to mention that

**Considering the current agricultural situation and climate change impacts, rapid economic development by improving biosaline agriculture interrelated with intensive animal farming and industrial livestock production seems to be an applicable development strategy.**

### 3.4.2.Salt Tolerant Plants

Table 8. Salt Tolerant Grains Potential for Animal Feed

Types of Plant Picture	Plants	Gross Energy MJ <sup>1</sup> /Kg	Metabolizable energy MJ <sup>1</sup> /Kg	Digestibility (%)
	Dry rolled Barley	21,59	9,91	85,2
	Sesbania aculeata	22,34	7,96	70
	Kallar grass	20,24	6,75	33,05
	Kochia indica	17,61	6,41	40,45
	Suaeda fruticosa	13,93	4,70	58,47
	Acacia ampliceps	18,04	7,26	71,35
	Eucalyptus camaldulensis	23,32	5,85	36,90
	A. nilotica	25,76	7,09	36,90
	Leucaena leucocephala	22,66	8,71	59,65

<sup>1</sup> Specific Energy

Table 9. Energy and Protein content of various feed grains (14).

	Barley*	Corn*	Wheat*	Oats*	Sorghum*	Field Peas**
<b>Dry-matter basis</b>						
<b>Energy</b>						
TDN, %	88	90	88	77	82	87
NE <sub>m</sub> (Mcal/kg)	2.06	2.24	2.18	1.85	2	2.25
NE <sub>g</sub> (Mcal/kg)	1.4	1.55	1.5	1.22	1.35	1.48
<b>Protein</b>						
Crude protein (%)	13.2	9.8	14.2	13.6	12.6	25.2
Undegradable protein (% of CP)	27	55	23	17	57	30
<b>Fiber</b>						
Neutral detergent fiber (%)	18.1	10.8	11.8	29.3	16.1	11.4
Acid detergent fiber (%)	5.8	3.3	4.2	14	6.4	6.7

\* NRC, 1996

\*\* Lardy et al., 2009

TDN = Total digestible nutrients

NE<sub>m</sub> = Net energy for maintenance

NE<sub>g</sub> = Net energy for gain

Some salt tolerant plants types and their gross energy, metabolizable energy and digestibility is given in Table 8 and Table 9. In these tables Barley seems to be most suitable to be growth in salted lands for animal feed.

### 3.4.2.1. Barley one of the most Salt Tolerant Plant

Barley is an ancient crop dating back to 7000 B.C. and is considered one of the most widely adapted grain crops in the world. Barley is the fourth most important cereal grain in the world, with uses by humans and animals for food, feed and beverages (Picture 18). Grown in temperate regions of the world, barley is more tolerant to drought and saline soils than other cereal grains.



Picture 18. Barley for Cattle Feed

### 3.4.2.2.Kallar Grass (*Leptochloa fusca*) is a salt tolerant plant

[Poaceae] is a resilient deep-rooting grass cultivated as a summer fodder crop in Africa, the Middle East, and Southeast Asia. It is generally tolerant up to 10 dS/m and can withstand salinity of 22 dS/m with an associated 50% reduction in yield. Kallar grass, which performs well in sodic and waterlogged soil conditions, has been used in the reclamation of highly degraded lands. With up to five cuttings, it can yield 40 tons/ha of nutritious and palatable fodder per year; it is considered a water hungry grass and plantings are not feasible in dry areas where water is scarce.(Picture 19,Picture 20).



Picture 19.Kallar grass for animals feed



Picture20 Kallar Gras salted lands croop

### 3.5. INTENSIVE ANIMAL FARMING and INDUSTRIAL LIVESTOCK PRODUCTION IN UZBEKISTAN:

Intensive animal farming is also known as factory farming by opponents of the practice, is a modern form of intensive farming that refers to the keeping of livestock, such as cattle, poultry at higher stocking densities than is usually the case with other forms of animal agriculture—a practice typical in industrial farming by agribusinesses.



Picture 21. Proposed modern cattles barns for Uzbekistan



Picture 22. Proposed Modern Cattle Barn Facilities for Uzbekistan in salined lands.

The main products of this industry are meat, milk and eggs for human consumption. There are issues regarding whether factory farming is sustainable.

The conventional chicken and eggs, sausage, and other meat products were imported from other republics. In late 1991 and early 1992, Uzbekistan appeared in the grip of severe shortages. As a result of the new agricultural policy, 400,000 hectares of irrigated lands were transferred to 2.5 million families as homestead lands, the cotton monoculture was limited, areas for grain crops were increased in the first years of independence. Farmers - the new enterprising class of owners – received the opportunity to fully meet the demand for grain, flour, meat, milk, fruits and vegetables, and thus have turned the importer of meat, grain and other products into the exporter. Livestock industry's transition to the private sector has affected the production increased.

### 3.5.1. Modern integrated milk-meat facilities

The competition to produce inexpensive meat, eggs, and dairy products has led animal agribusiness to treat animals as objects and commodities. The worldwide trend is to replace small family farms with “factory farms”—large warehouses where animals are confined in crowded cages or restrictive pens.

Proposed Modern Cattle Barn Facilities for Uzbekistan in salined lands and Entegrated Modern Meat and Milk Facilities are given in Picture 22, Picture 23,Picture 24.



Picture 23. Proposed Meat Facilities for Uzbekistan .

The existence of the strong support industries is an important determining factor to develop policies to modern integrated milk meat industry. Therefore when we study on the proposed

strategic policy we consider the supporting industry as biosaline agricultural oriented sector interrelated intensive animal farming and industrial livestock production.

The establishment of a modern food industry will depend on the existence of suppliers of agricultural raw material (milk ,meat,spicies). They also require intensive animal farming located at large irrigated salined lands to produce animal feed .

In order to do that all low soil fertility salined areas should be replaced to pastures which large area of land where animals feed on the grass, to be growth biosaline based animal feed . This policy will also accelerate the other sectors like adequate filling ,packacing equipment,and a modern retail system;car and veichle manufactures to thrive.

Sustainable industrial competitivenes and medium-term economic growth can therefore be acheived only through such an integrated approach starting reuse of large salined uneconomical agricultural lands to grow animal feed in Uzbekistan.

During recent years, the Government of Uzbekistan has been paying substantial attention to the livestock sector's development, and to cattle breeding, in particular.

We consider that the Uzbekistan Government is ready to search for appropriate solutions to address the existing issues, which is confirmed by the implementation of planned activities to strengthen environment for the sector's development.

The proposed strategy is directly related with the high production of animal feed crop and industrial livestock production.

High level state support should be provided to procurement of pedigree livestock and allocation of large amount of salined lands for feed crop production; increasing motivations for rural residents to breed livestock as well as private sector to establish intensive animal farms and modern food industry.





Picture 24 Proposed Entegrated Modern Meat and Milk Facilities for Uzbekistan’s salined lands

### 3.6. A 100 000 ha SIZED PILOT SALTED LAND FARM PROJECT

In this report a 100 000 ha large livestock farming area in salted land in Uzbekistan is proposed .As a hypothetical approach it is indicated in Figure 20. This pilot project area is recommended to be an irrigated and salinized agricultural land in Uzbekistan.

In this farm an integrated approach will be implemented. On one hand a salt tolerant plants for animal feed will be growth with modern irrigation systems(Picture 18) ,on the other hand the farm involves raising the animals, which include cattle, swine, sheep, horses, and to a lesser extent, goats and mules,

The Pilot Project Farm also involves the processing of the animal products for consumers. The slaughtering, butchering, and packing aspects of the livestock industry developed along the same lines.

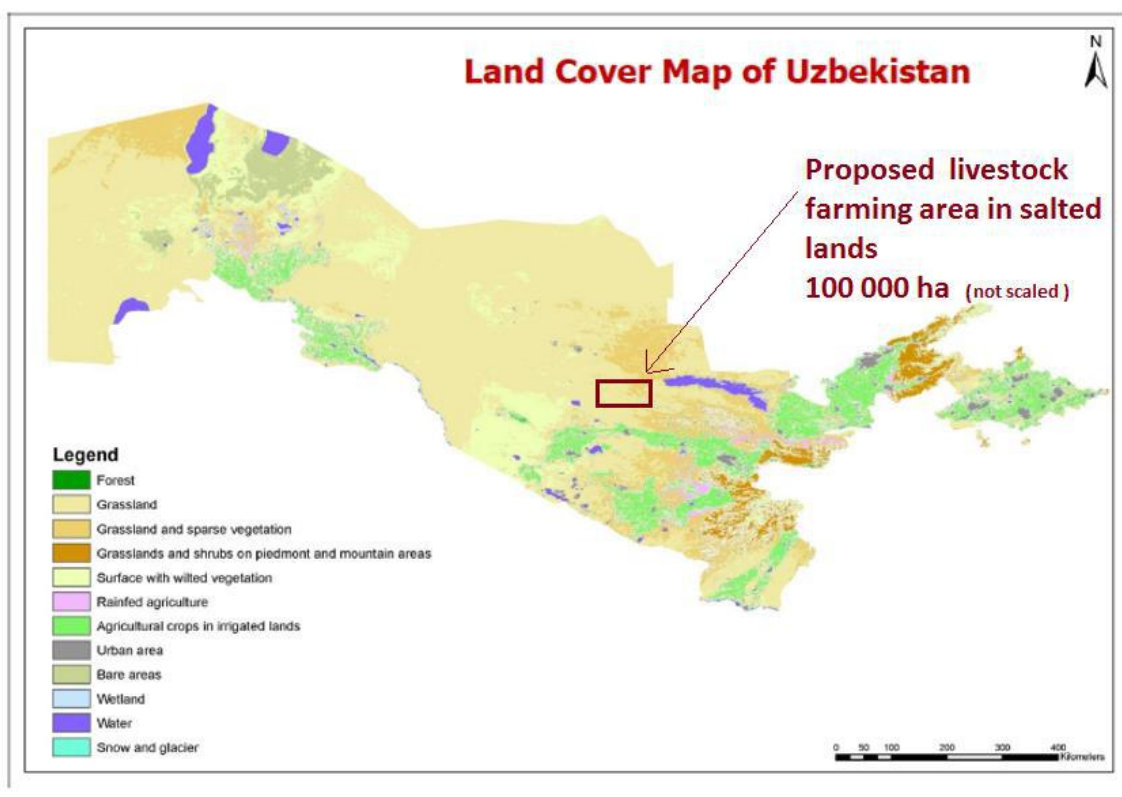


Figure 20. Proposed livestock farming area in salted land in Uzbekistan (16).



Picture 18. Springler irrigation and drainage for salted lands .

### 3.6 PROPOSED STRATEGY IMPACT IN GENERAL

Intensive animal farming and industrial livestock production based on the biosaline agriculture in Uzbekistan, will be an innovative development strategy that brings several benefits as follows;

**The proposed strategy impacts can be classified as follows;**

- This strategy will benefit to gain salined soils for agricultural production again.
- This strategy will benefit to increase the yield, grow self sufficient food in Uzbekistan,
- This strategy will benefit to develop the industrial livestock production sector in Uzbekistan.
- This strategy will benefit to develop new agribusiness sectors
- This strategy, as human workforce oriented will benefit to increase employment volume and rate
- Biosaline Agricultural production based Intensive animal farming will benefit to produce large amount of natural animal graft to be used for salined soil rehabilitation process
- This strategy will be an important step further and an essential driving force to development of the Uzbekistan Economy

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