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INNOVATIVE TECHNOLOGIES IN SOLVING PROBLEMS OF DESERTIFICATION AND DEGRADATION OF SOILS IN TURKMENISTAN

The article is devoted to solving one of the main environmental problems of the world-land degradation and desertification. The main types of desertification are listed. The main man-caused and anthropogenic causes of land degradation and desertification in the country have been determined to date. Traditional methods of combating degradation and desertification are considered, as well as innovative technologies in land reclamation and in the system of rational nature management in Turkmenistan for solving these problems. The problem of soil degradation and desertification is considered not only at the level of one country, but also at the global level. Also the main way to fight with this problem is to inform the public and provide qualified personnel.

***Keywords**: soil degradation, desertification, land devastation, technogenic, anthropogenic, global, reclamation, salinization, ground water, struggle, innovative technologies of land reclamation.*

Formulation of the problem

The problem of land degradation and desertification is one of the global global environmental problems. It is acute not only for countries with arid climate; in recent years, this problem has become urgent for the southern and southeastern regions of Ukraine – and not so much due to the general warming of the climate, but due to the occupation and (as a result) dehydration of the territory of the Crimean peninsula and the conduct of military operations to the east of the country.

The earth for humanity was and remains the main source of sustenance at all times. But intensive use of soils for the production of agricultural products leads to a change in their natural state and fertile properties. The problem of land degradation in the world is almost 80 % associated with irrational economic activity [1]. In Turkmenistan, the total amount of degraded land reaches almost 70 % [2]. This leads to large economic losses in agriculture and causes huge, not always compensable damage to biodiversity in these areas. And the further warming of the climate expected in the coming decades translates the problem of degradation of soils and desertification of territories into a category defining the national security of the country.

The search for solutions to environmental problems associated with desertification of territories and degradation of the soil cover in Turkmenistan, were started even in the days of the existence of the USSR. However, the measures developed and traditionally applied since then are ineffective. Today, to solve the problem of desertification of territories, urgent measures are required and new innovative technologies for land rehabilitation are introduced.

The aim of this work is to study the current ecological situation in Turkmenistan with the solution of desertification and soil degradation problems and to consider innovative technologies for solving these problems.

The main part

Types of soil degradation in Turkmenistan and its causes

One of the most acute environmental problems in Turkmenistan is soil degradation, exacerbated by its ecological-geological and climatic characteristics and the nature of farming. The main types of soil degradation in the conditions of the Turkmen are:

1. Pollution of soils with man-made wastes and chemicals.
2. Irrigation erosion.
3. Overmoistening and secondary salinization of soils.
4. Overmoistening of irrigated soils.

At the present time, about 50 % of the territory of the irrigated land of the country due to a close groundwater table is considered to be miraculously inefficient.

Bogging soil – one of the factors of the destruction of the land. The indicator of its manifestation is a nearly close (0.3 – 1.0 m) flood of groundwater on irrigated and real earth. The excavation, as a rule, is developed in the adjacent canal of irrigation canals, the network of which covers the entire territory of Turkmenistan, in local lowlands, on agro-irrational depressions (depressions in the relief), where infiltration water from the irrigation canals and irrigated fields constantly.

Another factor in the degradation of soils under irrigated land is irrigation erosion. Erosionally inaccessible counts the teritory with a slope of more than 0.002, where the washout occurs, washing and debris of soil microcosm [3]. In the Turkmenistan, it has made a name for itself on the sloping establishments of the main and western foothills of the Kopetdag.

Degradation of irrigated soils occurs as a result of the use of agricultural machinery in the growing season. The load caused by the movement of heavy equipment, as well as the processing of fields at high humidity (above the "physical ripeness") cause a significant compaction of the soil, reducing its fertility [4]. Thus, more than 50 % of the territory of Turkmenistan, occupied by cotton, has a reconsolidated sub-plow layer, the volumetric mass of which exceeds 1.5 g/cm^3.

Types of desertification of land in Turkmenistan and its causes

Desertification is one of the types of land degradation in arid and dry sub-humid areas. It occurs under the influence of a number of natural and man-made factors. On the territory of Turkmenistan, the following types of depletion have been canceled: degradation of rock cover, bogging of pastures, water and wind erosion, technical depletion, soil erosion.

The reasons for the depletion of the country's territory are both natural and anthropogenic factors. The number of natural factors pertains to long-lasting winters and climatic fluctuations. In the conditions of the arid climate of Turkmenistan, natural factors determine the main internal desiccation value, and the natural degradation of natural ecosystems is caused by anthropogenic factors [5]. They include livestock rearing, uncontrolled felling of other cracks, open-cast mining of raw materials, geological exploration using heavy equipment, the impact of industrial complexes and excessive irrigation. The rise of these factors is strongly reversed as a result of the erosion of natural balance in the ecosystems, as well as in the coverage of the territory.

In Turkmenistan, the following methods are widely used to combat soil degradation and desertification, which can be attributed to "traditional" ones:

1. Overmoistening and secondary salinization of soils.
2. Complete transition to irrigated (first of all to drip) farming. Rational use of water resources.
3. Application of methods of mechanical stabilization of sand.
4. Rational management of pasture livestock.
5. Development of special technologies for agroland reclamation in deserts and mountains.

Innovative methods to combat degradation and desertification of land in Turkmenistan

Cardinally solve the problem of degradation of agricultural soils and a reduction in the amount of irrigation water used can the introduction of innovative technology of plant cultivation of closed soil. Due to the prevention of evaporation and the possibility of repeated use, thermal complexes allow to reduce the consumption of irrigation water volume by 90 % (from the one used for growing plants in the open ground) [6]. This way you can grow small-sized shrubs and trees, as well as many types of vegetables and greens. Energy for lighting and air conditioning of greenhouses can provide solar panels [7]. Conventional agriculture in Turkmenistan is limited by high temperatures during the hot season and lack of irrigation water. The introduction of closed-ground plant cultivation technologies will solve this problem.

For the early identification of desertification and de-grading of lands, careful monitoring of the state of all the country's lands in the risk zones is necessary. A modern climate monitoring system and associated hydrological and biological processes is an absolutely essential link in the system of rational nature use. For example, satellite tracking of clouds will allow predicting their movement, which is especially important for arid territories. Due to the unique geographical location, Turkmenistan is provided with a large amount of light hours and inexhaustible energy of the Sun and wind. These unique conditions contribute to the introduction of a new method of land reclamation called "thermal steam". It is in the improvement of the physical properties of saline horizons under the influence of solar radiation and wind. As a result of the dumping of plowing, the saline horizon turns out to the surface, if possible loosens and during the hot summer period is exposed to the sun and wind. Dehydration and irreversible coagulation of soil colloids occur, as a result of which the physical properties of the saline horizon are improved. But this method of land reclamation is applicable for improving the properties of solonetsous soils and saline soils of dry and semidesert zones only with a small amount of precipitation, high and sharply fluctuating temperatures.

Effective struggle against desertification and degradation of soils in Turkmenistan is also facilitated by the rapid growth of the scientific and technical potential of the country.

In order to increase the effectiveness of control over the quality of the biosphere, the requirement is imposed that environmental standards of newly constructed industrial facilities be passed to ecological standards, which in an obligatory order pass the appro-

priate examination in terms of their safety for the surrounding environment.

In many branches of the national economy innovative innovation technologies are being introduced. Large-scale investment projects are being implemented. So, in the Karakum, the Turkmen Lake "Altyn Asyr" is being built, which will improve the state of the irrigated land by root and will solve numerous problems related to the erosion of the soils, bogging and drought, which will have a favorable effect on the ecology of the entire region [8]. The Turkmenistan ratified the UN Conventions on combating desertification and changing the climate. Within the framework of these Conventions (beginning in 1996), there is an intensive work on the implementation of the National Program for the Development of Empty Territories in Central Karakum, including the construction of nuclear facilities in the desert [9]. Already today the technical potential of the Turkmen equipment reaches an equivalent of $1{,}4 \cdot 10^9$ tons of standard fuel per year, and the planned reduction in greenhouse gas emissions should reach 74 %. With the financing of the Global Environment Facility, a new two-million-dollar project to address the problems of land degradation and desertification was launched. The project will be implemented in three project regions: on irrigated land, in the Karakum Desert and in mountain villages. The project will implement specific technical measures to combat land degradation: in the mountains – reforestation, improvement and management of pastures; in the desert – fixation of moving sands; in the irrigated zone – restoration and increase of the fertility of saline lands. In recent years, a number of projects have been implemented in Turkmenistan as well, including a large number of projects. Among them is the FAO project on "Management of seabed and water sources in irrigation systems". Pilot projects in the Mary and Lebap velayats, as well as projects that are financed by USA State Department, GTZ [10], are aimed at the modernization of local irrigation systems.

Conclusions

The main man-caused and anthropogenic causes of The main man-caused and anthropogenic causes of soil erosion and desertification of territories in Turkmenistan are analyzed.

It is shown that in Turkmenistan, where the volume of degraded land is almost 70 %, this leads to large economic losses in the field of agriculture and causes huge, often irreparable damage to biodiversity in these areas. And the climatic changes expected in the coming decades translate the problem of land degradation and desertification of territories into a category defining the national security of the country.

It is shown that the "traditional" methods of combating desertification that have been carried out for many years can not completely prevent the degradation processes, but only suspend them for a short time.

Cardinal solution of the problem of land degradation can be the introduction of innovative technologies in the system of nature management in Turkmenistan: crop cultivation, a modern satellite system for monitoring climatic, hydrological and biological processes, the use of alternative energy sources, and innovative resource-saving technologies.

The proposed measures will be useful in the territories of the south and southeast of Ukraine, over which the same danger is imminent.

References

1. Babayev, A. (1995). Problems of Desert Development. , 17 – 19.
2. Durmanov, D. N., Karmanov, I. I., Efremov, V. V. (1991). Theoretical Foundations and Ways to Regulate Soil Fertility. *Moscow, Agrpromizdat Publ.*, 302 – 304.
3. Kiraev, R. S., Hara, S. L., Mamedov, B. K., Esenov, P. R. (2003). Rational use of arable lands of Turkmenistan. *Ufa, BGAU*, 200 – 260.
4. Voropayev, G. V. (1979). Hydrological and technical aspects of territorial redistribution of water resources in the USSR. *Journal "The problems of desert explore", 3,* 3 – 8.
5. Hara, S. L. , Mamedov, B. K., Esenov, P. (1999). The problems of irrigated deserts in Turkmenistan. *Journal "The problems of desert explore", 3,* 17 – 23.
6. Bobylyov, S. N., Hojayev, A. Sh. (1997). Environmental economics. *Moscow, Teis Publ.*, 220 – 227.
7. Fet., V., Atamuradov, H. I. (1999) Biogeography and Ecology of Turkmenistan – Dordrecht (The Netherlands): *Kluwer Academic Publishers,* 650.
8. Krivileva, S. P., Ginkul, A. P. (2017). The main ecological problems of Turkmenistan and ways of their solution. *Kharkov, Tochka Publ.*, 66– 69.
9. Golitzin, M. V. (2004). Alternative energy sources. *Moscow, Nauka Publ.*, 156 – 159.
10. Karadjayev, D. (2004). Turkmenistan is a country of well-being. *Journal "The Neutral Turkmenistan", 5,* 1 – 2.

Література

1. Бабаев, А. Г. Проблемы освоения пустынь [Текст]/ Бабаев А.Г. – Ашхабад: Ылым, 1995. - С. 17– 19.
2. Дурманов, Д.Н. Теоретические основы и способы регулирования плодородия почв [Текст]/ Д.Н. Дурманов, И. И. Карманов, В. В. Ефремов. – М.: Агропромиздат, 1991. - С. 302 – 304.
3. Кираев, Р. С. Рациональное использование пахотных земель Туркмении [Текст]: учеб. пособие / Р. С. Кираев., С. Л. Хара, Б. К. Мамедов, П. Р. Эсенов. – Уфа: БГАУ, 2003. – 260 с.
4. Воропаев, Г. В. Гидрологические и технические аспекты территориального перераспределения водных ресурсов в СССР [Текст]/ Г.В.Воропаев // Проблемы освоения пустынь. – 1979, № 3. – С. 3 – 8.
5. Хара, С. Л. Опустынивание орошаемых земель в Туркменистане [Текст]/ С.Л. Хара, Б. К. Мамедов, П.О. Эсенов // Пробл. осв. пустынь. – 1999, № 3. – С. 17 – 23.

6. Бобылев, С. Н. Экономика природопользования [Текст]/ С. Н. Бобылев, А. Ш. Ходжаев. – М.: Теис, 1997. - С. 220 – 227.
7. Фет, В., Атамурадов, Г.И. Биогеография и экология Туркменистана [Текст] / В. Фет, Г.И. Атамурадов. - Dordrecht (The Netherlands): Kluwer Academic Publishers, 1999. - 650 с.
8. Кривилева, С. П. Основные экологические проблемы Туркменистана и пути их решения [Текст]/ С.П. Кривилева, А.П. Гинкул – Харьков: Точка, 2017. - 69 с.
9. Голицын, М. В. Альтернативные энергоносители [Текст] / М. В. Голицин. – М.: Наука, 2004. - 156 – 159 с.
10. Караджаев, Д. Туркменистан – страна благополучия [Текст] / Д. Караджаев // Нейтральный Туркменистан. – 2004, № 5. – С. 1 – 2.

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ІННОВАЦІЙНІ ТЕХНОЛОГІЇ У ВИРІШЕННІ ПРОБЛЕМ ОПУСТЕЛЮВАННЯ ТА ДЕГРАДАЦІЇ ПОЧВ У ТУРКМЕНІСТАНІ

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Стаття присвячена вирішенню однієї з головних екологічних проблем світу – опустелюванню і деградації грунтів. Розглянуто основні типи опустелювання, характерні для Туркменістану: деградація рослинного покриву:

- *вітрова і водна ерозія;*
- *техногенне спустошення земель;*
- *заболочування пасовищ;*
- *первинне і вторинне засолення земель, що зрошуються.*

Визначено основні на сьогоднішній день техногенні та антропогенні причини деградації і опустелювання земель в країні. Розглянуто найбільш перспективні для регіонів з аридним кліматом методи боротьби з деградацією і опустелюванням.

Запропоновані інноваційні технології в системі природокористування Туркменістана, і зокрема в меліорації, для вирішення даної проблеми. Запропоновані заходи стануть в нагоді на територіях півдня і південного сходу України, яким загрожує аналогічна небезпека.

Ключові слова: *деградація ґрунтів, опустелювання, спустошення земель, техногенний, антропогенний, глобальний, меліорація, засолення, грунтові води, боротьба, інноваційні технології меліорації*