EEET ECOLOGICAL ENGINEERING & ENVIRONMENTAL TECHNOLOGY

Ecological Engineering & Environmental Technology 2022, 23(5), 72–83
https://doi.org/10.12912/27197050/151624
ISSN 2719-7050, License CC-BY 4.0

Received: 2022.06.17
Accepted: 2022.07.16
Published: 2022.08.01

Determination of Environmental Risks of Agricultural Land of Urbanized Territories around Mining Enterprises

Oleksiy Pirikov[1], Oksana Lunova[2*], Natalia Tyutyunnyk[3]

[1] Expert of NGO "Development for Future" Rizdvjana Str., 29 A, Kharkiv, 61052, Ukraine

[2] State Ecological Academy of Postgraduate Education and Management, Metropolitan Vasyl Lypkivsky Str., 35, Kyiv, 03035, Ukraine

[3] Laboratory of Soil Fertility and Soil Protection Technologies State Enterprise "Experimental Economy" Donetsk NSC IGA NAAS, Myru Str., 1 Village of Sukha Balka, Toretsk, Donetsk Region, 85299, Ukraine

* Corresponding author's e-mail: lunovaov@ukr.net

ABSTRACT

An agroanalysis was carried out, which showed that there is a natural connection between the gross content of nutrients and their mobile nitrogen compounds in the soil. A comparison of the content of gross and mobile forms of phosphorus in the soil showed that in ordinary chernozems the content of gross forms of phosphorus is 0.11–0.13%. The content of gross potassium in soils varies between 1.7–2.4% and the content of mobile from medium to very high degree of security. The study area in terms of the organic matter content of carbon has a rate of 0.9–3.2% (compared to background soils – 3.12%). The results of the research will serve as a starting point for substantiating the alleged contaminated agricultural land, which will contribute to the constant monitoring of areas, the basis of which is to control the condition of the soil cover of agricultural land.

Keywords: agricultural lands, land pollution, ecological risks, mining enterprises, soil fertility.

INTRODUCTION

In the world, the high intensity of man-made pressure on urban ecosystems has exacerbated the problem of maintaining their stability and preventing degradation. Important problems, in this case, are to ensure effective treatment of sewage (Malovanyy et al., 2016, Shmandiy et al., 2017), utilization of sewage sludge (Tymchuk et al., 2020), the use of natural sorbents for the treatment of pollutants contaminated with harmful pollutants (Kostenko et al., 2017; Malovanyy et al., 2019). Particularly important issues for urban areas are the transformation of soil cover, changes in the biological activity of soils, and, accordingly, the ability to perform full environmental functions. Environmental indicators are the main tool for assessing the state of the environment, especially in Europe and Central Asia.

Mining companies are serious polluters of the environment. Mining is the extraction of minerals that absorbs large areas of ldestroytroys the topography of the earth's surface, and the formation of large volumes of rock heaps. Quarries, dumps, and other elements of the industrial landscape lead to significant changes in the hydrological regime of territories, to the processes of water and wind erosion, reducing the yield of agricultural land. Quarries create unfavorable living conditions for people near mining companies.

Domestic and foreign experience in the protection and rational use of soils, of course, shows that exceptional and most effective measures do not solve this problem. Scientific and intellectual potential and socio-political conditions provide the basis for the transformation of agriculture into economically highly productive agriculture. This is possible only in the conditions of systemic use and the establishment of the bioclimatic potential of lands. Such systemic use determines the deep macro-specialization of soil regions. The formation of anti-erosion soil protection and reclamation-landscaped agricultural landscapes presupposes the solution of optimization problems to obtain the maximum net profit from land and preserve or establish soil fertility and the environment as a whole. The results of such research are needed in practice because the land and soil were taken from land users and disturbed to ecome unsuitable for productive use in agricultural production.

Therefore, studies to determine the environmental risks of agricultural land in urban areas are relevant.

Eigenbrod (2020) shows that global monitoring of global land-use models is insufficiently covered, as even the latest models are largely based on the classical theory of land rent in equilibrium. The paper (Molotoks, 2018) shows that the issue of lack of accurate global data on land-use change remains unresolved in the world. A study (United Nations 2021) found that agricultural land is constantly expanding around the world. The reason for this is the increase in demand for agricultural products (Vos, 2019). Difficulties related to global population growth, urbanization, and non-food agricultural production, among other human activities, are also causing the loss of productive agricultural land (Creutzig, 2019) of various sizes in China (Li, 2018), Europe, and Africa (Jayne, 2018). Moreover, the area of projected urban expansion intersects with some of the most productive agricultural lands in the world, especially in Asia and Africa (Felicia 2022). Therefore, land use and change are the main considerations for the transition to sustainable development (Heck, 2018). Efficient management of agriculture with minimal costs and the negative impact on the environment is a problem faced in the twenty-first century, especially in industrial regions (Lunova, 2020).

Also, the analysis of European experience in the field of protection of land and water resources in environmental activities, as well as identifying ways to adapt the foreign experiences to domestic practice, is a priority area of research in modern conditions (FAO, 2002). According to (AL Hashemi, 2021), a third of the world's area is covered by destructive degradation processes. At the same time, it was found that 28% of the world's agricultural land is used for growing crop products that are not consumed, ie spoiled. It is obvious that the use of natural resources unnecessarily causes overexploitation of natural resources, their further depletion, and degradation. An option to overcome the relevant difficulties may be the introduction of soil and water protection, environmental measures and rationalization of resource use on a global scale. In the European Union (Germany, France, Poland) soil protection measures are recognized as a priority and in need of active state support for their implementation. The main condition for the effective functioning of agriculture is the constant care for soil protection and the implementation of a system of measures to increase fertility. Moreover, the main principle 7 of the legislation of these countries is the inadmissibility of measures that lead to deterioration, pollution, and depletion of natural resources. Another area of natural resource protection in the EU is the extensification of farming. Many developed countries (USA, Germany, the Netherlands, Canada) have realized the importance of protecting soil fertility and have legislated a whole system aimed at their preservation.

The reason for this may be the objective difficulties associated with the concentration of mines concentrators, and other industrial enterprises (metallurgical, chemical) in the territory, which significantly worsens the environmental situation. The immediate threat to the environment is not only the intensive activities of coal mining companies, but also their closure, which is a problem and also leads to detrimental effects on the environment. In addition to the significant negative impact on the environment during armed conflicts, which will affect the state of ecosystems and natural resources and the lives of the population long after their end. As you know, in May 2016, the United Nations Environment Assembly adopted a resolution on commitment to environmental protection in areas affected by armed conflict. The UN Commission on International The UN Commission on International Law is currently reviewing the international legal framework concerning the protection of the environment before, during, and after the armed conflict.

An option to overcome these difficulties may be to hold permanent urgent monitoring. This approach was used in the work (Blaga, 2017), but research was conducted only in the controlled territory of Ukraine.

All this suggests that it is appropriate to conduct a study to determine the environmental risks of agricultural land in urban areas around mining companies throughout Ukraine.

The study aims to determine the environmental risks of agricultural land in urban areas around mining enterprises (radius 20 km) using a set of chemical and physical analytical methods. This will provide an opportunity to systematize the approach to environmental assessment of environmental risks of pollution of agricultural land use.

The selection of soil samples with GPS binding for analysis was carried out according to the research scheme. To achieve the goal of the research program is expected to solve the following tasks:
- inspect agricultural lands and take soil samples;
- identify the environmental risks of agricultural land in urban areas.

MATERIALS AND METHODS

The study was conducted in two stages:
1. Preparatory stage – in the preparatory stage, the following measures are initially envisaged: organizational work and preparatory work for the survey of land plots are carried out.
2. Field stage – during the land survey, there is a sampling of soil samples using soil characteristics.

Sampling for agrochemical analysis is carried out by taking into account the vertical structure, heterogeneity of soil cover, relief, and climate of the area. Selection points soil samples were taken according to the location of local mines near agricultural land. The research area is agricultural land with appropriate agricultural technologies and measures.

Schematic representation of the technology of soil sampling for the implementation of research work "Reducing the risk of natural disasters in the regions affected by the conflict in eastern Ukraine." Equipment and materials for fieldwork:
- planning and cartographic basis of land use;
- shovel according to GOST 19596;
- plastic, paper or linen bags, and cardboard box with current regulations;
- kraft bags according to GOST 2226;
- satellite geopositioning device.

The main sources of pollution around the city of Toretsk, Donetsk region are mines: North, Toretsk, Central, Artem, St. Matron, metallurgy, and chemical industry (branch of PJSC "Avdiivka Coke Plant", New York, Donetsk region).

The obtained material is processed based on DSTU and DSTU ISO and methods of mathematical statistics using cluster analysis.

Sampling for agrochemical analysis is carried out by taking into account the vertical structure, heterogeneity of soil cover territories, and climate. Soil sampling points were selected according to the location of local mines near agricultural land (Fig. 1). The research area is agricultural land with relevant agricultural technologies and measures.

To determine the physico-chemical and other indicators of the soil use the average sample of a particular land plot, which is made from each soil separation separately. And laboratory analysis of averaged samples of variegated soil cover is carried out from each soil weeding or agricultural group of the field, or land.

A soil survey was conducted on soils of agricultural use with a system of fertilizers and crop rotations (Fig. 2).

Point 1 near the village of Druzhba is an administrative-territorial unit subordinated to the Toretsk City Council of the Donetsk Region of Ukraine. North mine impact zone. Geographical data: sample 1 – 48° 24'45.03 "N 37° 53'46.81" E; sample 2 – 48° 25'11.77 "N 37° 53'08.36" E. The average height above sea level is 217 m. Soil characteristics of selected soil samples:
- sample 1 – chernozem ordinary medium-eroded on clays;
- sample 2 – chernozem ordinary medium-washed on loose sandy rocks.

Point 2 is located near the village of Daphne - subordinated to the Toretsk city community of Bakhmut district of Donetsk region of Ukraine. Zone of influence of Toretska mine. Geographical data: sample 1 – 48°25'46.38 "N 37°52'06.69" E; sample 2 – 48°26'14.26 "N 37°51'35.79" E. The average height above sea level is 175 m. Soil characteristics of selected soil samples:
- sample 1 – chernozem ordinary low-humus carbonate;
- sample 2 – chernozem ordinary weakly eroded on loose sandy rocks.

Point 3 are agricultural lands of SE "Donetsk" NSC IGA. The area of influence of the Central mines and the Artem mine. Geographical data: sample 1 – 48° 21'10.16 "N 37° 48'50.91" E; sample 2 – 48° 21'47.93 "N 37° 47'57.75" E. The average height above sea level is 175 m. Soil characteristics of selected soil samples:

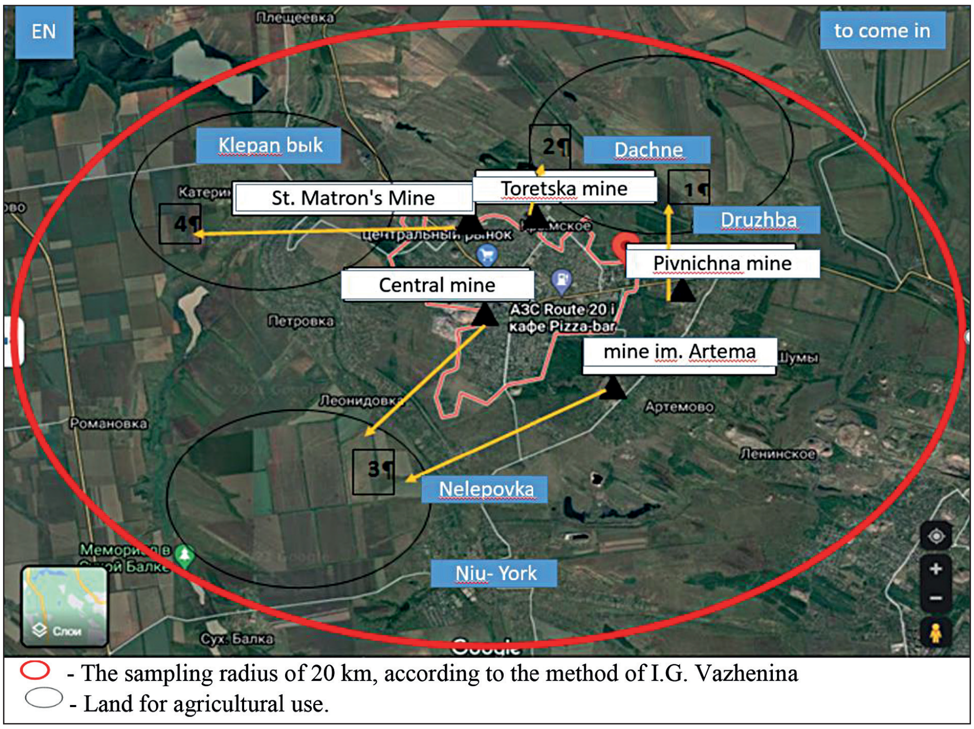

Figure 1. Schematic representation of the technology of soil sampling. GPS binding area with 8 soil sampling points: 1 – selection of 2 soil samples in 0–30 cm layer of soil (contaminant – closed mine North); 2 –selection of 2 soil samples in 0–30 cm layers of soil (contaminant – the existing mine Toretskaya); 3 – selection of 2 soil samples in 0–30 cm layer of soil (pollutant – the existing mine Central, closed mine named after Artem); 4 – selection of 2 soil samples in 0–30 cm layer of soil (contaminant – closed mine of the Holy Matron)

- sample 1 – chernozem ordinary medium washed on the eluvium of sandstones;
- sample 2 – chernozem ordinary strongly eroded on forest rocks.

Point 4 agricultural lands of SE DG "Donetsk" NSC IGA. The area of influence of the mine of St. Matrona. Geographical data: sample 1 – 48° 25'45.65 "N 37° 46'53.69" E; sample 2 – 48° 24'21.27 "N 37° 44'55.07" E. The average height above sea level is 175 m. Soil characteristics of selected soil samples:

- sample 1 – chernozem ordinary medium eroded on the eluvium of sandstones;
- sample 2 – common chernozem strongly eroded on sandstone eluvium.

The sampling of soil samples is selected according to the location of local mines.

a) b)

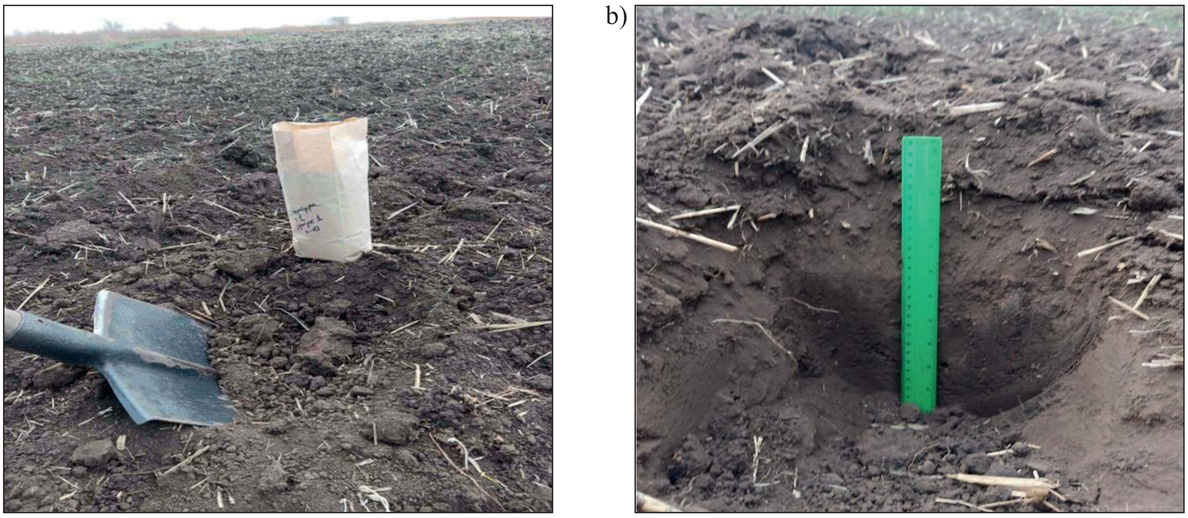

Figure 2. The technology of soil sampling: a) the first sage; b) – the second stage

The survey of agricultural lands is carried out to determine indicators of soil quality, their changes due to economic activity, and soil assessment. All this is done to develop proposals and measures for the protection, preservation, and restoration of soil fertility, efficient use of minerals, organic fertilizers, and chemical ameliorants. On this basis, conditions are created to ensure state control in the field of soil fertility protection.

RESULTS AND DISCUSSION

When determining the agrophysical indicators of the soil during the reaction of the soil solution (pH of the aqueous extract), it was found that this indicator varies from 6.8 to 8.5 according to the area of selection (Table 1). According to (Adamenko, 2014), the soils at these sampling points correspond to the reactions of the soil solution from slightly alkaline - close to neutral according to the gradation of soil grouping. This indicator determines the genetic and production soil properties and is also one of the diagnostic features of the soil.

The reaction of the soil solution of chernozem soils in the region is inherent in the neutral grouping. That is, anthropogenic pollution of soils for agricultural use affects the balance of common chernozem with a tendency to increase its alkalinity, which must be considered when growing crops (Table 1). Since the increase in alkalinity affects the supply of nutrients.

The main means of agricultural production is the soil, and the physical properties of the soil are closely related to the main processes taking place in it. Almost all physical properties of soils (porosity, moisture capacity, water permeability, water capacity, air, and heat regimes) depend on the particle size distribution. When analyzing the soil of the study area, we obtained results that showed that the soil cover is dominated by chernozems of the different particle size distributions (Table 2).

The study of the structure of these soils was guided by the results of the measurement protocol and a single classification scale for particle size distribution. The soil in the studied samples is characterized as medium-heavy loam with a content of physical sand of 29.2–63.9% and a content of physical clay reaching 34.1–70.8% (Table 3).

The studied subzone is dominated (92%) by ordinary chernozems with a physical clay content of 46–75%. The range of fluctuations in the

Table 1. Protocol of measurement results of soil samples (0–30 cm soil layer)

No. n/a		Selection / samples	The pH of water, pH units	Soil solution reaction/gradation of soil grouping
1	Point 1	Sample 1	8.4	Medium alkaline
2		Sample 2	7.6	Weakly alkaline
3	Point 2	Sample 1	6.8	Close to neutral
4		Sample 2	7.9	Weakly alkaline
5	Point 3	Sample 1	8.5	Medium alkaline
6		Sample 2	7.7	Weakly alkaline
7	Point 4	Sample 1	7.9	Weakly alkaline
8		Sample 2	7.8	Weakly alkaline

Table 2. Protocol of measurements of the distribution of granulometric composition of soil in selected samples according to Kaczynski

Soil sampling point		The content of particle size fractions, %					
		1–0.25 mm	0.25–0.05 mm	0.05–0.01 mm	0.01–0.005 mm	0.005–0.001 mm	<0.001 mm
Point 1	Sample 1	12.07	5.02	29.57	3.80	13.85	32.58
	Sample 2	4.48	3.84	25.12	7.57	16.04	42.95
Point 2	Sample 1	1.07	5.64	22.45	8.50	17.76	44.58
	Sample 2	3.64	29.02	21.25	8.82	7.14	29.08
Point 3	Sample 1	22.85	23.47	17.64	4.35	4.12	25.65
	Sample2	9.72	17.56	23.32	7.45	11.76	30.19
Point 4	Sample 1	17.92	18.78	19.21	5.14	10.71	28.24
	Sample 2	12.64	15.24	24.43	7.05	12.72	27.72

parameters of winter wheat productivity with such particle size distribution is 23–32 c/ha in terms of natural fertility and 28–36 c/ha. Since chernozems are the main background of the soil cover in this area, their properties are determined by hydrothermal characteristics and particle size

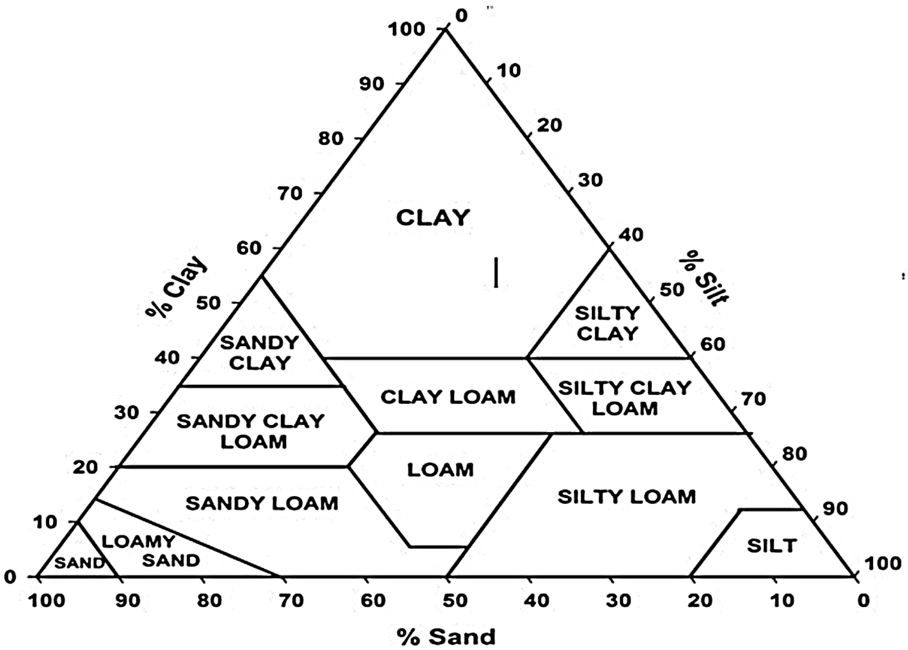

Figure 3. Agrophysical characteristics of soil samples (graphic material, interpretation of data of physical soil indicators of soil particle size distribution according to agro-assessment of lands of the Food and Agriculture Organization of the United Nations

Table 3. Agrophysical characteristics of soil samples. Protocol of results of measurements of granulometric composition of soil in Mastersizer 3000E laser diffractometer

Selection point / Area of influence of mines / Geographical coordinates		The content of particle size fractions,%						
		1–0.25 mm	0.25–0.05 mm	0.05–0.01 mm	0.01–0.005 mm	0.005–0.001 mm	<0.001 mm	The sum of fractions <0.01 mm
Point 1 – North Mine	Sample1 48° 24’45.03 “N 37° 53'46.81" E	7.54	17.26	22.35	6.05	18.76	28.01	52.82
	Sample 2 48° 25’11.77 “N 37° 53'08.36" E	6.36	13.90	20.91	6.35	20.93	31.48	58.75
Point 2 – Toretsk mine	Sample 1 48° 25'46.38 "N 37° 52'06.69" E	7.40	14.18	24.04	7.14	18.92	28.20	54.25
	Sample 2 48° 26’14.26 “N 37° 51'35.79" E	8.18	21.91	22.96	5.51	16.85	24.53	46.88
Point 3 – the Central mine and named after Artem	Sample1 48° 21’10.16 “N 37° 48'50.91" E	12.64	26.13	21.84	5.95	13.74	19.68	39.28
	Sample 2 48° 21’47.93 “N 37° 47'57.75" E	8.80	19.07	23.93	6.65	16.76	24.65	48.06
Point 4 – w. Holy Matron	Sample1 48° 25’45.65 “N 37° 46'53.69" E	10.58	20.06	22.91	7.12	15.92	23.37	46.40
	Sample 2 48° 24’21.27 “N 37° 44'55.07" E	9.95	19.00	23.50	5.56	16.94	24.41	47.41

distribution. Under the conditions of humidification, this area corresponds to $SCC_{v\text{-}ix}$ 0.83–0.89. According to the aridization of climatic conditions, the favorableness of the territory for agriculture decreases, but in general, it is quite suitable for sunflower-grain production.

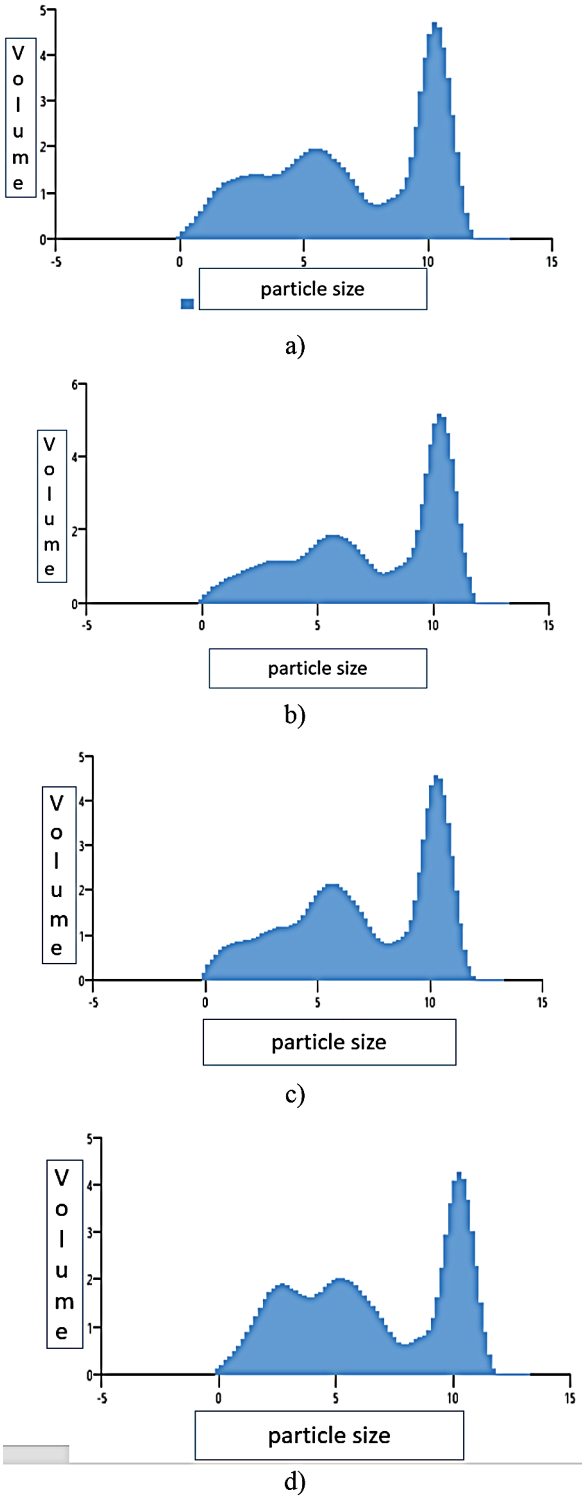

Figure 4. The results of measurements of the particle size distribution of the soil: a) point 1 sample 1; b) point 1 sample 2; c) point 2 sample 1; d) point 2 sample 2

In addition to the classical method of determining the particle size distribution of the studied soils of agricultural lands in the region, research was conducted by analyzing, systematizing, and comparing the methods and classifications used (graphic material, Table 3, Figure 3).

The analysis used publications of both Ukrainian scientists and researchers from other countries on the determination of particle size distribution, available on the Internet, and their own experience of NSC IGA "named after ON Sokolovsky" in the GLOSOLAN network of the FAO project. Which takes an active part in the development of domestic soil science, and in the implementation of comprehensive soil research in Ukraine and other countries.

Cooperation in the framework of international work with the FAO on the impact of climate change and desertification on soil conditions requires the creation, adaptation, and harmonization of national and international methods for determining the particle size distribution (FAO, 2002). To do this, the laser-diffraction method (LDM) is useful, because it allows you to determine the distribution of parts by fractions, the boundaries of which can be set simultaneously by classification Kaczynski, and any other. But this method is the latest and requires the development of methods for use in soil science. Existing methods of particle size analysis, soil classification, and established fraction boundaries were highlighted. They noted that each of the methods has its advantages and disadvantages (Moeys, 2019) developed a program to build a triangle of soil texture of different classifications. About the use of LDM, (ISO 13320: 2020 (E)) provides only recommendations for measuring the distribution of particles by analyzing their light-scattering properties and does not consider methods of sample preparation for analysis.

Pedotransfer functions (PTF) were developed and used by LUCAS A. Makó and co-authors to convert particle distribution indices by sieve-pipette for topsoil samples. This allowed optimizing the clay-silt and silt-sand boundaries for soils with organic matter as well as for soils without organic matter. Al-Hashemi and co-authors, following a study of seven different soil samples from Saudi Arabia, reported that the differences between LD and aerometer methods were insignificant from a geotechnical point of view. In addition, we compared the indicators of the LDM and sieve method and noted the consistency of these sand methods, but they still differed slightly, due to the non-spherical shape of natural sand particles (Table 3, Fig. 3).

As we know, there is no work in Ukraine on the use of a laser diffractometer in soil science, but the transition to a three-member FAO classification system needs to be developed for effective cooperation with the FAO for soil protection. It is well known that quantitative determination of the content of elementary soil particles in the soil is the main component of particle size analysis, as it largely depends on soil fertility.

In determining the agrochemical parameters of the studied soil agroanalysis showed that there is a natural relationship between the gross content of nutrients and their mobile nitrogen compounds in the soil. Microorganisms that assimilate mineral forms of nitrogen, show the level of mobilization processes in the soil can serve as a criterion for determining the effective doses of nitrogen fertilizers (Fig. 5, 6). A comparison of the content of gross and mobile forms of phosphorus in the soil showed that in ordinary chernozems the content of gross forms of phosphorus is 0.11–0.13%. It was also found that the content of mobile forms varies sharply according to the degree of security from medium to very high (Fig. 5, 6). Therefore, it is important to know the correct relationship between soil, fertilizer, and plant.

The content of gross potassium in soils varies between 1.7–2.4%, and the content of mobile from medium to a very high degree of security (Fig. 5, 6). This is due to a lack of moisture and low, in general, agricultural culture. The use of different strategies of crop rotations, fertilizers, and agro-technological processes helps the agronomist to achieve maximum results (Fig. 7).

Indicators of the agrochemical condition of the soil are the total carbon content. This indicator can be considered mandatory, it is used on almost all soils. In the cultivation of any crop, a regional indicator is used, which is characterized by the

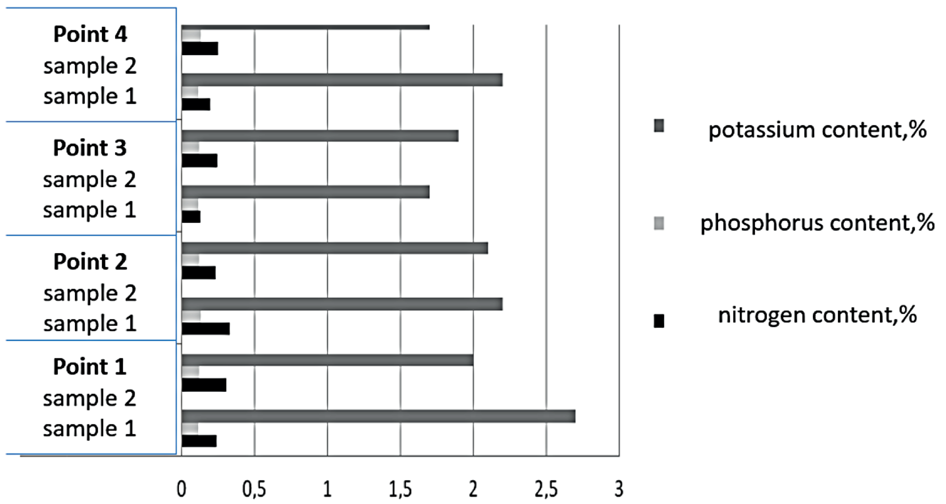

Figure 5. The range of distribution of the content of gross forms in the 0–30 cm layer of soil

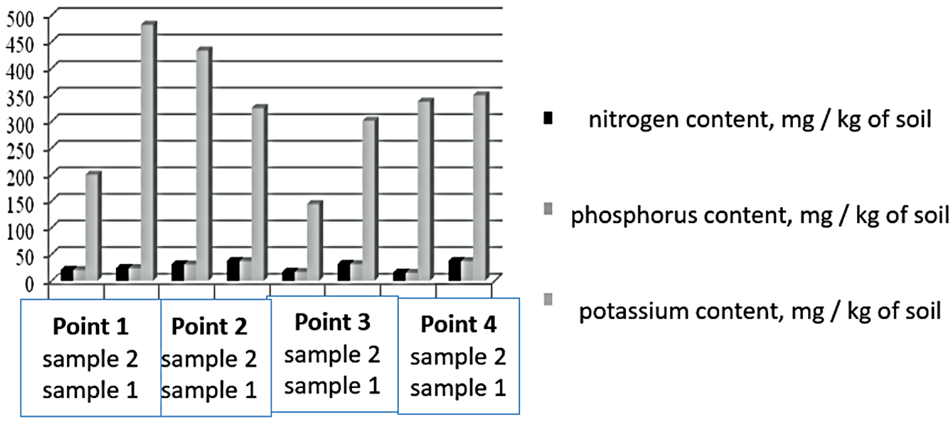

Figure 6. The range of distribution of the contents of mobile forms in the 0–30 cm layer of soil

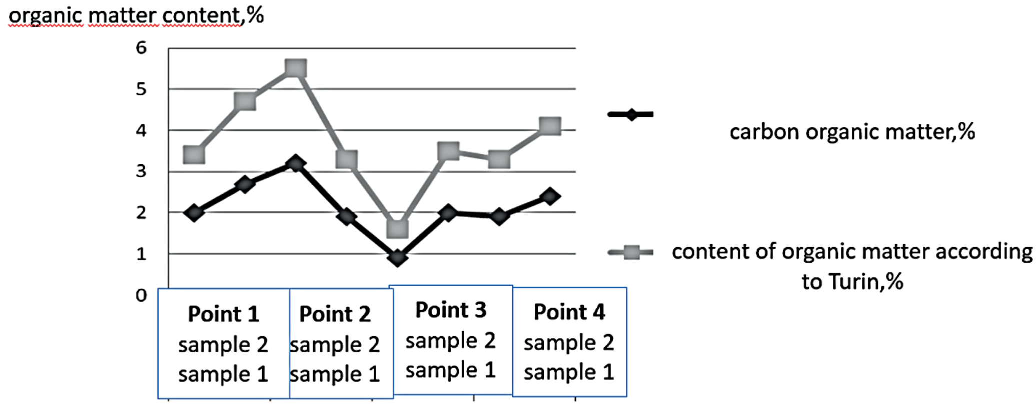

Figure 7. The range of distribution of the content of organic matter according to the area of selection (0–30 cm layer of soil)

natural or anthropogenic transformation of soils with certain specifics (saline, wet, eroded, degraded, and others). The study area in terms of the organic matter content of carbon has a rate of 0.9–3.2% (compared to background soils – 3.12%). The content of organic matter according to Turin (humus content) has a high, high, and very high degree of security (corresponds to zonal soils).

The scientific novelty of the obtained results - a scientific study of the state of agricultural soils according to their main physical and chemical properties under the influence of ethnogenesis in soils of different functional zones.

The basis of agricultural land is arable land, the ecological condition of which in today's conditions is deteriorating, which is primarily due to the development of degradation processes with a particularly strong anthropogenic load. Soil degradation means a significant reduction or even loss of basic biosphere function, which is fertility. The main features that determine the level of soil fertility are their provision with humus, and nutrients, and their water-physical and physicochemical properties, which undergo changes in the process of agricultural land use and are subject to human regulation.

Under the influence of anthropogenic factors which chernozems gradually lose their inherent natural fertility, which has a high and increased degree of security due to the culture of agriculture. According to the results of soil and agrochemical land surveys, the risks of land degradation have been identified.

The risk of flooding mines leads to:

1) raising the level of groundwater. As a result, it causes an increase in the mineralization of aquifers, soils, and waters of the river network by mine waters. These waters contain a large number of soluble chemical compounds, including harmful ones, and make them unusable;
2) increasing the alkalinity of the soil solution, which must be taken into account when growing crops, as increasing the alkalinity affects the supply of nutrients to agriculture products;
3) getting into the soil of mineralized water during irrigation of agricultural land plots affect the secondary salinization of soils:

- risk of unbalanced agricultural nutrition plants leads to a decrease in the quality of agricultural products;
- the risk of finding agricultural land near mine dumps is a dangerous impact on landfills, these techno-soils are toxic because they are saturated with heavy metals, and, accordingly, there is a loss of soil fertility;
- risk of degradation processes due to violation of basic laws of nature;
- risk of reduction of organic carbon where soils lose their biosphere functions (carbon sequestration);
- risk of hostilities, contamination of soils with chemical products due to explosions of ammunition; destruction of landscapes and vegetation due to the use of military equipment and construction of fortifications; destruction of large areas of agricultural land;
- risk of deterioration of the soil situation due to lack of monitoring of their condition and appropriate response;
- risks of obtaining environmentally hazardous products (wheat grain, sunflower seeds, animal feed).

The research on technogenic-anthropogenic-chemical pollution of the environment is carried out, which means the change of chemical properties of the environment. High concentration of industrial, agricultural production, and transport infrastructure in combination with a significant population density have created a huge burden on the largest biosphere in Ukraine and Europe.

The study of agricultural land surveys revealed risks of land degradation: spatial heterogeneity of organic matter content of the studied fields (Fig. 1), this result allowed to recommend for farmers to plow to a small depth of soil, in contrast to (Lunova, 2020). At the same time, it is a favorable measure to improve the water-air regime and physical properties of chernozem soils, restore soil fertility, and to promote adaptation to climate change. The biosphere or ecosystem has almost lost the ability to regenerate with the advent of scientific and technological progress. Artificial substances began to flow into the cycle, which significantly disrupted the natural cycle of substances, led to a reduction in the diversity of ecosystems, the accumulation of waste that was not mineralized by natural destructors.

Pollution of agricultural lands in the region with heavy metals is mainly due to atmospheric emissions from enterprises, due to the use of mineral fertilizers and pesticides where the concentration of such chemical elements as lead and cadmium in the soil increases. As a result of the research we obtained the following result: the relationship between the supply of heavy metals to plants and the quality of the soil (for example, growing plant products on farmland in the area of Toretska mine is risky) (Table 1–3, Fig. 4). products with excessive Cd content In the areas under the influence of the Central and Artem mines, it is risky to obtain products with excessive Cd and Pb content. Yes, as the concentration of these elements in the soil is higher than the background value for the region. Characteristics of data on the content of nutrients in the soil in the study area:

- Cd – in the range from background to moderate. Contamination of agricultural lands on Cd is facilitated by the influence of mines Toretska, Central, them. Artem and St. Matron;
- Pb soil contamination in the area of influence of the mines Central and them. Artem;
- low supply of soils with nutrients such as Zn, Fe, Cu;
- the concentration of manganese in the soil varies from low to very high security.

All this is explained by the fact that the negative environmental consequences of anthropogenically altered - the loss of natural soil fertility due to reduced organic matter content in the soil, which in turn increases the bioavailability of heavy metals. Due to this, the change in indicators should be used as an ecological indicator of imbalance in urban ecosystems.

The development of this study may be in the agrochemical certification of agricultural land, the area of fertile soil decreases every year, and the areas of degraded, eroded, contaminated land, on the contrary, increase. The entry into the soil of a huge amount of industrial waste, chemical fertilizers, pesticides, etc. contributes to the formation of artificial biogeochemical provinces with altered chemical composition and soil properties.

As for the second task of the study, the issues of environmental safety have always been relevant. Unlike (Panishko, 2013), when the war was fought only in eastern Ukraine, now the issue of environmental security concerns the whole of Ukraine. This is due to the military invasion of the Russian Federation and the loss of the departmental system of control over the state of environmental security in the occupied territories (Fig. 1). The main condition for the resumption of this control is the immediate cessation of war. The following must be introduced on agricultural lands:

- monitoring system for the elemental composition of soil and cultivated products,
- system of protection of soil cover from man-caused pollution, rational use and management with urgent implementation of a set of environmental measures.

The disadvantage of this study is that it is necessary to constantly monitor all components of the environment of Ukraine, but this is not possible in today's conditions. The development of the study consists of priority measures that will ensure the environmentally balanced functioning of the territory of Ukraine. Moreover, solving environmental problems will become a key component of sustainable development of Ukraine.

CONCLUSIONS

The survey of agrochemical parameters of the studied soil of agricultural lands showed that there is a natural connection between the gross content of nutrients and their mobile nitrogen compounds in the soil. The content of the mobile from medium to a very high degree of security.

The study area in terms of the organic matter content of carbon has a rate of 0.9%–3.2% (compared to background soils – 3.12%). A comparison of the content of gross and mobile forms of phosphorus in the soil showed that in ordinary chernozems the content of gross forms of phosphorus is 0.11–0.13%. The content of gross potassium in soils varies between 1.7–2.4%, which is explained by the lack of moisture and low, in general, agricultural culture. The use of different strategies of crop rotations, fertilizers, agrotechnological processes help the agronomist to achieve maximum results. In determining the environmental risks of agricultural land in urban areas at the regional level, it was concluded that the environmental situation requires urgent implementation of a set of environmental measures. This is since the region needs to develop new modern methods, taking into account the current environmental situation and forecasting their changes. When using agricultural lands that are at risk of pollution, it is necessary to introduce a monitoring system for the elemental composition of soil and cultivated products with a system of protection of soil cover from man-made pollution, their rational use and management.

REFERENCES

1. Adamenko M., Darmofal E. 2014, Otsinka ekolohichnoho ryzyku v shakhtnykh rehionakh kompleksno- informatsiinym metodom. Systems obrobky informatsii, 8, 171–173. (in Ukrainian)
2. Al-Hashemi B.H. 2021, The validity of laser diffraction system to reproduce hydrometer results for grain size analysis in geotechnical applications. https://doi.org/10.1371/journal.pone.0245452.
3. Amosha O., Starychenko L., Cherevatskyi D. 2013, Stan, osnovny problemy i perspektyvy vuhilnoi promyslovosti Ukrainy: nauk. extra National Academy of Sciences of Ukraine, Institute of Economic Economics, 44. (in Ukrainian)
4. Blaha A., Zahorodniuk I., Korotkyi T., Martynenko O., Medvedieva M., Parkhomenko V. 2017, Na mezhi vyzhyvannia: znyshchennia dovkillia pid chas zbroinoho konfliktu na skhodi Ukrainy. Ukrainska Hensilska spilka z prav liudyny, 88. (in Ukrainian)
5. Buzylo V., Pavlychenko A., Kulyna S., Kiiashchenko V. 2013, Shliakhy zabezpechennia ekolohichnoi bezpeky pry likvidatsii vuhlevydobuvnykh pidpryiemstv. Rozrobka rodovyshch, 437– 440. (in Ukrainian)
6. Viana C.M., Freire D., Abrantes P., Rocha J., Pereira P. 2022, Agricultural land systems importance for supporting food security and sustainable development goals: A systematic review. Science of the Total Environmen, 806. https://doi.org/10.1016/j.scitotenv.2021.150718
7. Creutzig, F. 2019. Assessing human and environmental pressures of global landuse change 2000–2010. Global Sustainability, 2, E1.
8. Eigenbrod, F., et al. 2020. Identifying agricultural frontiers for modeling global cropland expansion. One Earth. https://doi.org/10.1016/j.oneear.2020.09.006
9. FAO. 2002. New Partnership for Africa`s development: Comprehensive Africa Agriculture Development. FAO, Rome. https://www.fao.org/3/y6831e/y6831e00
10. Akinyemi F.O., Speranza C.I. 2022 Agricultural landscape change impact on the quality of land: An African continent-wide assessment in acquired and displaced agricultural lands International Journal of Applied Earth Observations and Geoinformation, 106. https://doi.org/10.1016 /j.jag.2021.102644
11. Prayitno G., Dinanti D., Hidayana I.I., Nugraha A.T. 2021 Place attachment and agricultural land conversion for sustainable agriculture in Indonesia Heliyon journal homepage: www.cell.com/heliyon https://doi.org/10.1016/j.heliyon.2021.e07546
12. Heck V., Hoff H., Wirsenius S., Meyer C., Kreft H. 2018. Land use options for staying within the Planetary Boundaries - Synergies and trade-offs between global and local sustainability goals. Glob. Env. Change, 49, 73–84.
13. Igaz D. 2020, Laser diffraction as an innovative alternative to standard pipette method for determination of soil texture classes in central Europe. https://doi.org/10.3390/w12051232
14. ISO 13320: 2020 (E). 2020. Particle size analysis - Laser diffraction methods. [Second edition 2020-01] International Standard. Geneva, Switzerland, 66.
15. Jayne T.S., Chamberlin J., Headey D.D. 2014. Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. Food Policy, 48, 1–17.
16. Karmazynenko S., Kuraieva I., Samchuk A., Voitiuk Y, Manichev V. 2014, Vazhki metaly u komponentakh navkolyshnoho seredovyshcha m. Mariupol (ecological and geochemical aspects), 168. (in Ukrainian).
17. Kostenko E., Melnyk L., Matko S., Malovanyy M. 2017. The use of sulfophthalein dyes immobilized on anionite Ab-17X8 to determine the contents of Pb (Ii), Cu (Ii), Hg (Ii) and Zn Ii) in liquid medium. Chemistry & Chemical Technology, 11(1), 117-124. https: // doi.org/10.23939/chcht11.01.117
18. Li, Y., Li, X., Tan, M., Wang, X., Xin, L. 2018. The impact of cultivated land spatial shift on food crop

production in China, 1990–2010. Land Degrad. Dev., 29(6), 1652–1659.

19. Lunova O., Yermakov V. 2020, Pollution of the lithosphere as a result of the functioning of the halo field / XVIII International Scientific and Technical Conference “Problemy ekolohichnoi bezpeky”, 48–54. (in Ukrainian)
20. Lunova O. 2019, Ocinka ekologichnyh ryzykiv tehnoekosystem na prykladi rajoniv vugil’nyh rodovyshh Donbasu [Estimation of ecological risks of technoecosystems on an example of areas of coal deposits of Donbass] Ekologichni nauky: naukovo-praktychnyj zhurnal, 4(27), 38–44. (in Ukrainian)
21. Lunova O., Yermakov V. 2020, Zvit pro naukovo-doslidnu robotu. Reducing the risk of disasters and vulnerability of the population in Eastern Ukraine, 1–73. (in Ukrainian)
22. Makó A. 2017. Pedotransfer functions for converting laser diffraction particle-size data to conventional values. European Journal of Soil Science, 769–782. https://doi.org/10.1111/ejss.12456
23. Malovanyy M., Shandrovych V., Malovanyy A., Polyuzhyn I. 2016. Comparative Analysis of the Effectiveness of the Regulation of Aeration Depending on the Quantitative Characteristics of Treated Sewage Water. Journal of Chemistry, (8), 1–9. http://dx.doi.org/10.1155/2016/6874806
24. Malovanyy M., Petrushka K., Petrushka I. 2019. Improvement of Adsorption-Ion-Exchange Processes for Waste and Mine Water Purification. Chemistry & Chemical Technology, 13(3), 372–376. https://doi.org/ 10.23939 / chcht13.03.372
25. Meyfroidt P., Roy Chowdhury R., de Bremond A., Ellis E.C., Erb K.-H., Filatova T., Garrett R.D., Grove J.M., Heinimann A., Kuemmerle T., Kull C.A., Lambin E.F., Landon Y., le Polain de Waroux Y., Messerli P., Müller D., Nielsen J.O., Peterson G.D., Rodriguez García V., Schlüter M., Turner B.L., Verburg, P.H. 2018. Middle-range theories of land system change. Glob. Env. Change, 53, 52–67.
26. Moeys J. 2019, The soil texture wizard: R functions for plotting, classifying, transforming and exploring soil texture data. URL: https://cran.r-project.org/web/packages/soiltexture/vignettes/soiltexture_vignette.pdf.
27. Molotoks, A., Stehfest, E., Doelman, J., Albanito, F., Fitton, N., Dawson, TP, Smith, P. 2018. Global projections of future cropland expansion to 2050 and direct impacts on biodiversity and carbon storage. Glob Chang Biol, 24(12), 5895–5908.
28. Nabyvanets Y. 2018, Ocinka mozhlyvogo vplyvu konfliktu na shodi Ukrai’ny na jakist ‘poverhnevyh vod (za rezul’tatamy spil’nyh doslidzhen’ laboratorii ‘SDBUVR ta Instytutu navkolyshn’ogo seredovyshha, Slovac’ka Assessment impact of the conflict in eastern Ukraine on the surface water quality [based on the results of joint research by the SDBUVR laboratory and the Institute of the Environment, Slovak Republic] Ukrai’ns’kyj gidrometeorologichnyj instytut Derzhavnoi ‘sluzhby Ukrai’ny z nadzvychajnyh sytuacij i Nacional’noi ‘akademii’ nauk Ukrai’ny. (in Ukrainian)
29. Panyshko A., Eremenko A., Khoziaikyna N. 2013, Puty reshenyia problemy zakrыtyia uholnыkh shakht // Suchasni resursoenerhozberihaiuchi tekhnolohii hirnychoho vyrobnytstva, 166–174. (in Ukrainian)
30. Shmandiy V., Bezdeneznych L., Kharlamova O., Svjatenko A., Malovanyy M., Petrushka K., Polyuzhyn I. 2017. Methods of salt content stabilization in circulating water supply systems. Chemistry & Chemical Technology, 11(2), 242–246. https://doi.org/10.23939/chcht11.02.242
31. Smith W.K., Nelson E., Johnson JA, Polasky S., Milder J.C., Gerber J.S., West P.C., Siebert S., Brauman K.A., Carlson K.M., Arbuthnot M., Rozza J.P., Pennington D.N. 2019. Voluntary sustainability standards could significantly reduce detrimental impacts of global agriculture. PNAS, 116(6), 2130–2137.
32. Schulte P. 2017. Laser diffraction size analysis of loess-paleosol sequences – pretreatment, calculation, interpretation: Dissertation. Daily examination date, 163. http://publications.rwth-aachen.de/record/691033/files/691033.pdf
33. Thakur T.K., Dutta J., Upadhyay P., Patel D.K., Thakur A., Kumar M., Kumar A. 2022, Assessment of land degradation and restoration in coal mines of central India: A time series analysis, Ecological Engineering, 175. https://doi.org/10.1016/j.ecoleng.2021.106493
34. Tymchuk I., Shkvirko O., Sakalova H., Malovanyy M., Dabizhuk T., Shevchuk O., Matviichuk O., Vasylinych T. 2020 Wastewater a Source of Nutrients for Crops Growth and Development. Journal of Ecological Engineering, 21(5), 88–96. https://doi.org/10.12911/22998993/122188
35. United Nations. 2021. Glasgow leaders’ declaration on forest and land use. UN Climate Change Conference UK 2021. [accessed 2021 November 21]. https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/
36. Vos R., Bellù L.G. 2019. Global trends and challenges to food and agriculture into the 21st Century. In Campanhola C, Pandey S, (Eds.) Sustainable Food and Agriculture. Academic Press, 11–30.