Food and Agriculture Organization of the United Nations

DIALOGUE #9

FAO-GEF project:

Integrated natural resources management in drought-prone and salt-affected agricultural production landscapes in Central Asia and Turkey (CACILM-2)

global environment facility
INVESTING IN OUR PLANET

November 2023

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World Day to Combat Desertification in Central Asia

The climate change impacts affecting Central Asia - droughts, soil salinization, dust storms and sandstorms - are depleting agricultural productivity, killing livestock, and jeopardizing food security in the region's countries that were relatively prosperous in the recent past.

Over the past 30 years, Central Asia's population has tripled while natural resources have degraded dramatically. Changing climate and reducing irrigation water, while decreasing food security, threaten to push the number of people living below the poverty line and intensify competition for natural resources.

Degradation of soils and pastures leads to a decline in the productivity of agriculture (between 10 and 38 percent of GDP in the economies of the region) that provides livelihoods for between 18 and 65 percent of the population.

Since independence, crop yields in the region have fallen by almost a third. Between 60 and 80 percent of farmland in Central Asian countries has been eroded over 30 years. The causes include climate change impacts, inefficient land management, excessive application of chemical fertilizers and plant protection, unsustainable use of fresh water, including due to the deterioration of irrigation systems, as well as other anthropogenic factors affecting the environment, including partial loss of flora and fauna diversity.

As you know, the project is aimed at reducing the burden on the environment by introducing effective practices and modern approaches to the rational use of natural resources to reduce their degradation and simultaneously increase crop yields, increase drought preparedness, counter salinization, as well as assistance in the implementation of two UN Conventions - on combating Desertification and Climate Change.

A regional knowledge-sharing platform for sustainable land management has been organized. Eighteen pilot areas have been identified in five countries where fieldwork has been underway for four years.

In close cooperation with national and international partners, research is conducted, farmers are trained intensively, salinity and drought maps are produced, and teams of well-trained soil doctors are organized to disseminate knowledge to farmers in pilot regions.

Kazakhstan, with the assistance of CACILM-2, operates an open interactive geoportal in English and Russian, where data on the country's various soil properties have been uploaded. The salinity and drought maps generated by the project are an integral part of the geoportal.

Nurseries of salt- and drought-tolerant plants are being arranged at an accelerated pace in the countries to disseminate the agro-technologies tested in the pilot areas, which contribute to faster adaptation of agriculture to climate change and combating desertification, research is underway and farmer trainings are scaled up, including by organizing Field Days.

Field Days in Kazakhstan in 2023 were dedicated to combating pasture desertification by, inter alia, switching to

the cultivation of efficient drought- and salt-tolerant varieties of perennial forage crops, developing comprehensive local pasture management plans that consider, inter alia, the carrying capacity of pastures and their rotation to prevent trampling of this precious resource. Bereketli Garagum State Nature Reserve in the Ahal province of Turkmenistan hosted a scientific workshop on sustainable pasture management on June 17, the World Day to Combat Desertification. Focused on methods of effective utilization of desert pastures in the context of intensifying droughts and desertification processes in the Central Karakum, the workshop contributed to strengthening the knowledge and skills of farmers' field school members in advanced technologies and sustainable management of desert pastures by means of combined fixation of shifting sands in the Central Karakum.

CACILM-2 pilot regions in Uzbekistan are suffering from excessive drought. Therefore, with the assistance of FAO and GEF, the country continues intensive planting of seedlings under the Million Fruit Trees program, and continues training target groups of farmers on transition to resource-saving technologies of soil cultivation, cultivation of agricultural products under cover (in greenhouses), wide introduction of drip irrigation, as well as the use of drought- and salt-tolerant fodder crops.

On June 15 and 16, the Regional Dialogue «Scaling up Nature-based Solutions for Resilient Landscapes in Central Asia» was held in Tashkent (Uzbekistan) with the assistance of several international organizations, where Makhmud Shaumarov, CACILM-2 Regional Coordinator, presented the experience gained by the programme in five countries of the region during its four years of activity.

Water-saving technologies introduced in the countries with the project assistance include drip and sprinkler irrigation systems (in all project countries), transfer of greenhouses and hothouses for covered cultivation to vulnerable households (20 in Kazakhstan, 16 in Tajikistan, 11 in Turkmenistan and 129 in Uzbekistan), construction and rehabilitation of wells for pasture restoration (ten in Turkmenistan and two in Uzbekistan), and construction of ten sardobas in Turkmenistan.

Makhmud Shaumarov emphasized that sustainable rehabilitation of degraded arable land in the countries requires favorable legal and investment environment for sustainable natural resource management (SNRM) in the long term. Political will, commitment and concerted interagency cooperation, sustained funding for research and education on SNRM, and development of national plans for sustainable land management and drought resilience are essential as well.

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2 Study tour of the project team and key partners to Ankara, Konya, and Mersin provinces (Turkey)

The agricultural sector in Turkey is well developed. The country is the world's leading producer of a wide variety of products - figs, tobacco, lemons, lentils, pistachios, and hazelnuts.

According to the World Bank's 2021 data, the value added of the agricultural sector grew from USD 27.5 billion in 2000 to USD 48.9 billion in 2019 (Eurasian research). Even with the agricultural employment rate declining (from 39.3% in 2000 to 18.4% in 2019), the sector's labor productivity climbed from USD 7,200 to USD 16,900 over the same period.

The country has taken considerable efforts to overcome the threats of drought and deforestation and has accumulated vast experience in the management of natural resources. Turkey is also investing heavily in the FAO agricultural sector development programs in Central Asia and is one of the participating countries in the CACILM-2 project and an active member of its Steering Committee.

Therefore, Turkey hosted the study tour for the representatives of partner governmental institutions in Kazakhstan, Turkmenistan and Uzbekistan and key CACILM-2 personnel.

The eventful program of the week-long visit began with a visit to the FAO Subregional Office for Central Asia and a meeting with Viorel Gutu, FAO Sub-regional Coordinator for Central Asia and FAO Representative in Turkey. It was followed by a meeting at the Ministry of Environment, Urbanization and Climate Change of Turkey, where the heads of the General Directorate for Combating Desertification and Erosion, the General Directorate of Agricultural Research and Policy, the General Directorate of Forestry, the Central Research Institute for Soils, Fertilizers and Water Resources presented to the guests an overview and achievements of their units in the field of combating desertification and sustainable management of natural resources.

During seven days, the project team and key partners visited greenhouses and nurseries where plants are grown for afforestation of desert areas and dune stabilization, an agricultural equipment manufacturing plant and workshops for pre-packing and packaging of agricultural products, as well as the national laboratory for food quality testing.

One of the field visits was to the forest strip around Altınapa Reservoir in Selçuklu district of Konya province. The surface area of the lake is 2.20 km2 at full capacity. Afforestation works started here in 1990 and by now their area has reached 9,900 hectares. To complement the main species - Lebanon cedar and pinecone - the plantations include oak, acacia, rosehip, and juniper.

The group also visited the Hacıalan Model site. This site was designed specifically for technician training to demonstrate various erosion control techniques. Forestry engineers from various regional forestry departments come here to learn about the most effective methods to combat erosion.

As it was emphasized by the study tour participants, the program of the trip was extremely fruitful due to several aspects:

- Data on the structure and activities of the General Directorate for Combating Desertification and Erosion, as well as Turkey's experience in the field of sustainable land management were very timely given the upcoming reorganization of subordinate organizations of the Ministry of Agriculture of Kazakhstan carrying out soil surveys (soil, geobotanical, agrochemical, irrigated land monitoring, etc.).
- It will also be helpful to Central Asian countries seeking more effective approaches to controlling the use of natural resources
- Turkey's experience in achieving land degradation neutrality within the UNCCD, the framework and platforms used for monitoring and decision-making can also be put into practice by relevant governmental institutions in all Central Asian countries.
- Application of agroforestry to combat desertification and soil erosion was very impressive.
- The participants expressed interest in project finance mechanisms.
- The rehabilitation of degraded lands implemented by the Turkish government inspired the tour participants, and they will also be proposed to the government, at least via the development of incentive mechanisms for soil fertility restoration activities
- The Forestry Committee of Kazakhstan is very keen on gaining Turkey's experience in afforestation and forest fire suppression.

«This tour was very rewarding for us,» said Muhammadjon Kosimov, national project manager in Uzbekistan. «The scientific approach to planting and propagating every seedling has been very inspiring for all of us. For instance, out of 151 species of eucalyptus imported from Australia for introduction in Turkey, only two species succeeded in soil and climate tests. Now they are being propagated."

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3 International conference on **global salt-affected soils** in Tashkent

The capital of Uzbekistan hosted three major international events on salt-affected soils in early June 2023: the second meeting of the International Network on Salt-affected Soils (INSAS), the 6th plenary meeting of the sub-regional Eurasian Soil Partnership and the Global Soil Laboratory Network (GLOSOLAN) training on saline soil analysis. The major international forum gathered 150 participants including professionals from such countries as Armenia, Australia, Bangladesh, China, France, Georgia, Islamic Republic of Iran, Italy, Kazakhstan, Kingdom of the Netherlands, Kyrgyzstan, Malaysia, Pakistan, Senegal, Spain, United Arab Emirates, United Republic of Tanzania, Turkmenistan, Uzbekistan.

Organized by the Global Soil Partnership (GSP), the sub-regional Eurasian Soil Partnership (EASP), and FAO Uzbekistan in collaboration with the Ministry of Agriculture of the Republic of Uzbekistan and several partners.

Makhmud Shaumarov, Regional Project Coordinator, delivered a speech at the Regional Dialogue on the role of resource-friendly solutions for forestry and agriculture sectors and their resilience to climate change in Central Asia.

The Regional Coordinator presented the positive experience gained by the project in ensuring favorable conditions for the introduction and scaling up of sustainable natural resource management practices in Central Asia.

As emphasized by Makhmud Shaumarov, the project has been very active at both regional and national levels, as well as at the project sites in the countries since 2018.

At the regional level, cooperation with national and regional institutions has been reinforced, work is ongoing with global knowledge platforms (WOCAT, TECA), and drought/salinity mapping (LDN map) is underway.

The project mobilizes resources, continuously builds the capacities of the national and local partners, and places great emphasis on the dissemination of good SNRM practices to promote sustainable natural resource management practices.

The second meeting of the International Network on Salt-affected Soils (INSAS) took place in Tashkent in May 2023.

4

FAO water experts' mission **from Rome** visited Kochkor (Kyrgyzstan)

The mission objectives included assessment of the latest irrigation water control technologies implemented by the project. The project assisted the Kochkor District Water Management Department in obtaining a water monitoring network comprising six sites. The mission also commended the software installed by the project at the District Water Management Department, which is used to process water data in real time.

Kochkor district is the upstream area, so the monitoring network installation helps to quantify water availability directly from the sources.

The FAO expert mission concluded that the irrigation water monitoring system supported by the project has multiple advantages: it enables early action in case of water allocation problems, ensures equitable quantitative distribution among management bodies, and integrates remote areas.

The mission objectives included assessment of the latest irrigation water control technologies implemented by the project.

Therefore, the operation and improvement of the monitoring system in Kochkor district is one of the most effective water control technologies that is evidence-based and capable of addressing many issues at the national level.

During the visit to Kyrgyzstan, the mission held a number of meetings with the representatives of the relevant water management and agricultural organizations, who provided a very positive feedback to the water monitoring network established in Kochkor.

The country's government is currently planning the second phase of the monitoring systems development, which involves installation of additional 500 sensors. The overarching goal is to equip all 40 districts with monitoring systems.

Rough estimates indicate that full national coverage would require around 23,000 sensors including 3,300 at the public infrastructure level, which would require heavy investment.

Reference: An ultrasonic level gauge designed for non-contact measurement of water level at hydro-reclamation facilities and data transmission via cellular communication channels was invented by specialists of the Kyrgyz Research Institute of Reclamation under the leadership of the head of the Laboratory of Software and Hardware automation of Water Accounting and Water Distribution of the Research Institute Vitaly Shablovsky.

5 Regional project Coordinator visited Central Asian countries: strengthening partnerships and monitoring the project progress

Makhmud Shaumarov, Regional Project Coordinator, paid the visit to Kazakhstan, Uzbekistan, and Turkmenistan in June 2023.

The mission aimed to coordinate the implementation of the planned project activities in the countries of the region. Meetings with the key project partners in the field were to be held as well laying the foundation for successful partnerships in the next and final year of the project in Central Asia.

The mission program started in Turkmenistan, where the Regional Coordinator held a series of meetings with the project partners including the leadership of the Ministry of Agriculture, Scientific Information Center of the Interstate Commission for Sustainable Development under the Institute of Deserts of Turkmenistan. Discussions during the meetings focused on the project promotion in the area of updating the Forest Code of Turkmenistan, expansion of innovative technologies for sustainable natural resources management, as well as organization of political dialogue on drought and acknowledgement of this phenomenon as a natural disaster.

In addition, the UN Resident Coordinator and UNDP Resident Representative met in Ashgabat and agreed to further harmonize actions for sustainable natural resource management.

Makhmud Shaumarov also traveled to the regions where the project had supported the installation of greenhouses, construction of nurseries, sardobas and wells, and took part in a conference dedicated to World Environment Day held on June 5 at the Agro-Industrial Complex in Ashgabat.

In Kazakhstan, Makhmud Shaumarov met with the Country Operations Manager and the team of the Islamic Development Bank in Central Asia. CACILM-2 achievements in adapting and scaling up advanced technologies and practices for integrated natural resource management were presented at the meeting and agreement was reached to cooperate with the Bank in this area. In Almaty, another meeting was held with the management and key personnel of the Kazakh-German University. The meeting focused on cooperation in the field of sustainable natural resource management.

In Uzbekistan, the Coordinator together with Ekrem Yazici, Project Technical Director, Prof. Mustafa Türker and key CACILM-2 personnel in Uzbekistan met

Makhmud Shaumarov, Regional Project Coordinator, paid the visit to Kazakhstan, Uzbekistan, and Turkmenistan in June 2023.

with the Rector of Bukhara Institute of Natural Resources Management. The discussion covered crop diversification and transition to drought- and salt-tolerant plant varieties, application of resource-saving technologies for soil rehabilitation and reduction of salt washing practices.

During the visit, the project leadership also met with the director of the Forestry Department of Bukhara province, where five demonstration sites of CACILM-2 are in operation. The main objective is to contribute to soil restoration near the Aral Sea. For this purpose, 200 thousand hectares of land have been allocated in Bukhara province and search for sustainable solutions is underway.

The meeting with the leadership of the Research Institute of Karakul and Desert Ecology of Uzbekistan was dedicated to cooperation in improving the productivity of desert pastures, where the institute can benefit from the project's experience and recommendations in this field.

During the mission to Uzbekistan, the Coordinator also spoke at the Regional Dialogue: Scaling up Nature-based Solutions for resilient landscapes in Central Asia held in Tashkent on June 15-16, 2023.

6 Field Days held in Kazakhstan as part of the World Day to Combat Desertification

CACILM-2 held traditional Field Days in Kazakhstan as part of the events organized in Central Asian countries to celebrate the World Day to Combat Desertification.

The events aimed to disseminate knowledge on resource-saving technologies, production, and dissemination of adapted varieties of fodder and pasture crops resistant to drought and salinity, technologies to improve degraded pastures by sowing drought-tolerant crops and approaches to establish pilot silvopastoral systems and their demonstration in the field.

The participants - farmers and representatives of local authorities - were demonstrated rotation pasture technologies, and the discussions focused on the development and implementation of effective pasture resource management plans, including the technique of carrying capacity calculation, approaches to fodder stockpiling and livestock requirements.

The field workshops emphasized efficient drought-resistant crops that already provide Kazakhstan farmers with good fodder yields despite the arid climate in the southern regions of Kazakhstan.

The workshop became a dialog platform for exchanging opinions, knowledge, and experience, identifying urgent challenges confronting the livestock industry of Kazakhstan in the context of climate change, intensifying droughts, and pasture degradation, as well as for joint search for ways to address these challenges.

The Field Days are an effective knowledge school for farmers and other local partners, disseminating useful knowledge on crop cultivation under drought and saline conditions during such field events.

On June 16, the Field Day to demonstrate the cultivation of annual and perennial fodder crops for further scaling was held at Akylbay farm, Koksu (Tekeli) settlement, Zhetysu district; on June 20, the same workshop was held at Sayat farm, Sumbe settlement, Almaty region; and on June 29, in Koldy settlement, Almaty region.

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7

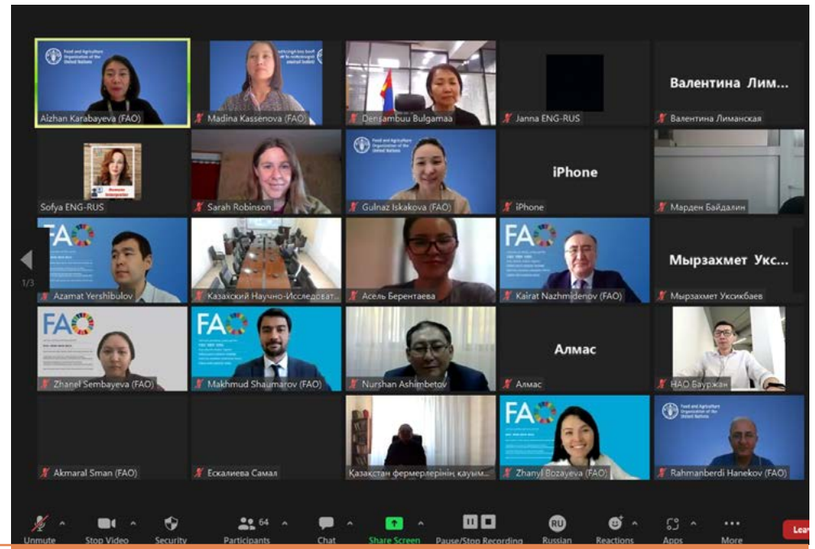
Sustainable management of **pasture resources** in Kazakhstan

The webinar «Sustainable Management of Pasture Resources in Kazakhstan» was held on April 13, 2023, online via Zoom.

Kazakhstan's pastures (187 million hectares, or almost 85 percent of all agricultural land in the country) are the fifth largest valuable natural resource in the world, which represents good potential for the manufacture and export of animal products to domestic and foreign markets.

Pasture degradation is one of the factors limiting this potential. According to experts, about 27 million hectares have already been degraded and this process continues, leading to a decrease in livestock productivity and an increase in the vulnerability of rural residents to climate change.

Village pastures, where the majority of livestock are concentrated, account for the overwhelming share of degraded pastures. Remote pastures degrade too because they remain unused and are overgrown with non-fodder plant species. Farmers are unable to utilize remote pastures due to collapsed infrastructure such as roads and bridges,



The webinar was attended by the representatives of government agencies, research and educational institutions, civil society organizations, as well as young scientists and professionals.

and lack of water sources. Other drivers are the lack of tools to regulate land relations and poor knowledge among farmers on how to manage this natural resource.

For several years, the project has been analyzing constraints and limiting factors in pasture use in Petrovsky rural county, Bukharzhyrau district, Karaganda province, and Talap rural county, Zhambyl district, Almaty province, as well as developing local plans for sustainable management of valuable natural resource - rangelands.

During the webinar, participants discussed institutional arrangements for sustainable management of pasture resources, as well as sustainable land management practices and techniques for restoring degraded rangelands. International experience of sustainable pasture management was demonstrated as well.

The webinar provided a platform for dialogue, exchange of views and experiences, and recommendations for actions needed in sustainable management of pasture resources.

The webinar was attended by the representatives of government agencies, research and educational institutions, civil society organizations, as well as young scientists and professionals.

8

Almas Tasbatyrov: **Conservation of natural resources** is a key to **business sustainability**

Farming is one of the most important and demanded areas in agriculture. In today's world, more and more people have opted for farming as their main source of income. But becoming a successful farmer takes not only education and skills, but also the ability to manage resources - both financial and natural.

Almas Tasbatyrov is one of such successful farmers. The farmer has a degree in agricultural economics and specializes in beef cattle breeding, forage production and forage harvester services.

He succeeds well in running the farm, but has difficulties managing natural resources, especially pasture in the face of severe water scarcity.

The welfare and prosperity of Tasbatyrov's farm directly depends on the state of the land, water, and pastures, and he is well aware that mismanagement of these resources can adversely affect his business.

The young farmer believes that maintaining and improving the condition of pastures is essential, as the grass stand deteriorates every year due to various factors, primarily droughts, soil corrosion and overnight temperature fluctuations. Water is also an important element for the farm and prudent use of this valuable resource helps to increase animal productivity levels and preserve the overall ecosystem.

Prior to the project, Tasbatyrov's farm experienced a number of problems including deteriorating pasture quality, unavailability of fallow land, and complete dependence on market prices for forage. However, after CACILM-2 came to the farmer's aid, things took a turn for the better. Fenced pasture areas of perennial grasses - such as sainfoin - appeared. The fallow plots were sown with perennial drought-resistant varieties of honeysuckle, sainfoin and alfalfa, owing to which the farm is already 60 percent self-sufficient in fodder for livestock.

Moreover, Almas intends to continue improving his land as he has sufficient knowledge and skills to do so. Thus, he will be able to increase the number of livestock and boost dairy and meat production. Moreover, to improve income, he intends to grow new crops like soy and hemp, which will also allow him to diversify the farm's products.

But what's most important to Almas is preserving his land and the environment. He understands the benefits of stewardship of natural resources and is committed to continue practicing pasture rotation and other sustainable approaches that will help maintain soil health and increase the land's fertility for years to come.

9 Kazakh Research Institute of **Livestock and Feed Production** received truck scale from the project

The powerful equipment is designed for weighing goods transported by trucks, measuring the weight of harvested seeds and hay.

Weighing large volumes of seed and hay with small scales severely complicated the work of the institute's personnel, in addition to the risk of incorrect estimates, which could affect reports and statistics on the propagation of drought- and salt-tolerant seeds.

The project's agreement with the Kazakh Research Institute of Livestock and Feed Production covers a wide range of subjects including:

- Introduction, production and dissemination of drought and salt tolerant crops (five genotypes of drought tolerant crops);
- Technology development and scaling up for the establishment of cultivated pastures and development of plans for their sustainable use;
- Expansion of pasture crop acreage for the propagation of seeds of local varieties;
- -Implementation of the Soil Scientists Program in Almaty province.

During the three years of cooperation between CACILM-2, Kazakh Research Institute of Livestock and Feed Production and farms, the following equipment was purchased and transferred to seed farms: two tractors, a disc harrow, a double-disc grain seeder with fertilizer tanks, a diesel pumping station, an irrigation machine, a cultivator, a trailed combined tool, a rotary tiller, a filed area measuring device, a mineral fertilizer spreader, a light harrow and a seeder, and a hangar for seed storage was built. Validation certificates and seed quality certificates have also been obtained.

10 World Overview of Conservation Approaches and Technologies (WOCAT) updated with **effective field practices tested in pilot sites in Kazakhstan**

Since early this year, sustainable land management (SLM) practices and technologies that were tested and proved to be effective in pilot sites in Kazakhstan have been documented and posted under CACILM-2 on the global portal WOCAT (World Overview of Conservation Approaches and Technologies), the World Database on Sustainable Land Management recommended by the UN Convention to Combat Desertification (UNCCD) (see https:// qcat.wocat.net/en/wocat/).

1. The practice «**Significant improvement of low-productive pastures by strip sowing of perennial drought-resistant grasses in the conditions of foothill-semidesert zone of southeast Kazakhstan**» is aimed at

accelerated substantial improvement of low-productive pastures by using the technology of strip sowing of perennial drought-resistant fodder grasses (sainfoin, honeysuckle) with preservation of natural grass stands.

The technology is inexpensive, as legumes are sown once every five years, whereas honeysuckle remains productive for 20-30 years. The implementation of this technology has an impact on improving pasture yields and creating a sustainable fodder base for livestock production.

The approach was applied on an area of 30 ha adjacent to Kapal village, Aksu district, Zhetysu province, at Bereke peasant farm.

2. **Practice has shown that introduction of sugar sorghum into rice crop rotation promotes restoration of degraded salt-affected soils, leads to their desalinization and improvement of physical and chemical properties** (pH, porosity, air permeability, etc.).

This also contributes to the diversification and profitability of agricultural production under severe water scarcity as it brings additional opportunities for obtaining quality feed for farm animals and, consequently, gradual transition to livestock farming.

The technology was implemented on an area of 20 ha at Akzharma-1 farm, Akzharma village, Syrdarya district, Kyzylorda province.

Dissemination of sustainable land management practices by organizing demonstration plots and field days is among the effective approaches to sustainable land management as it is designed to address declining agricultural land productivity, land degradation, increasing aridity in the region with more frequent droughts and lack of moisture. This approach contributes to addressing gaps in knowledge of new technologies and techniques for restoring degraded lands, in particular pastures, prospective drought and salt tolerant forage crops, and raising awareness of

The Field Days encourage the dissemination of information on SLM technologies, which is important for their further successful implementation.

the importance of their application for economically and environmentally viable agricultural strategies in the face of climate change.

During the Field Days at the experimental plots, farmers, representatives of local administrations, employees of research institutes and other partners learn about new technologies and techniques for restoring degraded lands, drought and salt tolerant crops that are unconventional for the region, and exchange contacts and experience. The Field Days encourage the dissemination of information on SLM technologies, which is important for their further successful implementation.

Background

WOCAT is a global network on sustainable land management (SLM) that facilitates the documentation, sharing and utilization of knowledge to support adaptation, innovation, and decision-making in SLM.

WOCAT provides free access to documentation on proven SLM practices from around the world and offers practitioners the opportunity to share their own SLM practices. Due to its long-term presence and extensive documented material (more than 2000 SLM practices), the WOCAT database has been officially recognized by the UN Convention to Combat Desertification (UNCCD) as the main recommended Global Database for the best SLM practices.

WOCAT defines SLM as the use of land resources, including soil, water, vegetation, and animals, to produce goods and provide services to meet human needs while ensuring the long-term productive potential of these resources and maintaining their ecological functions. SLM practice can be either an SLM technology or SLM approach.

The purpose of documenting and assessing land use practices is to publish and disseminate essential land use knowledge, support evidence-based decision-making, promote best, most effective practices, and thereby contribute to the prevention and reduction of land degradation and its restoration.

WOCAT, together with its network partners, has developed a well-established framework and standardized tools and methods for documenting, monitoring, evaluating, and disseminating SLM knowledge covering all steps from data collection through a few questionnaires to the Global SLM Database and the use of the information to support decision-making.

11

Project progress discussed in Turkmenistan

The project working group met at the National Institute of Deserts, Flora, and Fauna under the Ministry of Agriculture of Turkmenistan (MoAEP NIDFF).

The meeting was attended by the representatives of various departments of the Ministry of Agriculture, Academy of Sciences of Turkmenistan, Turkmen Agricultural University, Production Association 'Orimeidanlarısuvlandırash', Water Management Deisgn Institute, Kopetdag Nature Reserve, scientists, and experts of NIDFF, national manager, project experts and other specialists.

The meeting was opened by Mr. M. Yusupov, Deputy Head of the Department for Coordination of International Environmental Cooperation and Projects of the Ministry of Agriculture of Turkmenistan and Project Coordinator, noting that fruitful cooperation is evolving between FAO, the Ministry of Agriculture and Environmental Protection. The meeting participants were briefed on the accomplishment of tasks for 2022 and three months of the current year. The discussion also covered the action plan for the second half of 2023.

Rahmanberdi Hanekov, National Project Manager, gave a detailed account of each of the planned activities, as well as the technologies and methods being implemented in each pilot region. The participants were also familiarized with the plan for procurement of new agricultural machinery and equipment for 2023.

Planned trainings and workshops, as well as preparation of printed materials on effective methods and technologies were also discussed at the meeting. One of the key topics of the meeting was the updating of the National Action Program to Combat Desertification (NAPCD). As M. Durikov, Head of the Scientific Information Center of the Interstate Commission on Sustainable Development and National Coordinator of the UNCCD Convention, noted, Turkmenistan has accomplished a lot to implement NAPCD in recent years, including efforts to combat degradation of desert pastures, soil salinization, wind, and water erosion processes.

Meanwhile, with the adoption of the country's new program on social and economic development, the new National Strategy on Climate Change, the Forest Program, and the Aral Sea Program, an updated version of NAPCD needs to be developed. According to the scientist, it will be developed in the second half of the year with due consideration of modern requirements and tasks set in the programs of socio-economic development of the country.

Durdiyev, Head of the NIDFF laboratory, noted the significance of implementation of the National Digitalization Plan of the system to combat desertification processes on the territory of Turkmenistan. This will enable assessing the state of all agro-geosystems based on combined methods of ground monitoring and remote sensing, digital mapping of soil salinity in all the country's velayats and application of hyperspectral analysis to restore degraded soils.

The meeting was attended by the representatives of various departments of the Ministry of Agriculture, Academy of Sciences of Turkmenistan, Turkmen Agricultural University, Production Association 'Orimeidanlarısuvlandırash', Water Management Deisgn Institute, Kopetdag Nature Reserve, scientists, and experts of NIDFF, national manager, project experts and other specialists.

12

Workshop on pasture management under drought conditions held in Turkmen Nature Reserve

The project organized a workshop on «Methods of sustainable management of desert pastures under conditions of intensified drought and desertification processes in the Central Karakums» at the Information Center of the State Nature Reserve «Bereketli Garagum» in Ahal province.

The event aimed at building the capacity, knowledge, and skills of farmers' field school members in advanced technologies and sustainable management of desert pastures by means of combined fixation of shifting sands in the Central Karakum.

The workshop was attended by the employees of the National Institute of Deserts, Flora and Fauna, specialists of the State Nature Reserves «Bereketli Garagum» and «Kopetdag», members of farmers' field schools, and representatives of local communities. The workshop continued the practice of training local communities in the pilot districts on methods of integrated fixation of barkhan sands and technologies of planting and cultivation of various plant species of sandy soils, such as saxaul, sand acacia, Caspian willow for their further application in practice.

The workshop featured presentations on the status of biodiversity of the Kopetdag State Reserve, methods of sustainable desert pasture management based on combined barkhan sand fixation technologies in the Central Karakum, optimal timing of planting, seed collection, plant watering, etc. in the Karakum desert zone, and the need for local communities to participate in sustainable land management (SLM) in Ahal region.

13

Wells and sardobas constructed in Karakum to restore desert and semi-desert pastures productivity

The project is constructing wells and sardobas in the arid regions of Turkmenistan.

Most of the territory of Turkmenistan is occupied by Karakum — one of the largest deserts in the world. For centuries caravans traveled along the Great Silk Road, including the Karakum Desert, and people, having studied the peculiarities of the landscape and the challenging nature of the desert, built storages of fresh or brackish water in the sands to survive themselves, save their livestock and continue trading and cattle breeding.

In spring 2023, the project completed the construction of 10 wells (20 to 22 meters deep) and 10 sardobas (60 cubic meters each) to provide water to livestock and people in desert communities.

Wells and sardobas are constructed everywhere, so they are found throughout much of the desert zone of the country and are extremely important for watering 45 to 65 percent of the desert rangeland area.

Wells are designed to utilize groundwater for uniform watering and to preserve desert rangelands from overgrazing and degradation. Sardobas are designed to collect and utilize precipitation. They are built in the lowest places of takyrs (clay surfaces), so that precipitation flows down the channel and gradually accumulates in the storage (sardoba), where it is protected from the scorching sun rays and, therefore, rapid evaporation.

In the Karakum desert, surface runoff is generated by precipitation mainly in spring. Rains form groundwater, which is the only source of potable water supply for the local desert population and, most importantly, allows organizing watering for small ruminants throughout the territory of the Karakum Desert.

In spring 2023, the project completed the construction of 10 wells (20 to 22 meters deep) and 10 sardobas (60 cubic meters each) to provide water to livestock and people in desert communities.

Six wells and six sardobas were constructed in Bakharden etrap of Ahal velayat, and two wells and two sardobas were built in Dashoguz and Lebap velayats, respectively.

The constructed wells will ensure equitable watering and reduce degradation of desert pastures, as one well provides water for 0.7 to 1.0 thousand ha of pastures, and a flock of 150-220 sheep can graze around one well. The sardobas can store fresh water so that precipitation can be used for drinking and domestic purposes, but most importantly, they provide the opportunity to keep livestock and young camels.

With sufficient water supply, local communities can develop small-oasis farming for melon crops, vineyards, and plant trees, shrubs and semi-shrubs around houses and outbuildings. Additionally, if the water in the new well is highly saline, some of the sardoba water can be mixed with the well water for the sheep and goats to drink.

Equitable and sustainable watering of desert pastures will enable livestock farms to use valuable desert resources efficiently and prevent their degradation. Farms will be able to earn more income, the number of local farmers, shepherds, pasture users will increase, and they will be more actively engaged in remote desert livestock farming.

Proven effective watering technologies and pasture productivity improvement methods will facilitate their wider replication and implementation, as well as the use of INRM (integrated natural resource management) and SLM (sustainable land management) principles to maintain productivity of desert arid pastures in the context of climate change.

14 Landscape desertification

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In the context of climate change, landscapes of arid lands are exposed to considerable deformation due to natural disasters of various scales (floods, extended droughts, fires over vast areas, etc.). In arid lands, which are more fragile ecosystems, these factors coupled with the impact of anthropogenic factor (intensification of economic activity, population growth, etc.) affect the landscape alterations in the most extensive and harmful for the environment.

As a result, conditions are emerging for rapid changes in the ecological state, in some cases manifesting positively, in others - negatively. However, combined overexposure to different factors is the greatest danger for arid landscapes as it entails drastic disturbance of the balance.

Desert landscapes change most dynamically due to their fragility and vulnerability. Even a small impact may lead to their rapid degradation, while recovery requires a long time and significant costs. That is why the development of such landscapes should be carried out with caution and knowledge of their development nature.

At present, the desert territories of Turkmenistan are being intensively developed: industrial and transportation

infrastructure is built, lands are cultivated for growing agricultural crops, and the areas used as pastures are increasing. In some cases, this leads to the emergence and development of desertification processes.

As practice shows, planning of activities and methods to combat desertification require continuous improvement. The National Institute of Deserts, Flora and Fauna of the Ministry of Agriculture and Environmental Protection of Turkmenistan has accumulated considerable experience in controlling these processes.

Moreover, the country has established a robust legal framework to assist scientists and practitioners in this endeavor and maintains strong international cooperation. Turkmenistan signed the UN Convention to Combat Desertification (UNCCD) in 1996 and already a year later a national action program was developed. The program implementation is based on the 'policy of rapid response' to changes in environmental conditions. As a result, the country has eliminated many large pockets of desertification and created sustainable ecosystems. Working with the remaining small pockets requires a territorial approach, that is, conducting deep and detailed studies, as well as developing steps to restore these lands.

Based on the materials of long-term studies of the nature of the Karakum desert in 1983 the Institute has developed special criteria that have been successfully tested in the deserts of Mongolia, Libya, China, Iran, Uzbekistan, and other countries.

Currently, the UNCCD Secretariat has proposed a new approach to land degradation assessment called 'land degradation neutrality' (LDN). Its main goal is to detect these processes in a timely manner and prevent them from spreading. This approach estimates desertification at the global level and requires adaptation to local conditions at the national, regional, and local levels.

The local (territorial) level of assessment is the most accurate and convenient for studying individual natural areas and administrative territories:

- First, LDN is to be estimated in certain types of landscapes and in its morphological units over time, which is possible at the present stage only by means of remote sensing and mapping. It should be noted that the territory of Turkmenistan is covered by multiple satellites producing images of various types, resolutions, and times.
- Second, a new (dynamic) direction of landscape condition assessment, based on the study of its transformation, is developing effectively now.
- Third, anthropogenic factor contributes greatly to the emergence and evolution of desertification processes, and its burden on landscapes can be estimated only on the basis of statistical data of the administrative region.

Investigating the causes of desertification processes and developing measures to combat them requires a comprehensive analysis of the natural and socio-economic factors of the territory's development. An area in the southern part of the Central Karakum was selected to implement the new approach to the evaluation of these processes in Turkmenistan and to map the study area.

Studies have shown that the territorial approach allows obtaining more detailed data on the state of landscapes over time and compiling refined geotopological (high-resolution, detailed) maps of a particular region or area. Based on them, it is possible to obtain more substantiated and accurate materials to be used in the work on prevention of desertification processes occurrence and development, and to make appropriate and timely decisions.

The experience of applying the territorial approach in the above-mentioned area can be replicated for other administrative units with large desertification pockets. The key natural prerequisites of desertification processes are vulnerability of the landscape and its components to different kinds of impact, aridity of the climate, wide distribution of friable loose sand substrate, sparse vegetation cover, as well as high wind activity.

The territory under consideration includes areas differing in both genesis and age. The change of genetically different types of sediments can be traced from north to south: alluvial proto-Amudarya (Karakum Formation); alluvial-deltaic strata of proto-Tedjen (ridge-takyr complex); alluvial-proluvial foothill plain of Kopetdag.

The terrain of Ahal province is quite diverse: in the south-east - the valley and delta of the Tedjen River; in the south - the Kopetdag Mountains and the foothill plain; in the center - the Central Karakum. The plains are characterized by marine and continental sediments of Tertiary and Quaternary period with a height of 200 m and more. The sand deposits of the proto-Amudarya occupy the most part of the territory and are characterized by great thickness. In the Central Karakum, ridge, cellular, and knobby forms of sand terrain prevail. Sand ridges often reach a length of 10-15 km and a height of 20-25 meters.

Takyrs and solonchaks are widespread. The climate of the area is dry continental. The average ambient temperature in July is +32 °C, maximum is +47 ° C. The average temperature in January is from -0.5 to +0.5°C, and its absolute minimum is -28°C. The annual precipitation is 120-150 mm, with 300-350 mm in Kopetdag.

Sand desert soils and takyr soils prevail in the Central Karakum, with occasional solonchaks. Friable and loose substrate of sandy soils, sparse vegetation cover and dry climate create conditions for the development of aeolian processes here. On the foothill plain, light gray soils and meadow gray soils prevail. In oases, these lands are used for irrigated agriculture (cotton, grain crops, fruits, grapes, and melons).

The peculiarity of the landscape is to some extent reflected in the species composition of vegetation groups. The desert sand soils are dominated by a formation typical of the Karakums - sedge and white saxaul accompanied by species of kandym that

belong to large shrubs. Shrubs cover an average of 15% of the fixed sands, while the bulk of the sandy surface (40-70%) is covered with sedge turf. Such indigenous plant communities (sedge and white saxaul) are subject to strong anthropogenic impacts, which result in land degradation around wells and settlements. White saxaul communities here were replaced by kandym communities.

The most severe changes in soil-vegetation cover occurred in and around oases, from the territory of which drainage water had been discharged into the contact zone for a long time thus flooding (swamping) the low-lying areas of sands. Their subsequent desiccation led to the appearance of solonchaks here. In the contact zone, natural vegetation was replaced by moisture-loving species of phreatophytes, hydrophytes and halophytes (tamarix, akbash, yantak, reed, etc.) with high (60-70%) projective cover.

Construction of the Turkmen lake 'Altyn Asyr' on the territory of Ahal velayat required connecting the Tedjen central (length - 140 km), Akbugday (74.1), Ruhabat (74.3) and Geoktepi (86 km) inlets to the main collector. The transportation infrastructure of the province is well developed: the Turkmenbashi-Turkmenabat, Ashgabat-Karakum-Dashoguz (530 km long), Tedjen-Sarakhs-Mashad railroad, etc., the Ashgabat-Turkmenabat highway (600 km long) is under construction. The desert part of the velayat is covered with a dense network of dirt roads. Its territory is crossed by many water and gas pipelines, and the northern part is crossed by the main collector of the Turkmen Lake 'Altyn asyr' (100 km), to which water pipelines from irrigated lands are connected. Economic activity is intensively developing in this territory, which has a certain impact on the natural environment changing its landscapes depending on the time and degree of impact.

Thus, taking into account the natural conditions of Ahal province, availability of resources, nature of economic activity and social development, three major sectors have been identified on its territory:

- *agricultural* (irrigated farming and livestock breeding, creation of hydrosystem - canals, collectors, lakes, ditches, reservoirs);
- *technogenic* (exploration and extraction of minerals; residential and industrial development; creation of transport infrastructure - roads and railways, oil and gas pipelines, power lines);
- *recreational* (tourism).

External impacts on landscapes are characterized by both permanence and cyclicality, can be direct and indirect, which determines the degree of their change. As already mentioned, the new concept of desertification evaluation requires studying a specific territory (natural area) taking into account the dynamics of changes in its landscape, i.e. obtaining comprehensive information both on desertification processes and other manifestations on the Earth's surface.

Everything that occurs on the surface of the Earth is a change in the landscape. The latter is the place of origin, development, and completion of the life cycle of living things (biotic factors - living environment), as well as the location and propagation of non-living substances (abiotic factors - non-living environment), the origin, development and manifestation of various processes. The landscape and its natural resources are exploited by humans intensively, diversely, and unfortunately, sometimes irrationally.

Thus, it is necessary to undertake costly environmental protection measures. Proceeding from that, it is proposed to apply the term 'landscape desertification', as it implies covering a whole range of issues within a certain area of the territory from the initial to the final stages of occurrence and development of desertification processes on it, and, most importantly, specifies them.
According to geographers, a landscape is a relatively homogeneous area of the earth's surface, which qualitatively differs from others in external parameters, climate, geological structure, soil and vegetation cover and internal morphological structure. Furthermore, scientists distinguish an anthropogenic landscape as a natural landscape, but heavily modified as a result of human economic activity. Currently such landscapes account for more than 60%, and these are the areas with the best quality lands, while the rest are difficult to develop and unproductive.

As noted above, the landscapes of the area under consideration are rich in natural resources for agricultural purposes – fertile soils, vast rangelands, mountain rivers and groundwater. Therefore, irrigated farming and distant cattle breeding are widely developed here. Humans have utilized these landscapes over the centuries causing them to change. Thus, the landscapes of the foothill plain, intensively used as agricultural land, have been altered the most, i.e. transformed into cultural landscapes. Desert landscapes have changed less as these areas were used as seasonal grazing pastures, which kept them from complete degradation. Meanwhile, the lands around wells and settlements are heavily degraded.

Each landscape has its own characteristic features due to its individual vulnerability to external impacts.

Methods for evaluation and mapping of desertification processes under the new UNCCD concept

Desertification is a dynamic process determined by natural conditions and specific human economic activities; therefore, it should be studied in conjunction with landscape dynamics.

The new LDN concept involves estimation of desertification processes based on the key factor - the share of degraded land. To identify it, it is necessary to determine changes in three indicators in spatial and temporal dynamics: landscape condition; land productivity; and soil carbon (humus) stocks.

If none of the three indicators have deteriorated for some time, the territory does not degrade, but if at least one of them shows adverse dynamics, it means that digression process is underway. This method is generic in nature and its application at the national, regional, and local levels is a matter for consideration.

The most relevant and effective in this respect is the local (territorial) level of desertification evaluation, which allows specifying all indicators and elements of processes and phenomena of any natural and isolated (in terms of economic development) area taking into account the activities performed on a permanent basis.
Thus, the implementation of the new concept facilitates the assessment of desertification, although there are difficulties in obtaining historical data on the state of territories since reliable indicators can be obtained only through comparative analysis, i.e. determining the baseline makes it difficult to implement this concept.

It is possible to determine the spatial and temporal distribution of desertification processes by comparing the currently obtained data with baseline indicators. Determination of the baseline level is complicated, first of all, by the fact that only a small part of arid ecosystems is currently unaffected by human economic activity, and the result of estimating the degree of desertification depends on this indicator. Multiyear stationary observations are of great value for determining the baseline level.

For the desert territory of Turkmenistan, such work was carried out by N. T. Nechayeva. The baseline level can be taken as the areas of landscapes with no visible signs of degradation of vegetation cover, wind and water erosion, soil salinization, anthropogenic desertification, i.e. changes in the state of landscapes can be determined only visually and tentatively. Undoubtedly, such an assessment would not be accurate.

An important aspect of comparative analysis for studying landscape dynamics is data from studies conducted in nature reserves and the zone of human economic activity. There are two natural reserves in Ahal province - Kopetdag Nature Reserve (established in 1976; area - 49.8 thousand ha), where landscapes of mountainous and piedmont parts are characterized as minimally modified, and «Bereketli Karakum» (2013; 87.8 thousand ha) with its minimally modified desert territory.

Another approach to finding the baseline is the mapping method. In the 1980s and 2000s, the Institute of Deserts (currently the National Institute of Deserts, Flora and Fauna of the Ministry of Agriculture of Turkmenistan) produced: the map of desertification of arid territories of the USSR (scale 1:2500000), the map of desertification of Turkmenistan (1:1000000), the forecast map of desertification for 20 years (1:1000000), as well as large-scale maps of some districts and regions. Among other indicators, the types and degree of desertification, which were determined by special quantitative criteria, were mapped on them. The indicator of desertification degree shown on the maps can be used for comparative analysis of the dynamics of these processes in modern landscapes. Thus, 1985 can be the baseline year for the current assessment of desertification of the territories under consideration.

In addition, archive data of some organizations that were engaged in the study of water, soil and pasture resources, assessment results of various specialists who studied nature and economic activities in a particular territory, district and region can also be used. Field surveys detailing key sites and recording changes in the condition of landscapes or their components are an important component of such ecological monitoring. Therefore, when no data on the current state of landscapes are available, short-term field studies should be organized. The rate of modification of a particular landscape contour can be used to determine the dynamics of desertification processes.

Thus, human economic activity is conducted depending on the availability or diversity of natural resources of the territory, so its landscape changes differently and its indicators are very different. In this regard, to determine the rate of modification of the oasis landscape, it is necessary to establish the extent to which the area is tilled, while for the desert zone it is necessary to determine the degree of disturbance of the vegetation cover structure. The landscape modification rate is determined by the formula R=S/S1, where S and S1 are respectively the area of modified (disturbed) and almost untouched (slightly modified) areas. If R>0.5, the contour is considered modified, and the dynamics of the direction of this change (improvement or deterioration) can be determined through.

Remote methods of studying desertification processes, their assessment and mapping

Landscape-ecological method gives an opportunity to perform an inventory of landscapes of different taxonomic level, to assess their condition, to determine their resistance to different kinds of impact, the response of natural components to them, to study the degree of transformation and dynamics of change. It is based on continuous aerospace monitoring of desertification and application of GIS. Based on its results, recommendations can be developed to prevent the occurrence and development of desertification processes.

The data of long-term landscape-ecological studies show that the most informative are remote sensing methods, which give a clear picture of landscapes, heterogeneity of the study area, their boundaries, their interconnections, and components, allow to record changes in terrain, soil, vegetation cover, water sources and facilities of human economic activity.

Space images are an integral representation of the Earth surface featuring natural and economic objects. Their interpretation and study of natural patterns gives the researcher the most objective and complete material.

Using methods of indicative interpretation from space images, it is possible to develop indicators of desertification - the state of soils, vegetation, changes in the boundaries of flooding, salinization, lake drying and expansion.

Desertification could be monitored based on indicators of duration of development of various processes and phenomena, their dynamics, obtained by means of aerospace imagery. Depending on the degree of desertification, it should be done in regular intervals:

- severe – 3-5;
- moderate – 5-10;
- weak – 10-15 years.

Map materials, promptly prepared based on space images interpretation, provide an objective assessment of the environmental situation in the area. They are an official and objective document for decision makers.

To study the processes of desertification at the territorial level and their dynamics, satellite images with a spatial resolution of 30 m are needed. The images obtained from Landsat-7ETM+, Landsat-8-OLI/TIRS, Resurs-01 satellites were used in the evaluation and mapping of desertification processes in Ahal province as an example of development of the territorial (local) aspect of the national scheme to combat desertification.

The need for continuous research of desertification processes is primarily related to the requirement for a deeper study of the mechanism of their occurrence and development. The development and production of various maps that serve as the basis for other thematic maps of desertification play an essential role in this critical task.

However, intensive, and continuous change in the state of the natural environment requires the use of faster methods of mapping and expert assessments. For this purpose, it is extremely important to have basic maps - landscape maps, maps of landscape sensitivity to desertification processes, the degree of human impact on the natural environment, land use and territory zoning by frequency of observations.

The landscape map reflects landscape structure and spatial placement and provides a comprehensive description. This map is produced on the basis of combined interpretation (visual and automated) of space images, where homogeneous image patterns corresponding to different landscape categories are clearly distinguished. Another reference material for desertification assessment and mapping is a map of the degree of human economic activity impact on the natural environment. The anthropogenic factor today is the major one (87%) in the development of desertification processes.

One of the most important requirements of thematic mapping of desertification processes is application of systematic approach. It is a series of interconnected and complementary maps based on aerospace survey data. Long-term experience has shown that the more maps of different thematic focus and scale are produced for the study area, the more detailed and profound landscape relationships are revealed. Topoecological (large-scale) maps are especially important. The completeness and reliability of data for desertification control measures depends on the availability of maps of the territory. Today, numerous thematic maps are available, which once helped to develop a clear concept for combating desertification. Deterioration of the

environment caused by the aggravation of relations in the system 'nature-human' and, as a result, more frequent natural disasters (drought, sea level fluctuations) require a deeper and more comprehensive study of desertification processes.

Thus, the success of combating desertification requires the development and implementation of appropriate measures. The implementation plan at the territorial level should be based on compliance with the following principles:

- the territorial aspect offers good prospects for adaptation to the new UNCCD concept, allows obtaining prompt and specific data on the ecological state of an isolated territory, so that local authorities could make timely decisions and promptly implement all environmental protection measures, including ecological inventory of landscapes;
- comprehensive and detailed study of the ecological and socio-economic condition of the territory should be undertaken to avoid the proliferation of undesirable processes;
- timely and appropriate decision-making requires reliable data on the dynamics of desertification processes and accurate mapping material, which can be supported by aerospace landscape monitoring;
- create GIS and data banks for each individual area (landscape);
- the system of measures to combat desertification should be prioritized in the socio-economic development plan of each administrative district;
- the action plan should be comprehensive, covering all national economy facilities that have an impact on natural landscapes;
- priority in research should be given to an ecological approach (landscape-dynamic analysis) basedon the methods;
- the territory exploration should be based on mapping materials of different types, periods, and scales, including space images, which document landscape dynamics and desertification processes;
- to achieve a land degradation neutrality, possibilities of providing «vacation» to landscapes should be considered, i.e. short-term and long-term protection measures should be implemented;
- rapid identification of the ecological state of isolated and limited administrative and natural territories (landscapes) allows prompt decision-making to prevent undesirable processes;
- LDN adaptation to new conditions should be continuously improved considering the dynamics of landscapes.

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Project supports implementation of **National Forest Program in Turkmenistan**

Two nurseries (1 hectare each) and a demonstration plot (about 3 hectares) were organized within the framework of the project at the production sites of Baherden and Dashoguz forestry farms, as well as on the territory of the training farm of the Turkmen Agricultural University (TAU) named after S.A. Niyazov.

Drip irrigation systems with large water tanks have been installed at the nurseries and the experimental plot for sustainable water management.

The project procured 25,000 fruit and berry seedlings for the Ministry of Agriculture of Turkmenistan, the main project partner in the implementation of the National Forest Program, in order to expand horticulture areas in different soil and climatic conditions of Turkmenistan.

The seedlings will be grown on the land plots of the country's forestry farms and at the demonstration plot established on the premises of the training farm of the Turkmen Agricultural University (TAU).

In particular, the plan is to cultivate seedlings of salt-tolerant and drought-resistant fruit varieties (quince, elm, unabi) as well as other crops (safflower, quinoa, alfalfa, barley, etc.) to reduce salinity and improve land fertility.

Moreover, scientific and practical events with the use of modern field equipment for express analysis of soils to solve the problems of agronomic control and increase soil fertility are planned at the demonstration site of TAU. In addition, there are plans to conduct field training sessions with students, postgraduates, and young faculty, which will contribute to environmental education, skills, and knowledge on growing various agricultural products in local conditions.

Expanding fruit tree plantations on forestry plots and harvesting ecologically clean fruit - apples, pears, cherries, grapes, pomegranates, and sweet cherries - will provide farms with additional income along with promoting employment for local communities, especially women, which will help to address a number of gender issues.

This will prevent and significantly reduce the trends of secondary salinization, wind and water erosion, and lead to an increase in crop yields in irrigated areas.

During the sessions, FAO experts explained the organizational and economic principles of greenhouse management and ways to plan the preparation of a greenhouse for growing seedlings.

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Efficient organization of greenhouse farming as key to profitability

At the Hosildor Zamin nursery training complex located in Kashkadarya province, in early June, the project conducted another training on the effective use of greenhouses, which can become a good source of income with a skillful approach.

During the sessions, FAO experts explained the organizational and economic principles of greenhouse management and ways to plan the preparation of a greenhouse for growing seedlings. Improvement of tomato and other similar crops cultivation, peculiarities of growing rare vegetables and other important matters were discussed. The emphasis was on smart agriculture that involves leveraging digital technologies to optimize and automate daily processes, as well as sustainable use of resources and minimal reliance on crop protection products for growing safe food.

Classes were held for the students of the Hosildor Zamin training complex, who were selected from among the citizens listed in the 'Iron Notebook', 'Youth Notebook'

and ‘Women Notebook’ - databases of individual families in Uzbekistan in dire social situations and difficult living conditions.

“Kashkadarya province experiences acute deficit of irrigation water and competent organization of greenhouse farming will allow to grow crops efficiently, get good yields year-round while saving water resources,» noted the national manager of CACILM-2 project in Uzbekistan Muhammadjon Kosimov.

The Hosildor Zamin nursery training complex was established to preserve local varieties of fruit trees, their adaptation to changing climate conditions, as well as to propagate these varieties using the *in vitro* laboratory method.

The project was founded under an agreement between the Zamin Foundation, the Ministry of Agriculture of Uzbekistan and the Khokimiyat of Kashkadarya region with the support of the European Union and the World Bank. The curriculum has been developed with the participation of FAO experts, professionals of the International Agricultural University in Tashkent and the Research Institute of Horticulture, Viticulture and Winemaking named after academician M. Mirzayev, who are involved in the workshops and trainings at all stages of the educational process.

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«When old methods of agro-technique fail, we need to open ourselves to new knowledge and adopt advanced agro-practices» says Zhamshid Zhumakulov, owner of the Bakhtiyor farm, Kamashi district, Uzbekistan.

Three years ago, Zhamshid switched to no-tillage technology sowing the drought-resistant wheat variety ‘Kairok Tosh’ following the recommendation of the project specialists. The seeds were placed in the soil in such a way that the plants would obtain moisture in the deep layers. Throughout the growing season, the farmer had been watching the plants develop, and by the harvesting time, he was amazed to find that instead of the standard 400 kg of wheat per hectare, he had harvested a ton of wheat despite the lack of rainfall.

In addition to wheat, Zhamshid cultivates drought-resistant crops such as barley, millet, and safflower. The key success factor, according to the farmer, was the transition to no-tillage technologies.

Moreover, to take advantage of fall and winter precipitation, the farmer practices early sowing of crops and applies mulching, which helps to retain moisture in the soil and create optimal conditions for growth.

Resource-saving sowing technologies allow for precise depth and density of sowing, which ensures even plant growth. It also leads to more efficient consumption of resources and prevents soil erosion and compaction.

The transition to a new till technology was not easy. First of all, the established view of cultivation methods had to be disrupted. Meetings with CACILM-2 project specialists and trainings were helpful.

Zhamshid's neighboring farmers face the same difficulties because the transition to a new system of working with soil is never easy. However, Zhamshid willingly shares his knowledge with his neighbors and shows them in practice what has to be done to get more sustainable harvests.

«We have always had droughts in Kashkadarya, especially in Kamashi,» says the farmer. «But now the climate is changing very quickly, so we, farmers, need to adapt just as quickly.»

The farmer started sowing with the new technology from an area of four hectares. In 2022, he expanded the area to 25 hectares, half of which he sowed with the seeds received from the project. The remaining 12 hectares were sown with his own seeds and the harvest from them sold, and he had to build his skills in dealing with buyers effectively. As a result, farming has become profitable with minimal land cultivation costs.

The farmer estimated that the old tillage technology required impressive costs - UZS 500,000 per hectare, while zero tillage costs were UZS 50,000 per hectare, which is 10 times less (at 2021 prices).

In 2023, Kamashi farmers expect yields to at least double, and the crop area under the new technology is growing year after year.

The fields of Zhamshid and his neighbors have become a hub of learning and inspiration for many farmers who follow him and apply new technologies to their fields.

In 2022, the farmers united and formed the production cooperative 'Sara Urug Yangi Xayot'. Several female farm owners became active participants in the cooperative. With the assistance of the CACILM-2 project, the cooperative decided to purchase a seed sorting machine this year, and the tireless ladies plan to use it to produce oil from safflower, chickpea, and flax seeds.

«Before the project came to our area, I had never heard of plant varieties that are not afraid of drought and salt in the soil. Now, year after year, we are expanding the area of land cultivated with a technology that is effective for our climate zone and sowing plants that, despite the lack of rainfall, give good yields and bring us sustainable income,» says Zhamshid.

Farmers plan to purchase special equipment for their cooperative for deep seeding and expansion of the new tillage technology to 500 hectares.

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CACILM-2 key staff took part at the **international conference on Soil Salinity Control** in Tashkent

The capital of Uzbekistan hosted three major international events on salt-affected soils: the Second meeting of the International Network on Salt-affected Soils (INSAS), the 6th plenary meeting of the sub-regional Eurasian Soil Partnership and the Global Soil Laboratory Network (GLOSOLAN) training on saline soil analysis. The major international forum gathered 150 participants including professionals from such countries as Armenia, Australia, Bangladesh, China, France, Georgia, Islamic Republic of Iran, Italy, Kazakhstan, Kingdom of the Netherlands, Kyrgyzstan, Malaysia, Pakistan, Senegal, Spain, United Arab Emirates, United Republic of Tanzania, Turkmenistan, Uzbekistan.

The organizers were the Global Soil Partnership (GSP), the sub-regional Eurasian Soil Partnership (EASP) and FAO in Uzbekistan in cooperation with the Ministry of Agriculture of the Republic of Uzbekistan and a number of partners.

The Second meeting of the INSAS network was a prominent event in the series of activities dedicated to soil salinization.

The meeting was held to assess the progress made in the field of combating salinization to date, to identify priorities and develop plans for 2023-2024, as well as to strengthen the cooperation of network members and improve their knowledge and skills in the field of sustainable management of natural resources and controlling soil salinization. INSAS trainings included modeling the movement of water and salts in soils, identification of stakeholders and assessment of their impact on sustainable management of saline lands, as well as mapping of soil salinity using electromagnetic induction at the farm level.

«It is very important that all recommendations, including scientific and technical information, are developed taking into account accessibility for farmers. It is the farmers who are the end users and face the challenges of salt-affected soils in everyday life, they must understand and effectively implement these recommendations.»

On the sidelines of the conference, CACILM-2 organized a field trip, where experts discussed the causes of salinization, the socio-economic consequences of soil degradation, shared best practices and considered the possibilities of further strengthening regional cooperation in this area.

said INSAS Chairman Jorge Battier-Sales. «When developing regulations on the sustainable use of water and soil protection, the possible impact of these processes on the environment should be considered. This integrated approach is very important for achieving sustainable development.»

Trainings on the analysis of salt-affected soils by the Global Network of Soil Laboratories (GLOSOLAN) were held at the 'Tuproqsifattahlil' enterprise under the Ministry of Agriculture of the Republic of Uzbekistan. Laboratory classes were conducted by international experts and representatives of the International Network on Salt-affected Soils (INSAS). The participants learned how to measure soil salinity, pH, and boron content. They also learned more about the management of soil laboratories including the current international standards for quality control and assurance.

During the 6th plenary session of the Eurasian Soil Partnership (EASP), representatives of 12 Eurasian countries discussed the existing barriers to the introduction of sustainable soil management methods in the region and agreed on measures to strengthen regional cooperation and knowledge exchange to overcome the identified problems. The obligations of the Eurasian Soil Partnership are set out in the unanimously adopted Tashkent communique. At the plenary session, a new Partnership action plan was discussed and concurred, and a new chairman and vice-chairman were elected.

On the sidelines of the conference, CACILM-2 organized a field trip, where experts discussed the causes of salinization, the socio-economic consequences of soil degradation, shared best practices and considered the possibilities of further strengthening regional cooperation in this area.

The past events make an important milestone in the development and strengthening of international cooperation to combat land salinization and ensure soil health globally. Such activities are key to improving the sustainability of agricultural and food systems, as well as improving production, nutrition quality, environmental conditions, and quality of life.

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