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THE EVALUATION OF ENVIRONMENTAL SUSTAINABILITY OF GRAY FOREST SOILS UNDER DIFFERENT USES

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Introduction. Soil is a major component of the environment and the biosphere in general. It is known, that this natural resource performs important biosphere functions: productive (biomass production, food), ecological (bioecological, bioenergy, biogeochemical, hydrological, gas-atmospheric) and social. Current state of land resources of Ukraine is of concern, because of the significant areas of fertile soil are land degradation processes. Among the main reasons of soil degradation effect is the non-compliance with the ecologically balanced ratio agricultural lands, forests, meadows and water areas, as well as a significant increase in anthropogenic pressure on the soil in last ten years, which negatively affected sustainability agrarian landscapes *(Patika V.P., Tarariko O.G., 2002).*

Soil degradation is present also a consequence of the use of modern technologies in farming, crop rotations with sow sunflower, rapes, corn, etc. and imperfect organization of relationships in the agricultural sector. In this case, very actual are the soils fertility and their properties research for proposal a measurements of minimization soil degradation processes *(Balyuk S.A., 2010).*

The aim of the work was to assess the ecological sustainability of dark gray podzolic soils in intensive agricultural use, identification of degradation processes and development of ways to improve their fertility. For comparisons investigated the parameters similar soils in the forest belt that is located nearby, where among tree species *Quercus robur* prevailed, *Acer platanoides*, *Fraxinus excelsior*, and grass cover for the most part was represented by weeds and cereals.

Materials and methods research. Environmental sustainability research soils were carried out on cultivated lands of LLC "Agrofirm" Ivankiv". Ivankiv urban-type settlement is located in Boryspil district of Kyiv region. Geomorphologically zoning is a forest-steppe plain Dnieper lowland. Relief mostly flat, sometimes wavy well-marked elevations alternate with lowlands, which is not uncommon pass into the swamps. By typology soils, mostly predominate dark gray podzolic and chernozems podzolic light loam in the woods. The farm specializes mainly in growing cereals, legumes and oilseeds mainly corn, soybeans and sunflowers as well winter wheat to pay rent.

During research were used methodological approaches described in the collective monograph "Agri-environmental monitoring and land certification "edited by *V.P. Patika, O.G. Tarariko (2002)* in the section "Modern degradation processes and ecological and agrochemical state agricultural lands of Ukraine ", prepared by a group of authors *(O.G. Tarariko, V.I. Soroka, D.M. Bentsarovsky, M.V. Kozlov, N.V. Palapa).* According to scientists, the essence ecological stability of soils is in their ability as a natural body, to counteract constant anthropogenic loading and to change the parameters very slowly for a long time.

According to the evaluation criteria excellent condition of agricultural soils parameters should be within optimal limits, which are due to the genetic characteristics of soils and their modern agricultural use. "Environmental sustainability soils "is a component of the integrated indicator" ecological condition of the soil "which also includes" agrochemical fertility indicators "and" parameters of sanitary and hygienic condition". A set of these indicators and their parameters were used during conducting averaged standards agricultural suitability lands for the creation of environmentally friendly raw material zones for production children's and dietary products food. At the same time, the lands were divided into suitable, limited suitable and unsuitable for these purposes.

Research of soil properties to assess its environmental sustainability was performed by the following methods: soil texture according to DSTU 4730: 2007; soil bulk density - DSTU ISO 11272: 2001; soil structure and lumpiness according to DSTU 4744: 2007; soil organic matter contents - DSTU 4289: 2004; soil acidity (pH_{Kl}) - DSTU ISO 10390: 2007; the amount of exchange bases GOST 27821-88; hydrolytic acidity - DSTU 7537: 2015; anti-deflation stability of soils - according to the equation of *E.I. Shiyatiy* and *O.V. Lavrovsky*. Repetition of analytical studies is four times. Statistical processing of experimental data is expressed through confidence interval of the weighted average indicator.

Research results and their discussion. Ecological and agronomic value of soils texture extremely large. The ratio in the soil of elementary mechanical particles of different sizes creates their polydispersity and high specific surface area. Also from the particle size distribution depend on the physical parameters of the soil – structure, density of addition, water permeability, soil resistance to water erosion processes and deflation.

The results of studies of particle size distribution with different uses of soils show that it prevails fraction of coarse dust and fine sand, and the sludge content is 13.1–15.6%. The full name of the soil by texture is dark gray podzolic sandy-coarse-grained light loam.

Estimation of the ability of soils to bind into aggregates by their particle size distribution has such an empirical dependence:

$$S_t = 34,7 + 0,9_{x1} + 0,3_{x2} – 0,4_{x3}$$

where St - indicator of soil ability to bind into aggregates, %; x1 - sludge content (mechanical elements less than 0.001 mm), %; x2 - content of fine-grained sand (0.05-0.25 mm), %; x3 - content of coarse sand (1.0–0.25 mm), %.

According to our data, the particle size distribution was calculated anti-deflation resistance of the soil on field that is intensively used after soybean harvest:

S = 34,7 + 11,79 +8,64 – 3,28 = 51,85 %

According to the classification of E.V. Shiyatiy this soil belongs to group III potential for danger of deflation. Confirmation of this fact is the presence a significant amount of dust in the air after the implementation of autumn technological processing operations. In terms of connectivity to soil aggregates in the forest belt was much more resistant to wind erosion and was - 58.12% and was assessed as the II group of potential danger of deflation.

S = 34,7 + 14,05 + 10,14 – 0,77 = 58,12 %

It is of great agronomic importance and structural and aggregate composition of the soil, because good structure determines provision of plants, microorganisms with water, heat and air, creates physical conditions of root development systems and migration of living organisms. Research of structural structure upper 0–10 cm layer of dark gray podzolic soil for different uses showed that the structure differed between the cultivated soil and forest belt. Thus, the content of lumpiness aggregates (more than 10 mm) in the field after soybeans was a significant amount of 28.9%, indicating the manifestations of agrophysical degradation, sprayed fraction (less 0.25 mm) was at the level of 7.62%, and the content of agronomical valuable aggregates was 61.0%. On dark gray soil under the content of boulders in the forest belt was much lower and amounted to 12.6%, dust - 7.20%, and agronomically valuable aggregates were 80.2%, which corresponds to the scale of *M. Savinov*, as an excellent structure.

The bulk density is the physical characteristic of the soil that determines it effective fertility and, consequently, crop yields. Crops react negatively both on the compacted soils, and on soils, having a loose composition that deprives root system of plants necessary contact with the solid part of the soil. Loose soils easily are subject to deflation, especially their dust fraction *(Bulygin S.Yu. et al., 2018).* Increased density, as well as low water permeability and, accordingly, superficial runoff and washing of fine soil.

We conducted research to determine the bulk density of soil in field after soybean harvesting (anthropogenic pressure on lands) and in the forest belt (without anthropogenic pressure) in soil layers 0-10, 10-20 and 20-30 cm. It was established that the soil cultivation significantly affects its density. Thus, the average bulk density was high and amounted to 1.44 ± 0.04 g/cm^3 in a layer of 0–10 cm; 1.47 ± 0.05 g/cm^3 in layer of 10-20 cm and 1.40 ± 0.05 g/cm^3 in the layer of 20-30 cm. It is noticeably higher than optimal values for growing cereals for this type soils. Results of bulk density shows about agrophysical degradation processes development in cultivated soil layer. While the density of soil under the forest strip was much smaller.

The humus content is an integral indicator level of soil fertility. Soil organic matter creates conditions for good plant life, suitability soil for agricultural use, its

physical condition and biochemical activity. According to our research, the average humus content after harvesting soybeans in the root layer of the soil was 2.89 ± 0.11% and is responsible for DSTU 4289: 2004 as an average indicator regarding the fertility of dark gray podzolic soil. Under the forest strip of humus in the soil was significantly more, and its content was 3.75 ± 0.05%, that assessed as elevated level. Analysis of physicochemical parameters, included in the definition of environmental stability of dark gray forest soil showed a correlation of exchange acidity with hydrolytic, which on arable land was in the range of 3.49 ± 0.30, and in the soil of the forest belt – 4.87 ± 0.79 mg-eq per 100 g of soil. The amount of exchange bases was at the level of 13.2 ± 1.22 mg-eq per 100 g of soil for agricultural use, classified from an ecological point of view, as limited suitable soils. Significantly higher - 20.1 ± 0.49 mg-eq per 100 g of soil, this figure was in the soil under forest belt, which we explain by a large replenishment of biogenic calcium and the resulting magnesium mineralization of deciduous litter and herbs legume and cereal associations.

Summarizing the results of studies of the cultivated soil, we note that such indicators as particle size distribution, the reaction of the soil solution, the degree of saturation of the soil with the bases correspond to the suitability for growing full-fledged environmentally friendly products, and the humus content in arable layer, the sum of the absorbed bases, anti-erosion resistance in content air-dry units and equilibrium. The bulk density was estimated as limited-suitable for growing good crop.

Conclusions. The results of research show that agricultural land use farms with saturation in crop rotation mainly of intensive crops - sunflower, corn, soybeans and the use of heavy agricultural machinery led to manifestations of agrophysical degradation in the form of excessive mudslides, soil spraying and increase in density. Decrease degradation processes are possible achieve the introduction of crop rotation of perennial grasses, which to a large extent, reduce the load on the soil and significantly improve its structure and organic matter content, and will be a good for winter wheat and other crops, increasing not only economic figures, but also the ecological stability of soils.

Trends in manifestation are revealed dehumidification of farm soils caused directly or indirectly their intensive agricultural use and violation of the optimal ratio between land types in the land use system. For stop of soil organic matter loosing must be conditions for the introduction into the system of fertilizers increased share organic manure or the green manure with maximum uses of crop residues.