FUNDAMENTAL PROBLEMS OF NITROGEN CYCLE MANAGEMENT IN MODERN AGRICULTURE

Nitrogen management in agriculture of Uzbekistan: status and prospects

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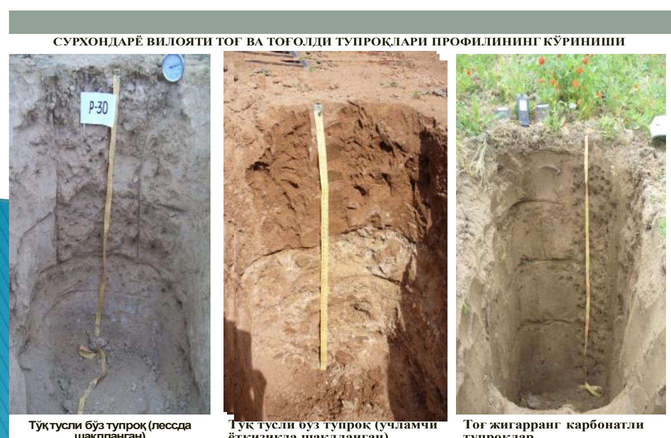
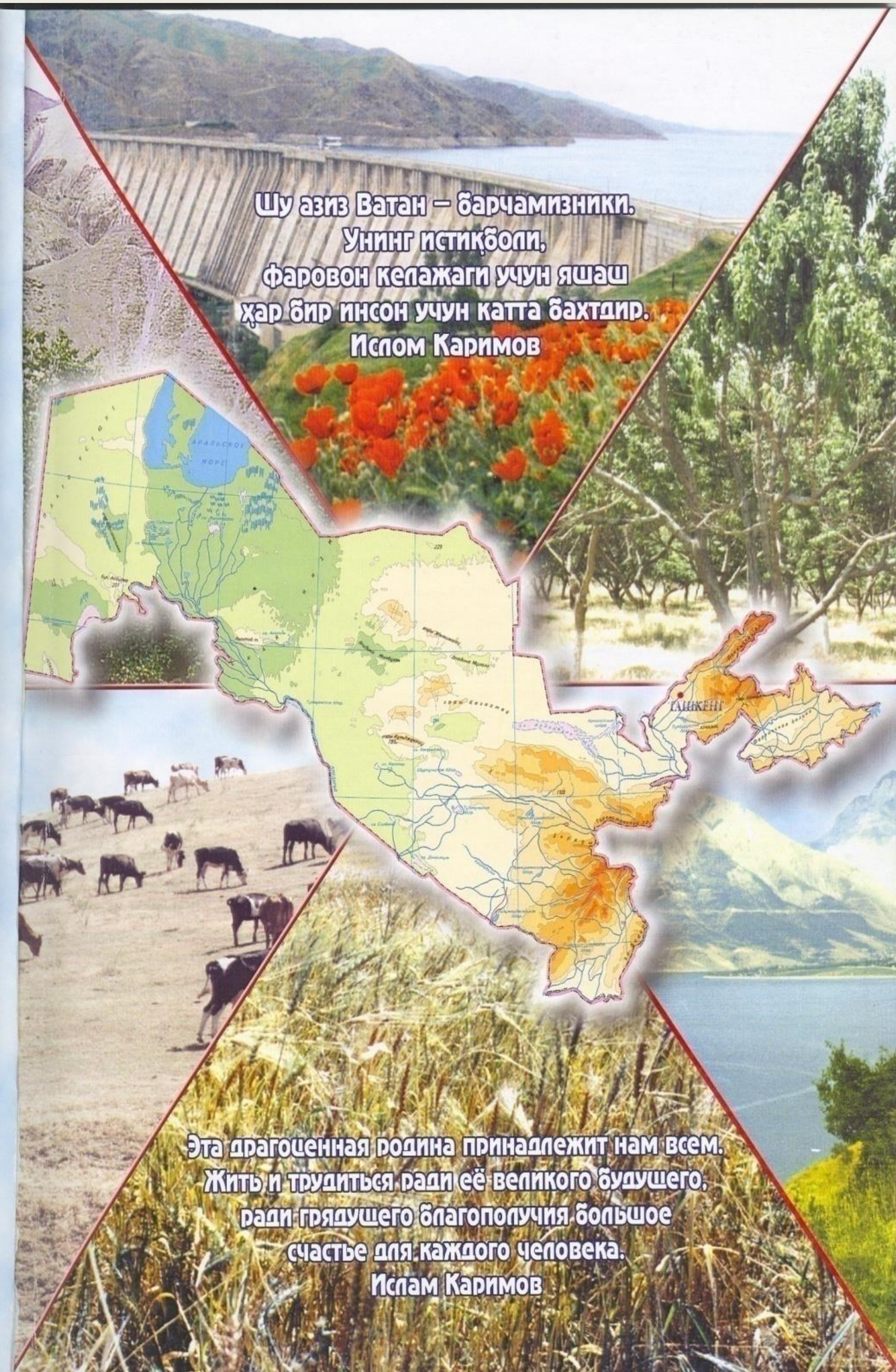


Brussels, October 2-4, 2019.

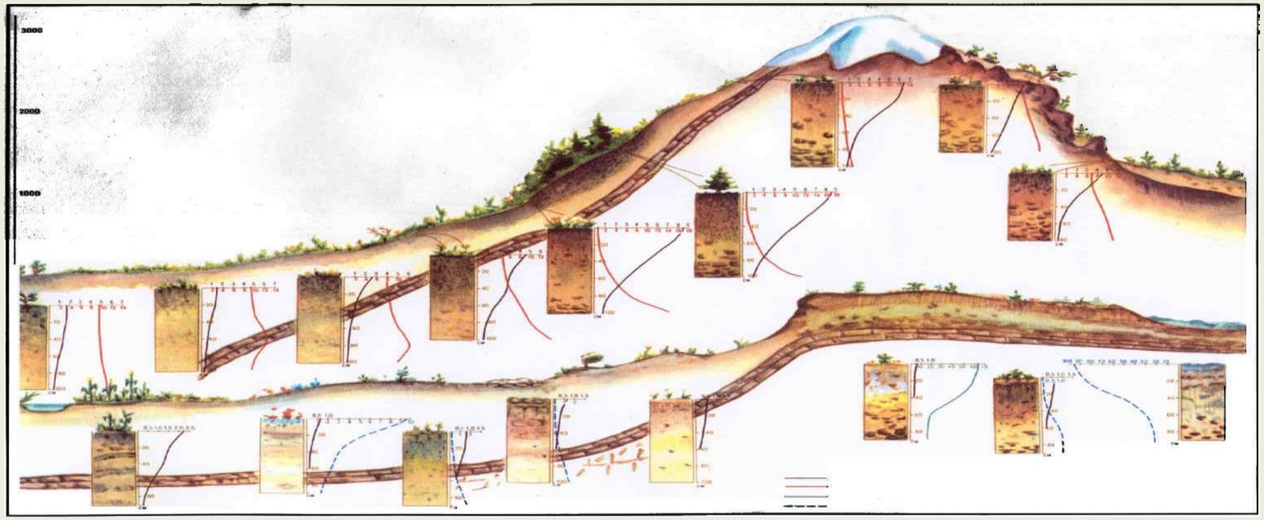


Planned measures are being taken to protect the environment, rational use of natural lands, and conservation of biodiversity in Uzbekistan. These activities reflect the desire to harmonize human activities with the laws of nature.

Such important activities include the rational use and protection of land, combating desertification and drought, protection from water and air pollution, the rational use and reproduction of natural resources.

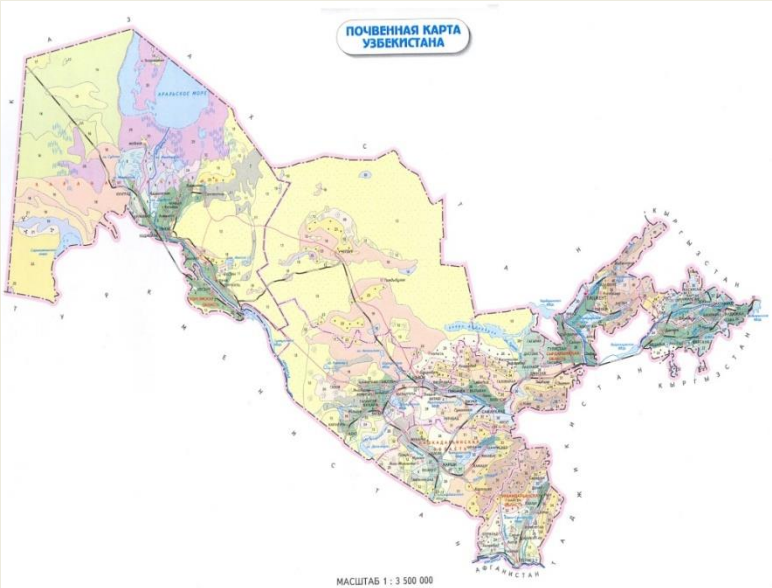
Uzbekistan is one of the large states of the Central Asian region, with more than 33 million people, with extensive experience in irrigated agriculture, combined with developing industry. According to the scheme of provincial division, Uzbekistan is included in the Central Asian soil-climatic province, characterized by a climate of continental (dry) subtropics and specific soils that are different from soils of the more northern regions of Eurasia. In the system of latitudinal soil and climatic zones, the flat part of Uzbekistan belongs to the southern zone - the desert zone with gray-brown, desert sand and takyr soils.

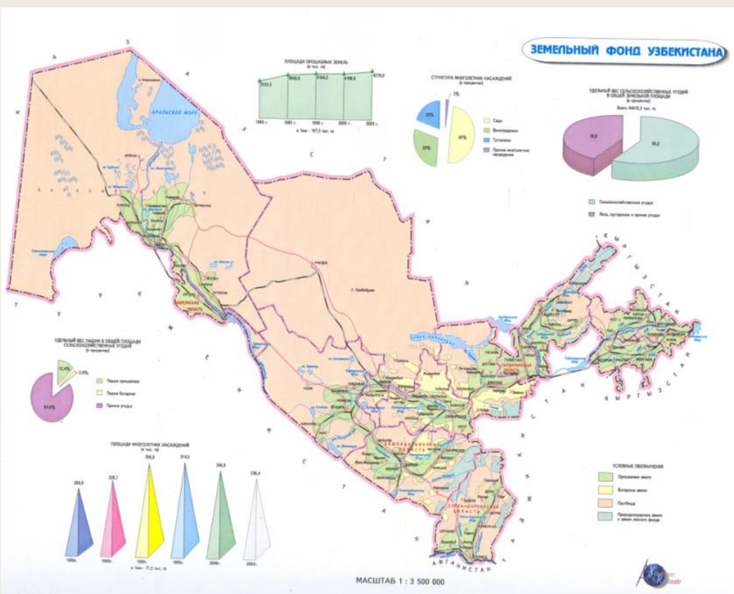
In the system of vertical zones (altitudinal zones) in the eastern part of the republic, serozem of foothills and low mountains, brown and brown mountain-forest soils of the mid-altitude mountain zone, and light brown meadow-steppe soils of high mountains are distinguished. Soils of high-altitude zones in the foothill zone occupy about 43% and soils of the flat desert zone about 57% of the area.



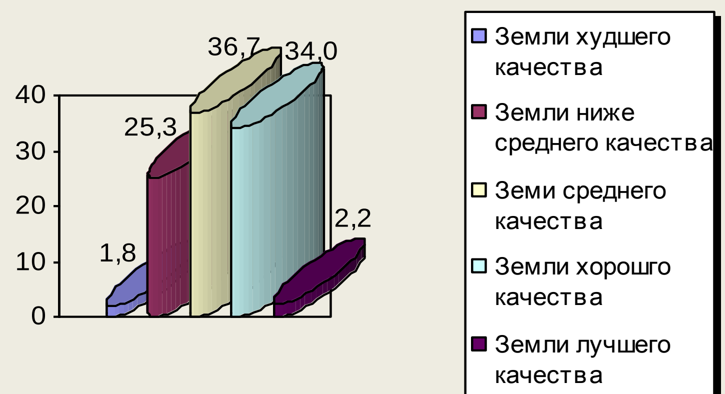
Types and subtypes of soil of the Republic of Uzbekistan

Soils	Area in thousand hectares	% to total
High altitude belts		
1. Light brown meadow-steppe highlands	540	1,2
2. Brown and brown mountain forest middlelands	1660	3,7
3. Dark serozem	1050	2,4
4. Typical serozems	3050	6,8
5. Light gray earths	2590	5,8
6. Meadow gray earth and gray earth meadow	780	1,8
7. Meadow gray earth belt	670	1,5
8. Wetland meadow gray earth belt	70	0,2
Total:	**10410**	**23,4**
Desert zone		
9. Gray-brown	11025	24,8
10 desert sand	1370	3,1
11. Takyr soils and takyrs	1780	4,0
12. Meadow-takyr and takyr-meadow	460	1,0
13. Meadow desert zone	1790	4,1
14.Wetland meadow desert zone	50	0,1
15.Salonchaks	1270	2,9
16.Sands	12100	27,2
Other lands (rocks, talus, chinks. Water surface.)	4155	9,4
Total:	**34000**	**76,6**
Total land.	**44410**	**100,0**





- Soil degradation is also associated with a violation of land reclamation measures associated with cotton monoculture, the use of high doses of mineral fertilizers and pesticides, the extreme inadequate use of organic fertilizers and the cultivation of perennial grasses and side crops.
- In the absence of organic matter, lack of moisture, irregular passage of tillage equipment, imperfect agricultural practices led to soil degumification, soil destruction, soil overbinding, in places the formation of a powerful plow sole and soil crust, a sharp deterioration in the agrophysical properties and biological activity of soils, in general desertification the soil.



Factors adversely affecting land productivity

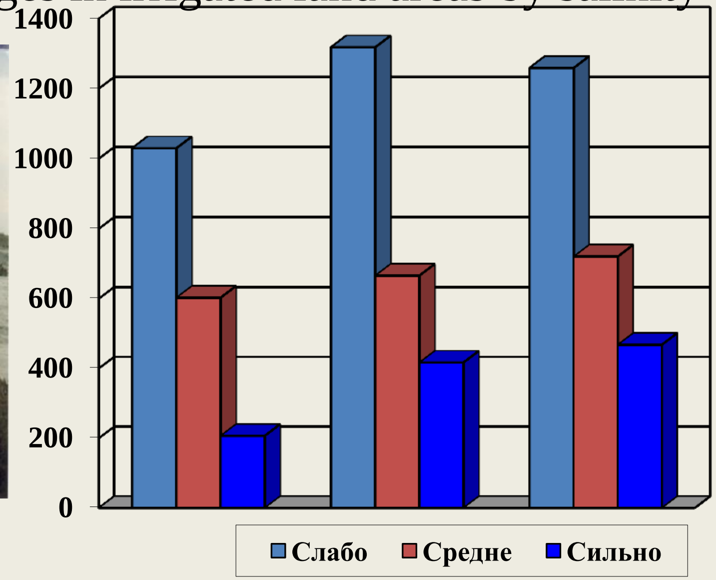
Problems	Causes	Consequences
Lack of evidence-based agricultural zoning	Raw material focus on cotton production in the past	Extensive agricultural development, irrational land use
Salinization	Inadequate and unsatisfactory operation of the drainage network	Deterioration of fertility, increased consumption of irrigation water, funds, fertilizers and labor
Rockiness	The development of stony lands.	Low fertility, increased consumption of irrigation water, costs, labor.
Plastering	Plaster land development	Waterlogging, low land fertility, salinization
Imperfect sown area structure.	Monoculture in the past	Lack of crop rotation, increased consumption of agricultural chemicals
Irrigation soil erosion.	Imperfect irrigation technique, development.	Degradation, leaching and removal of the fertile soil layer, nutrient deficiency
Wind erosion.	The absence of an effective system of shelterbelts.	Blowing out fertile soil, loss of nutrients
Development of low-fertile, highly saline lands. Water erosion	The development of water-intensive agricultural production in the past. Miscalculations in the development and exploitation of land. Plowing steep slopes.	Low fertility, high consumption of water, fertilizers, etc. Compaction, destruction of the structure, flushing, degression, ravine formation

- In the irrigated zone of 3.73 million hectares of land used, 2.9 million hectares or 75% are eroded to a varying degree.
- irrigation erosion on an area of 682 thousand ha or 20% of irrigated land.
- as a result of only irrigation erosion, soil removal can reach 100-500 t / ha, and the annual loss of humus can be 500-800 kg / ha, nitrogen 100-120 kg/ha, phosphorus 75-100 kg/ha and more.

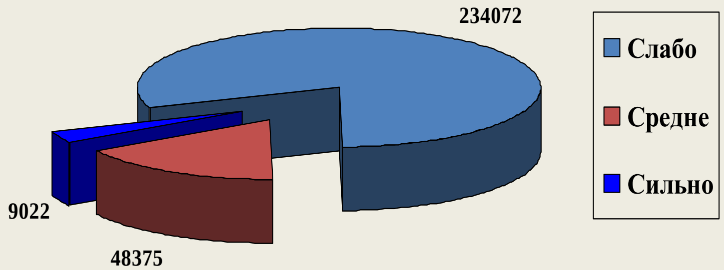
Erosion processes also affect the amount of utilized solar energy in the biomass of ecosystems in soils: as a result of erosion processes, up to 30-60% or more of solar energy utilized in phytomass, humus and microorganisms is lost, and taking into account the fact that the intensity of soil and biological processes in soils processes and the nitrogen regime associated with the reserves of the bound energy of the Sun, then we can conclude about the extent of damage to the ecosystem by erosion.

A major environmental problem in Uzbekistan is the problem of soil salinization. Over the past 30-50 years, the amount of saline land has gradually increased.

Dynamics of changes in irrigated land areas by salinity over the period



Plaster land



Over the past ten years alone, the area of irrigated saline lands increased by 608 thousand and in 2016 reached 2,446.3 thousand hectares - 65.9% of the irrigated area, medium and highly saline soils to 1,187.7 thousand hectares, i.e. 32.04% of the area. Aral disaster led to increased salt accumulation in the region.

NITROGEN AND CARBON CONTENT IN VARIOUS SOILS DEPENDING ON THEIR CULTURAL CONDITION

Soil and area	Background	Gross Content, in %		Ratio of C: N
		C	N	
Light gray soil	virgin land	0,66	0,089	8,25
	Alfalfa 3 year old	0,64	0,089	7,44
	Cotton old arable land	0,53	0,076	6,97
Dark gray soil	virgin land	0,99	0,106	9,34
	Alfalfa 3 year old	0,98	0,115	8,52
	Cotton old arable land	0,69	0,096	7,19
Meadow soils	virgin land	1,71	0,170	10,06
	Alfalfa 3 year old	1,59	0,162	9,81
	Cotton old arable land	1,46	0,156	9,36

The intensity of the processes of formation of gaseous forms of nitrogen is greatly influenced by soil moisture and density. After watering, the lowest nitrogen loss is observed in those options where N_{300}: P_{120}:K_{100}.

Dynamics of nitrogen gas losses depending on agricultural technology and doses of mineral fertilizers (N), mg per plot

Option	**Start of development plants**		**After making fertilizer**		**After watering**	
	nitrogen loss	**difference from control**	**nitrogen loss**	**difference from control**	**nitrogen loss**	**difference from control**
Control	65,9	-	134,9	-	138,6	-
$N_{200}P_{120}K_{100}$	71,5	4,6	159,7	24,8	185,0	46,4
$N_{300}P_{120}K_{100}$	95,1	28,2	133,4	-1,5	129,0	-9,6
$N_{400}P_{120}K_{100}$	131,1	64,2	159,4	24,5	122,8	-15,8
$N_{300}P_{180}K_{150}$	106,5	39,6	119,3	-15,6	123,5	-15,1
$N_{400}P_{210}K_{300}$	118,8	51,9	324,2	189,3	149,6	11,0
$N_{0}P_{120}K_{100}$	129,9	63,0	153,6	18,7	133,1	-5,5
Option	After loosening		After loosening		After loosening	
	nitrogen loss	difference from control	nitrogen loss	difference from control	nitrogen loss	difference from control
Control	118,5	-	251.1	-	66,9	-
$N_{200}P_{120}K_{100}$	173,4	54,9	281,7	66,6	89,4	22,5
$N_{300}P_{120}K_{100}$	214,2	95,7	328,4	113,3	56,4	-10,5
$N_{400}P_{120}K_{100}$	217,4	98,9	360,0	144,9	53,2	-13,7
$N_{300}P_{150}K_{150}$	190,0	71,5	344,4	129.3	80,8	13,9
$N_{400}P_{240}K_{200}$	294,3	175,8	327,4	112,3	97,0	30,1
$N_{0}P_{120}K_{100}$	165,2	46,7	306,0	90,9	110,9	44,0

- **The study of gaseous nitrogen losses immediately after fertilizer application showed that the doses of nitrogen fertilizers have a great influence on the activity of nitrification and ammonification agents: the more nitrogen fertilizers are applied, the higher the loss of ammonia nitrogen, i.e., the more intensive are the processes of ammonification in the soil, since high standards of nitrogen fertilizers inhibit the activity of nitrifying agents and they are not able to oxidize in a short time a large amount of ammonia nitrogen, which is introduced into the soil with fertilizers.**

- **After irrigation, gaseous losses of nitrogen are sharply reduced, this is especially clearly seen against the background of high doses of nitrogen fertilizers. Loosening of the soil activates microbiological processes in the soil and increases the loss of nitrogen in the form of ammonia and dioxide. Drying the soil contributes to greater nitrogen loss. By the end of the growing season, the losses of ammonia and nitrogen dioxide are sharply reduced, especially in the variants with high doses of nitrogen fertilizers; they are much lower in the variants with one and a half and double doses of phosphorus and potassium. Obviously, this is due to the growth of cotton and the formation of a continuous canopy, which helps to reduce the temperature of the soil between the rows, and, in turn, inhibits the activity of soil microflora.**

Agrotechnical dates for the use of mineral fertilizers for cotton

Cotton: according to field observations, it was revealed that in order to obtain 1 ton of medium fiber cotton, the crop develops 60 kg of nitrogen, 20 kg of phosphorus and 50-60 kg of potassium from the soil. Compared with medium-fiber culture, 20–25% more nutrients are absorbed from the soil to produce thin-fiber cotton. For the cultivation of a high-quality crop, optimal agronomic periods of nutrition are necessary.

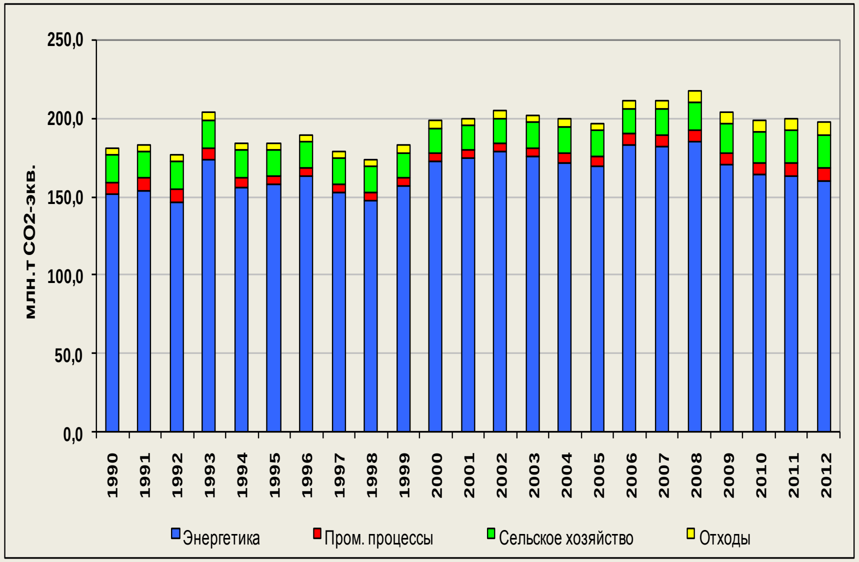
Annual rate of fertilizers, kg / ha	Fertilizer application dates					
	Before the autumn plowing	Before planting (during soil preparation)	With landing	When 3-4 leaves appear	Budding period	Flowering period
N P K 1: 0,7: 0,5						
	Phosphoric + Potash Fertilizers	Urea	Ammophos	Carbamide + urea	Ammonium nitrate + potassium chloride	Ammonium nitrate + ammophos
Nitrogen, %		20%	5%	25%	25%	25%
Phosphorus, %	60-70%		15-20%			15-20%
Potassium, %	50%				50%	
Soils washed from salts						
Nitrogen, %		20%	5%	25%	25%	25%
Phosphorus, %		60-70%	15-20%			15-20%
Potassium, %		50%			50%	

GHG emissions trends by sector for the period 1990 - 2012.

Currently underway:

- greenhouse gas inventory based on new IPCC guidelines with a higher level of detail.
- analysis of mitigation measures and assessment of their effectiveness (economic and environmental)
- creation of an internal system of assessment, reporting and verification (MRV), including:
- institutional structures;
- reporting of GHG emissions and reduced emissions;
- reporting on financial and technical assistance - to adequately compare our actions with those of other countries.

1990 – 2012 y.



GHG emissions structure:
- Energetics – 82 %;
- Agriculture - 10%;
- Waste and industrial processes - by 4%

Inventories and estimation of greenhouse gas emissions - the basis for determining mitigation potential

Key risks and threats for Uzbekistan

Uzbekistan belongs to the category of countries most vulnerable to climate change.

In the absence of additional resource-saving measures, the country may face:

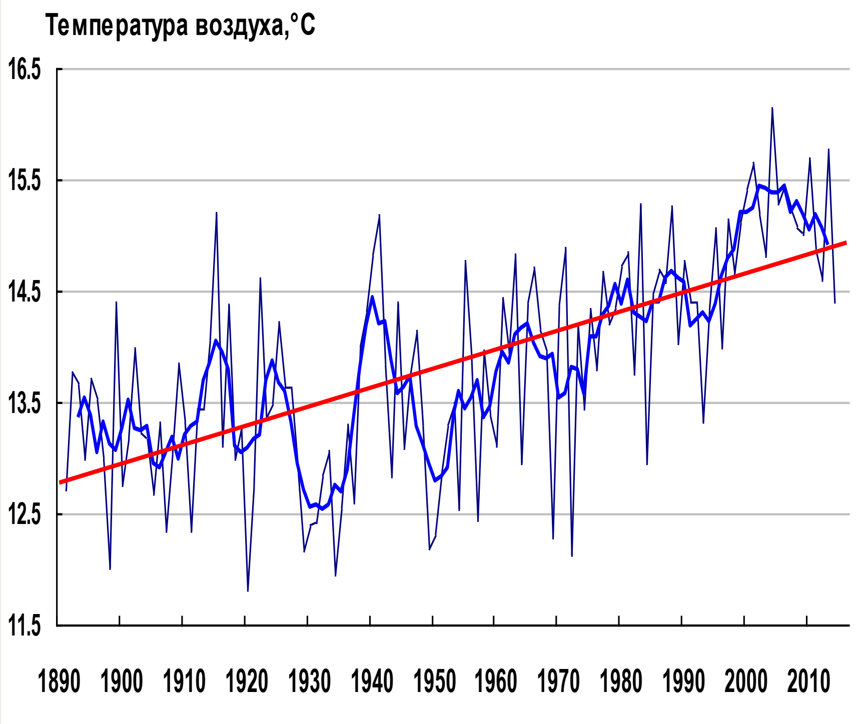
- **increased risk of increased greenhouse gas emissions, including N_2O, CO_2, CH_4, etc.**
- **the increased risk of water shortages, an increase in the number of droughts and other dangerous hydrometeorological phenomena leading to instability of agricultural production and threatening food security.**
- **reduction of glaciers (source of fresh water)**
- **increased risk of mortality associated with hot weather.**

Against the backdrop of the problems associated with the environmental disaster of the Aral Sea, which in fact is one of the largest in recent history of environmental disasters.

Observed Climate Change

CO2 emissions, million tons (IEA)

Countries	$CO_{2,}$ 1990	$CO_{2,}$ 2012
USA	4 863	5 032
China	2 211	8 519
Russia	2 180	1 551
Japan	1 071	1 217
Germany	950	745
….	…	…
Uzbekistan	180	205
CO_2 globally	20 988	31 491



In 2012, Uzbekistan ranked 38th in the IEA's ranking of CO_2 emissions from fuel combustion. The share of Uzbekistan was: in 1990 - 0.57%; 2012 - 0.35%.

Change in average annual air temperature in Tashkent Trend = 1.7 C / 100 years (according to Uzhydromet)

PARIS AGREEMENT - NEW GLOBAL LEGALLY BINDING CLIMATE AGREEMENT

- **April 19, 2017 - Uzbekistan signed a PS**
- **October 2, 2018 - the Law of the Republic of Uzbekistan “On Ratification of the Paris Agreement” (No. RUz-491) was adopted**
- **December 9, 2018 - The Agreement entered into force for Uzbekistan**

Uzbekistan Quantitative Commitment (INDC):

Reduce by 2030 the specific value of greenhouse gas emissions per unit of GDP by 10% compared to 2010 and revise obligations every five years starting in 2023 in order to increase ambitions.

Mitigation measures

1. Reducing sources and volumes of GHG emissions through the introduction of renewable energy sources, increasing energy efficiency and energy saving in key sectors of the economy.

The task in accordance with the state program for 2019.

Development of the State Strategy for the Transition to the Green Economy (low-carbon development) - regulatory document

- ➢ **Introduction of advanced mechanisms to combat climate change;**
- ➢ **Providing access to the GCF;**
- ➢ **Introduction of green technologies in all sectors of the economy, including in production.**

Indicator - Goal 7. SDG.

Task 7.1 - by 2030. increase renewable energy production

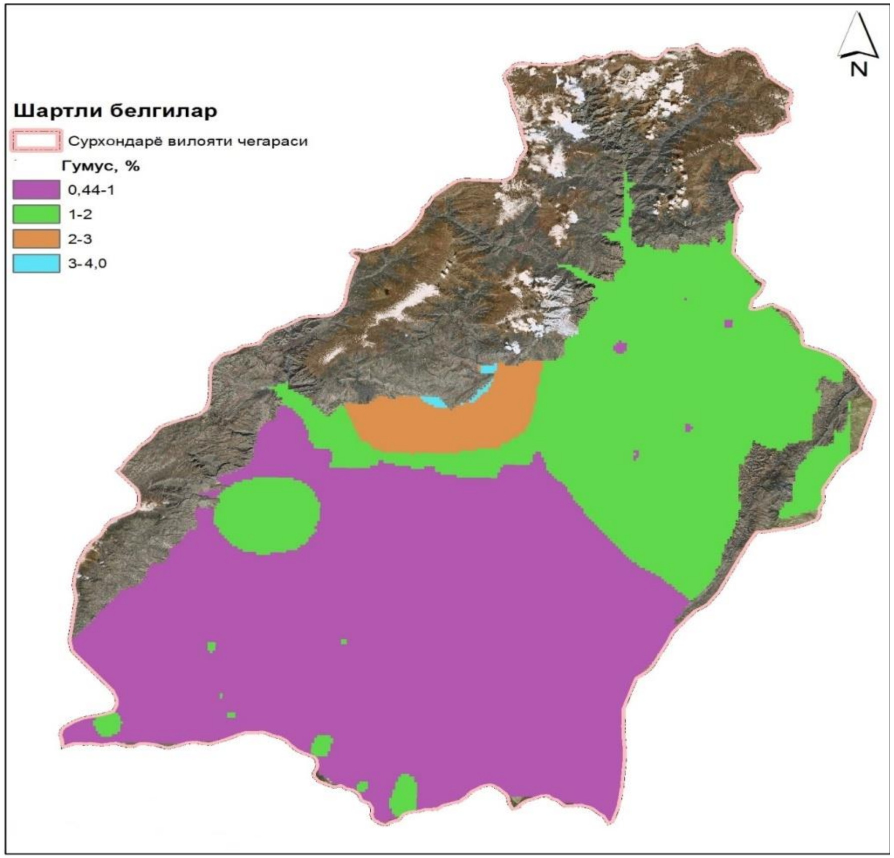
Task 7.2 - by 2030. double energy efficiency

2. Extension of greenhouse gas absorbers (biomass, water surface)

- ✓ **Restoration of degraded lands**
- ✓ **Expanding afforestation and reforestation (SDG 15.2.)**

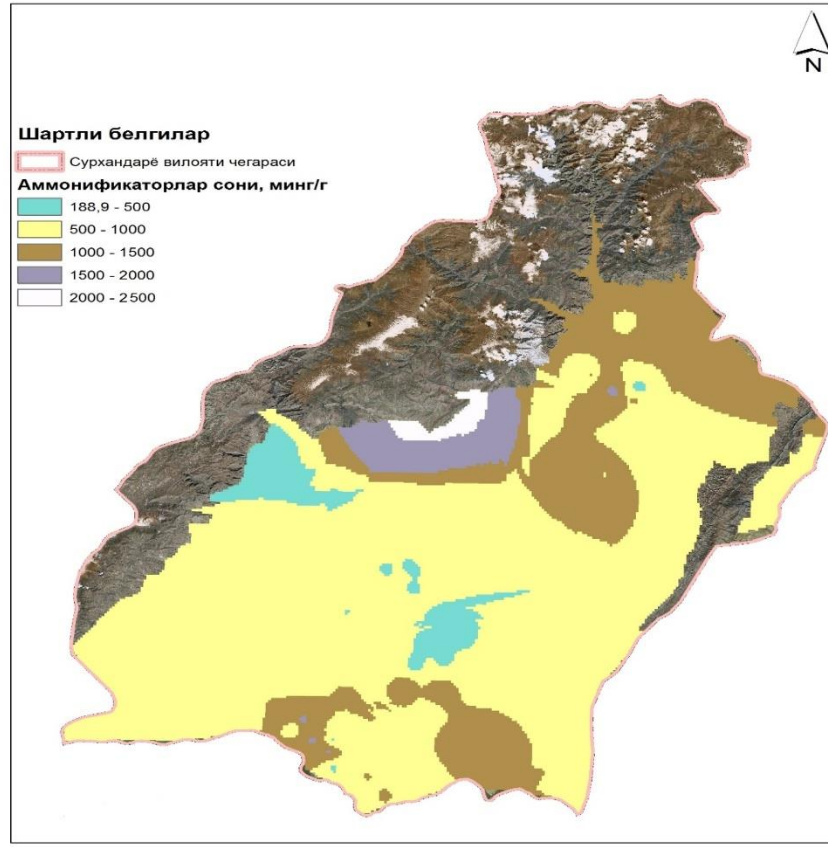
CO_2 accumulates in fertile land. Degraded Earth releases CO_2

CARTOGRAPHIC MODEL CHARACTERIZING THE CONTENT OF HUMUS IN THE SOILS OF THE SURKHAN-SHERABAD VALLEY



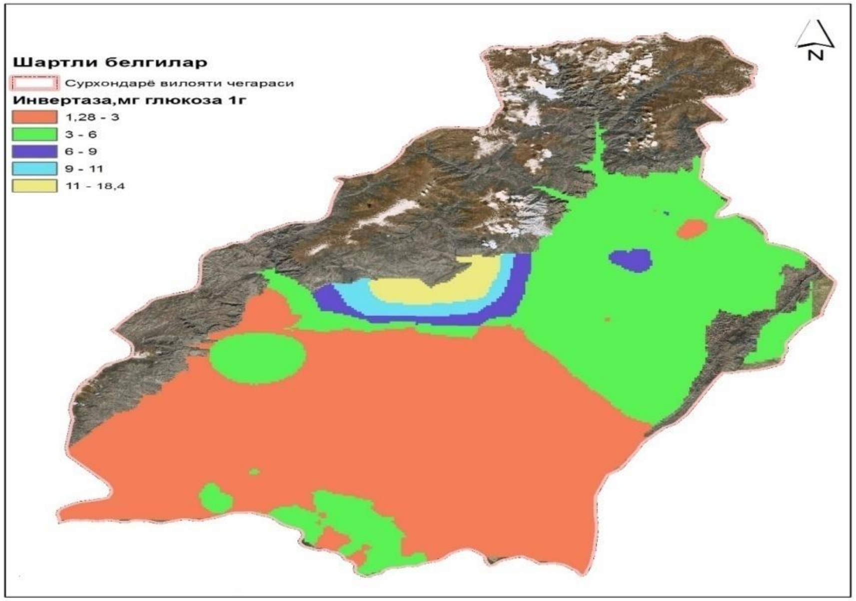
GROUPS	Degree of security	Ammonifier quantity, mln/g	Area , %
1	Very high	3-5	0,17
2	High	2-3	4,1
3	Medium	1,0-1,5	34,5
4	Low	0,5-1,0	61,0

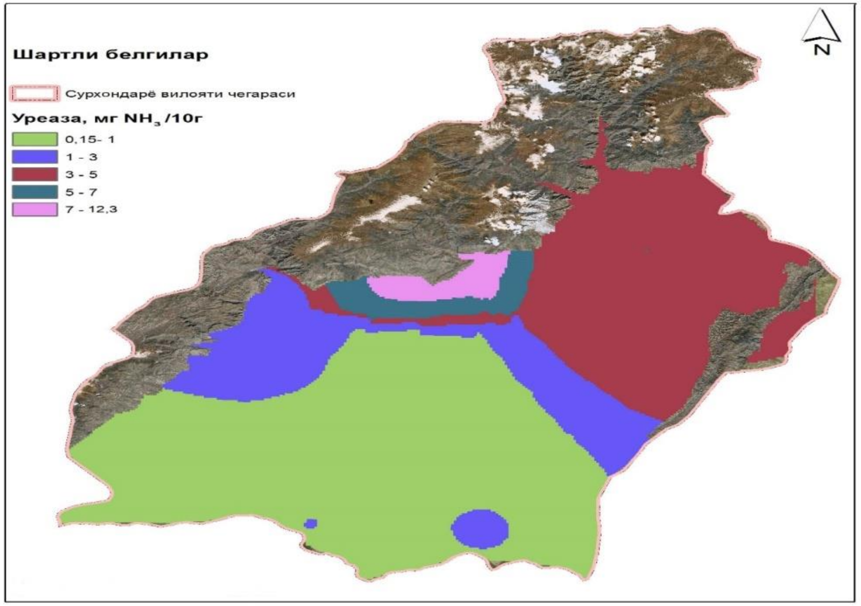
CARTOGRAPHIC MODEL CHARACTERIZING THE CONTENT OF AMMONIFIERS IN THE SOILS OF THE SURKHAN-SHERABAD VALLEY

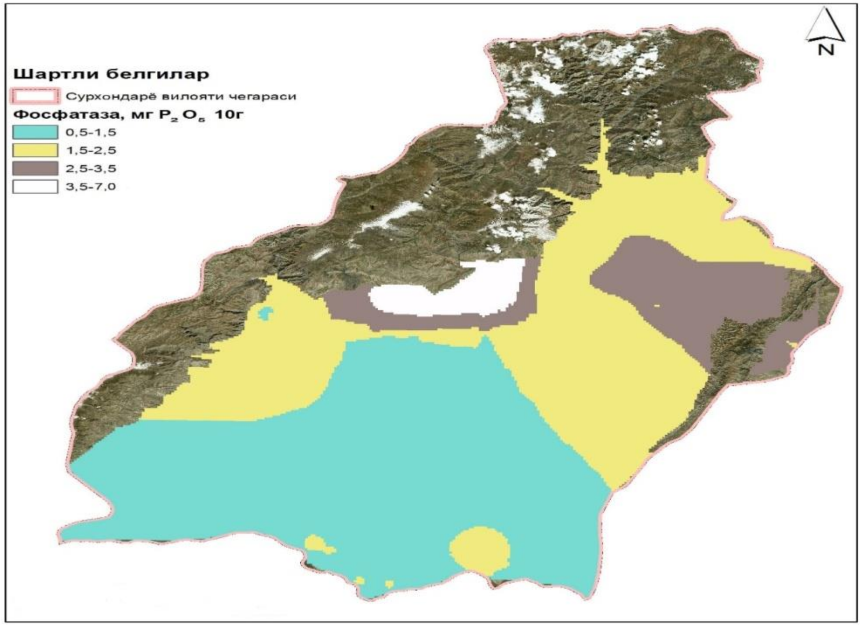


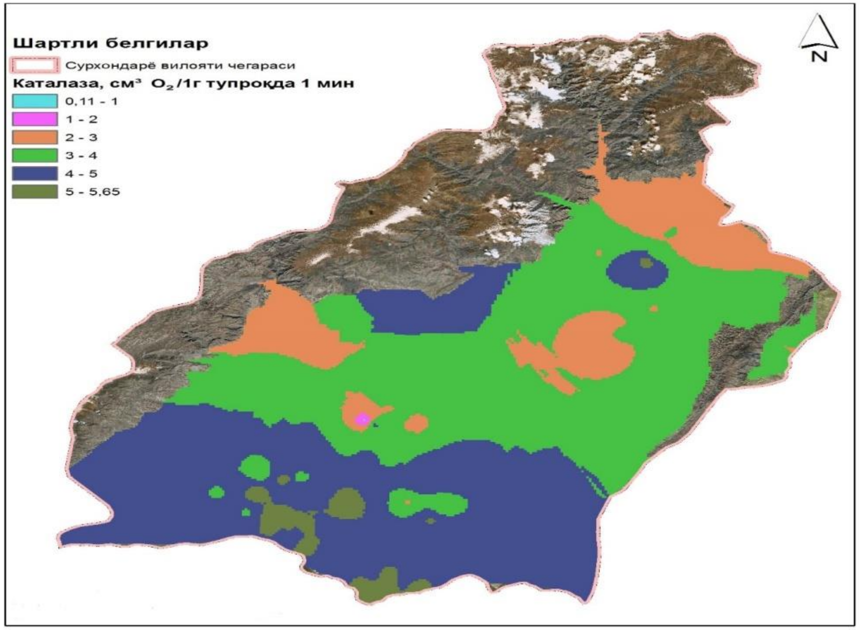
GROUPS	Degree of security	Ammonifier quantity, mln/g	Area , %
1	Very weak	<1	73,1
2	Low	1-2	26,0
3	Medium	2-5	0,9

CARTOGRAPHIC MODELS CHARACTERIZING THE ACTIVITY OF HUMUS ENZYMES IN THE SOILS OF THE SURKHAN-SHERABAD VALLEY









Agrotechnology of restoration of fertility and increase of productivity of desert pastures

- Most of the land fund of the Republic of Uzbekistan is occupied by pastures, which serve as the main source of forage for livestock. However, the destabilization of the environment as a result of anthropogenic factors and population growth led to the degradation of desert pastures.
- The insufficient stability of desert complexes, especially under the influence of anthropogenic factors, necessitates a systematic and periodic monitoring of the condition of desert pasture lands, obtaining operational information about the direction and extent of changes occurring in them. At the modern technical level, the problem of obtaining information is solved with the use of remote sensing materials of the Earth, allowing you to quickly receive a large amount of information about the status of desert pastures.



VEGETABLE LEGUMES TO INCREASE SOIL FERTILITY

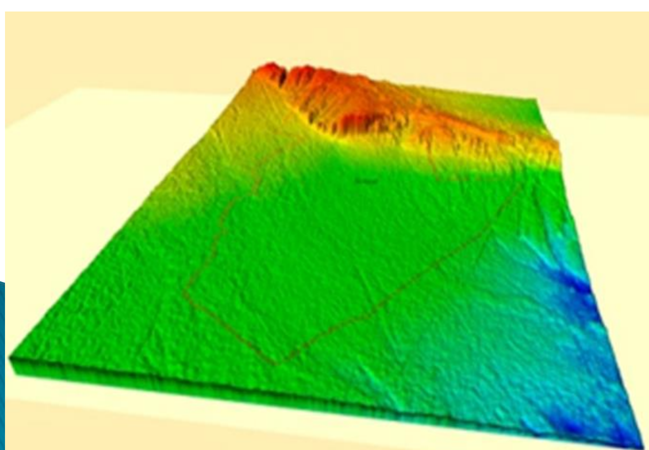
The technology is resource-saving, soil-protective, aimed at carrying out comprehensive measures to improve soil fertility and improve the ecological condition of the land.

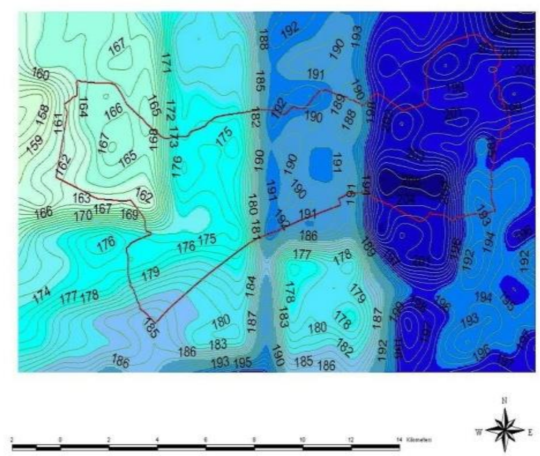
The cultivation of new vegetable legumes on dry, low-fertile degraded soils is recommended, the biological basis for the restoration and preservation of its productivity, the introduction of new biological products, and the implementation of new soil protection measures have been developed. The changes in soil properties and productivity during spring and summer sowing of vegetable legumes are shown. Given the soil and climatic conditions, various varieties of vegetable soybeans, mung bean, and asparagus beans are recommended.

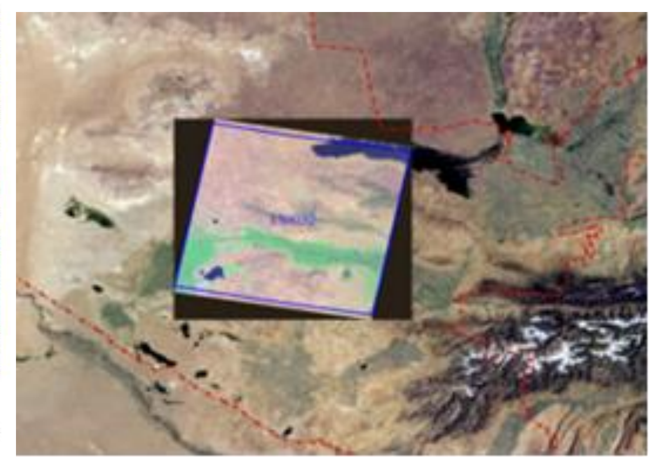
All crops enrich the soil with nitrogen, macro- and micronutrients, biologically active substances and are good precursors for cereals and other crops. The technology was developed in conjunction with ICARDA, the International Center for Horticulture, Research Institute of Crop Production of the Republic of Uzbekistan.

REMOTE SENSING AND GIS TECHNOLOGY PASTURES

The use of remote sensing methods for monitoring desert pastures using joint remote sensing methods (remote sensing of the Earth) is relevant, since remote sensing methods allow you to create operational digital maps with real borders of desert pasture vegetation. These cards allow you to assess the situation and take effective measures aimed at the conservation of natural forage land and their rational use. The Center for Remote Sensing and GIS Technologies has developed a technique for processing satellite images.







TRAINING OG FARMERS IN IMPROVING SOIL FERTILITY

The training of farmers is directed to resource-saving environmentally friendly technologies for improving and reproducing soil fertility, improving their ecological status, demonstrating the dissemination of best practices on sustainable land use. Taking into account the soil and climatic conditions for determining factors limiting fertility for farmers, a specialized training program is being developed, the subject and content of training are determined. The training production base is demonstration sites.

Theoretical classes are held on the basis of the scientific center “AgroEcoBiotechnology” NUUz named after Mirzo Ulugbek, as well as in field camps, experimental stations, agricultural colleges. Field training for farmers in basic farms is envisaged. Recommendations, brochures and other informational materials have been created for farmers.


10.07.2010yil








АГРОИЛМ-ФЕРМЕР
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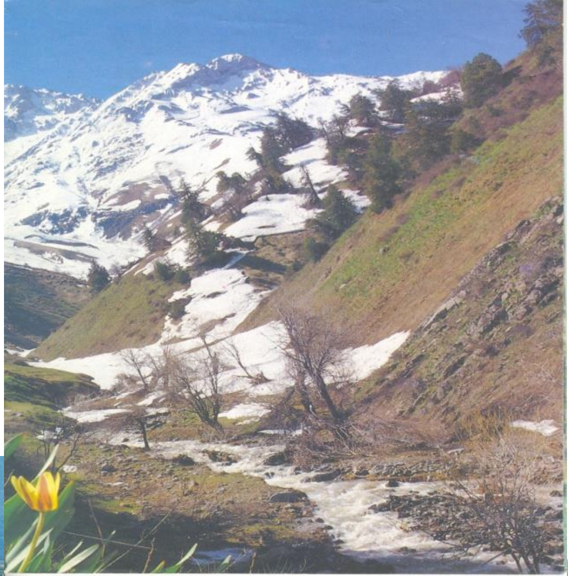
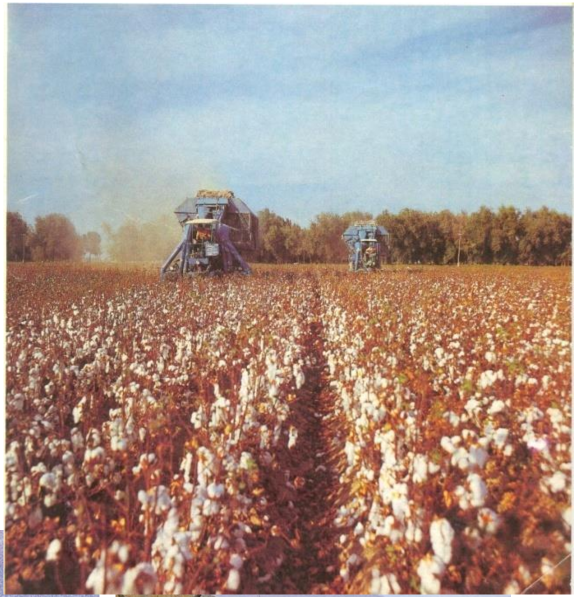
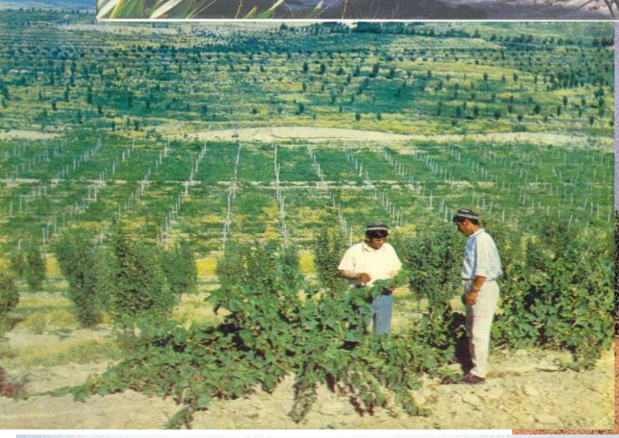
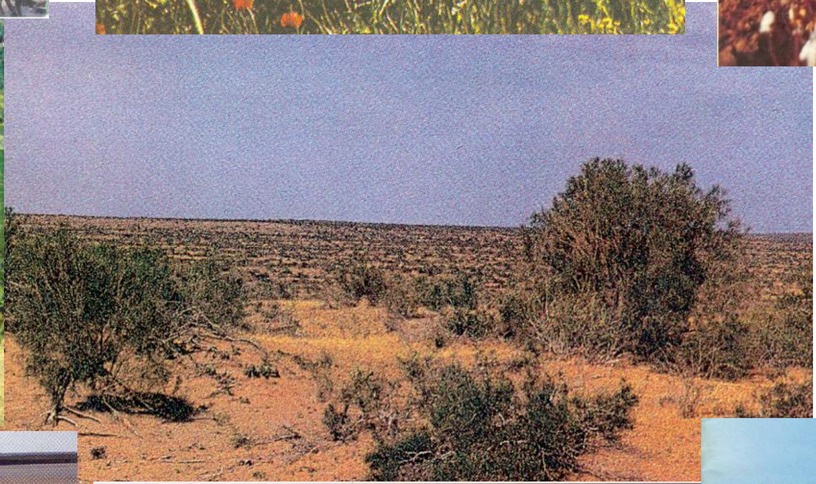
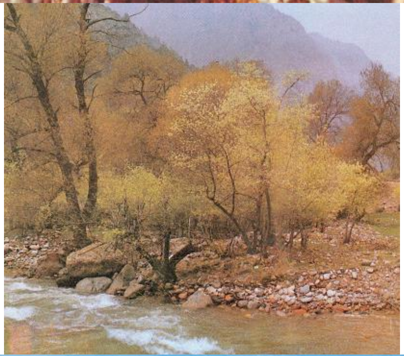
THE MAIN PRIORITIES FOR THE DEVELOPMENT OF SOIL SCIENCE IN UZBEKISTAN

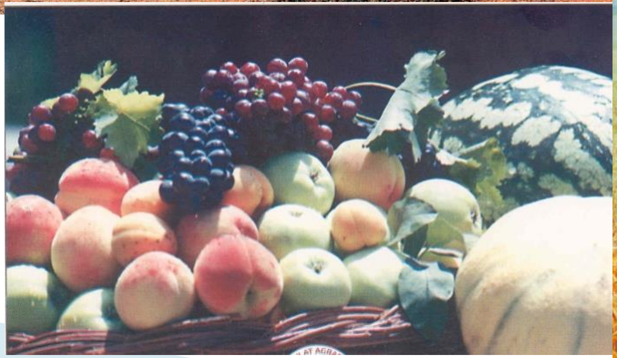
- introduction of resource-saving technologies, science-based crop rotation according to the best predecessors, taking into account soil characteristics;
- estimate the nitrogen loss from manure in the chains: “farm - manure - storage - field”;
- to determine changes in the agrochemical, physical and biological properties of soils with prolonged use of various types of fertilizer systems;
- to study the flows of nitrogen and carbon (nitrogen and carbon in the soil, nitrogen of fertilizers) (NO_2, NH_3, CH_4, CO_2,) (study with ^{15}N);
- evaluate the quality of plant products fertilized with organic and mineral fertilizers;
- study of ways to reduce the loss of gaseous nitrogen from the soil of fertilizers.
- narrowing the gap between the date of fertilizer application and the period when plants begin to actively absorb nitrogen;
- deep and accurate fertilizing;
- taking into account the forms of nitrogen when choosing the means of their application;

THE MAIN PRIORITIES FOR THE DEVELOPMENT OF SOIL SCIENCE IN UZBEKISTAN

- balanced mineral nutrition of plants, which increases nitrogen consumption from soil and fertilizer;
- increase in the utilization rate of nitrogen fertilizers;
- use of slow release nitrogen fertilizers;
- on highly biogenic soils of arid and extra-arid zones of application of nitrogen fertilizers in the form of urea;
- the use of nitrification inhibitors with urea and slow-acting fertilizers;
- the organic inclusion of agricultural science in the training of personnel for agriculture, the integration of higher education, agricultural science and production
- popularization of soil science, drawing public attention to the problems of rational use and protection of soils;
- development of international cooperation in the field of development of soil science.



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