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Impact of Comparative Assessment of Soil Quality on Determining the Value of Agricultural Land (Ukraine)

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ABSTRACT

The article raises the issue of changes in the value of land plots depending on their quality characteristics. This study investigated the change in indicators of the monetary assessment of individual agricultural districts (NAD) in connection with the indicators of agricultural production groups of soil quality valuation score. Using the normative indicators of the monetary valuation of land plots, the normative monetary valuation was calculated for 10 natural and agricultural districts of the Kyiv region of Ukraine. Thus, in the Skvyrskyi NAD, the normative monetary value is UAH 37,950.08 per 1 hectare, and the average soil quality valuation score in this area was 55 points by level, which is the highest value of this indicator in the Kyiv region. The lowest credit rating score (15) was recorded in the Chornobyl-Borodyansky NAD, where the norm of capitalized rental income was UAH 10,347.52 per 1 hectare. From 42 to 110 agro-production groups of soils are counted in each of the NADs. Based on the Kyiv region, the average indicators of humus content range from 1.91 to 2.47 %. We established a directly proportional relationship between the soil quality valuation score and humus content, in particular, the correlation coefficient between these indicators ranges from 0.8743 to 0.9376. The research results can be used to carry out land evaluation works on agricultural land.

Keywords: soil quality, land evaluation, cadastr, agricultural land, land plot, soil fertility, rational use of land.

INTRODUCTION

In modern conditions of management on agricultural land, it is advisable to consider the use of land resources through the prism of value formation by indicators of land productivity. The economic efficiency of land use is expressed by some natural, relative, and value indicators. Sustainable productivity of agriculture in conditions of constant climate change requires a comprehensive approach through the introduction of environmentally safe technologies.

Climate change, man-made disasters, the rise in built-up areas, and growing urbanization are far from an exhaustive list of threats to food security in the world. At the end of the last century, the problem of the negative impact of intensive land use arose not only in Ukraine (Koptyuk at al.,

2023). That is both the high plowing of the territories and the excessive use of mineral fertilizers, as well as the application of energy-consuming, soil-depleting technologies. All these factors prevent the sustainable use of land resources (Perrin at al., 2020; Rokochinskiy at al., 2021; Kovalenko at al., 2022; Wang at al., 2023). In recent years, urban expansion often occurred on some of the most productive agricultural land, which in turn increased the pressure on food systems. Over the last few decades, the loss of agricultural land has become a growing problem worldwide. That negatively affects the surrounding natural environment and food security (Bren d'Amour at al., 2017; Mugiyo at al., 2021). Therefore, the policy of preserving agricultural land should become one of the priority areas of the policy of each country.

Soil conservation is one of the main goals of sustainable development to ensure food security and environmental protection. Valuation of soil quality is crucial for land use; therefore, it is very important to determine those parameters and indicators of fertility that can become the basis of soil monitoring (Boone at al., 2018; Frolenkova at al., 2023; Openko at al., 2023). Since the monetary assessment of land plots is the basis for determining the amount of land tax and rent, the problem of land assessment based on soil surveys is particularly relevant. The objectivity of determining the monetary value of land depends on the accuracy of soil surveys (Yatsuk at al., 2021). Therefore, financing measures for rational use and protection of land are of great importance for ensuring sustainable development and environmental protection. Following Article 55 of the Law of Ukraine "On Land Protection" the financing of land and soil protection measures is partially carried out at the expense of funds from the land fee. That is why it is extremely important to objectively determine the tax assessment of land. In Ukraine, this role is played by the normative monetary assessment of land plots (Law of Ukraine, 2003).

Plisko at al., (2012) notes that the valuation of soil quality is rather complicated because soil is a heterogeneous body. For soil, it is rather difficult to establish unified quality standards and to determine the base indicators for calculating the overall soil quality valuation score. Sustainable development strategies involve achieving a balance between economic growth and environmental protection. In this context, the preservation of land productivity is an overriding goal. It is extremely important in ecologically unstable areas (Panas at al., 2013; Dmytruk at al., 2021). Climate change and environmental degradation pose an existential threat to both Europe and the whole world. The European Green Deal was developed to overcome these challenges and to combat environmental degradation. The purpose of this agreement is to transform the EU into a modern, resource-efficient, and competitive economy. The provisions of the European Green Deal on land use, agricultural production, and forestry are aimed at changes in the fields of climate, energy, land use, transport, and taxation. Legislative instruments are designed to achieve the goals set out in the European Climate Law and radically transform the economy and society for a fair, green and prosperous future (The European Green Deal, 2023). Determining the parameters of the formation of the value of agricultural land is the subject of numerous scientific studies, and the concept of agricultural land productivity through specifically defined indicators of soil quality requires detailed research.

The formation of an open market for agricultural land is extremely important for the sustainable development of territories. An important role in this is played by the evaluation criteria of agricultural land plots. Researchers emphasize the importance of accurate assessment of agricultural land for both local governments and landowners and land users (Tretiak et al., 2016; Popov et al., 2022). In addition, land valuation may be inaccurate due to methodological, technical and legal factors (Tavares et al., 2022). The process of improving the assessment of agricultural land should be based on the economic and political situation, because the issue of land pricing is complex and multifaceted, and the development of the land market depends on its solution (Buiak et al., 2019). Kasperevych, (2018) points out that modern methods of land valuation in Ukraine allow assessing only the economic benefit from the use of agricultural land, while ignoring the environmental effects that occur in agricultural production. The military aggression of the Russian Federation against Ukraine caused considerable losses to the Ukrainian people. A large part of the agricultural lands suffered significant damage. Damage to farmland has already cost Ukraine $18 billion, says the environment ministry. Due to the obviousness of environmental damage, land valuation needs new approaches, because the full amount of damages and damage to the

environment remains unknown (The Economist, 2023; Shchepak et al., 2023).

An analysis of research over the last decades proves that the condition of agricultural lands is deteriorating all over the world, caused by various types of soil degradation. Seeman T. notes that the price of agricultural land is an important factor in the sustainable development of agriculture in the Czech Republic, as well as the greening of production and the fight against soil erosion and the consequences of climate change (Seeman et al., 2020). The basis of the formation of the value of agricultural land in the Czech Republic is soil fertility indicators according to their main natural properties, according to which, according to the classifier, the land plot is assigned a corresponding code and its base price is established (Khodakivska et al., 2018). The area of agricultural land in Romania is significant, but the agrarian structure is the main reason for the low productivity of agriculture in this country compared to the agriculture of developed European countries. Despite the favorable physical and geographical characteristics of Romania's lands, the existing land policy, which should limit land grabbing, is a cause for concern. It is the establishment of fair land valuation that should become the basis of sustainable development of rural areas (Burja et al., 2016). On the way to joining the European Union, Ukraine should take into account the experience of Romania, where the transformation of agricultural enterprises is taking place to improve economic, social and environmental results in agriculture. The development and implementation of the mechanism of state regulation of the monetary assessment of land will contribute to a stable increase in revenues to the budgets from the ownership and use of land plots, the implementation of transactions with land, the improvement of the effectiveness of the implementation of measures for the rational use and protection of land, will stimulate the use of progressive, resource-saving land management measures (Koshkalda et al., 2021). Polish researchers note that the value of agricultural land plots is influenced by both location factors and the fragmentation of land plots. But the key determinants of cost were the geographical component and the quality of the soil. High-quality soils also drive higher land prices (Kocur-Bera, 2016).

Thus, many scientists note the role of qualitative characteristics of land plots in their evaluation. Taking into account the great variegation of the soil cover, the significant diversity of the soils of Ukraine, the difficulty of conducting large-scale soil surveys in modern conditions (the conditions of the war in the country and subsequent post-war reconstruction), it is necessary to single out the most objective indicators that are directly related to the value of land.

The main goal of research was to determine those indicators of land quality assessment that form the value of agricultural land in Kyiv region in each natural and agricultural district, as well as to identify the relationship between specific soil grading criteria and indicators of normative monetary assessment of land plots. The purpose of the study was to analyze the experience of using soil quality indicators to determine the monetary value of land plots and scientific and methodological substantiation of the formation of the value of agricultural land in the context of sustainable development.

MATERIALS AND METHODS

The analysis (induction and deduction) of regulatory documents and relevant publications on the specified topic and the assessment of the indicators forming the value of agricultural land plots were carried out. This research was conducted on agricultural land in the Kyiv region. The normative monetary assessment of land plots was calculated by the "Methodology of normative assessment of land plots" (KMU, 2021). The normative indicators of the normative monetary assessment for 2021, which are valid, are taken as the basis for the calculation. A correlation regression analysis of the indicators of agro-production groups of soils in ten natural and agricultural districts of Kyiv region was conducted during the study (Table 1).

The natural and agricultural district is a constituent part of the area characterized by similar genetic soil properties, the homogeneous structure of the soil cover, a set of climatic, hydrological, and geomorphological conditions, as well as the factors that fundamentally affect land productivity and efficiency of agricultural production. The allocation of districts is carried out within the region by the homogeneity of land use and soil cover.

Soil quality valuation data are a constituent part of the state land cadastre and the basis for the monetary assessment of agricultural land. They are taken into account when determining the tax value of land. The monetary assessment of land plots in Ukraine, depending on the purpose, can be normative and expert. Trends in the search for new methodological

Table 1. Natural and agricultural districts (NAD) of Kyiv region

NAR code	Name of NAR	Name of NAR zone	Name of NAR area	Name of NAR county
1	Chornobyl-Borodyansky	Polissia	Right Bank Polissia	Central Polissia
2	Vyshhorodsky	Polissia	Right Bank Polissia	Central Polissia
3	Boryspilsky	Forest-Steppe	Left Bank Forest-Steppe	Middle Dnieper- Seimsky
4	Pereyaslav-Khmelnytsky	Forest-Steppe	Left Bank Forest-Steppe	Middle Dnieper- Seimsky
5	Yahotynsky	Forest-Steppe	Left Bank Forest-Steppe	Middle Dnieper- Seimsky
6	Fastivsky	Forest-Steppe	Right Bank Forest-Steppe	Bugsko-Middle- Dniprovsky
7	Skvyrsky	Forest-Steppe	Right Bank Forest-Steppe	Bugsko-Middle- Dniprovsky
8	Bila Tserkva-Myronivsky	Forest-Steppe	Right Bank Forest-Steppe	Bugsko-Middle- Dniprovsky
9	Trypillya-Bukrynsky	Forest-Steppe	Right Bank Forest-Steppe	Prydniprovsky
10	Tetiiv-Bohuslavsky	Forest-Steppe	Right Bank Forest-Steppe	Bugsko-Middle- Dniprovsky

approaches to determining the monetary value of land in Ukraine are associated with the opening of a full-fledged agricultural land market (Novakovskyi, 2015). The monetary assessment geoportal was created as a result of a nationwide (all-Ukrainian) regulatory monetary assessment of agricultural land (KMU, 2018). The methodical principles of monetary assessment of agricultural land in Ukraine are presented in Figure 1. Tax assessment in Ukraine is determined based on normative indicators, which results in a deviation from the market indicators of land assessment. Qualitative monetary assessment will acquire a more important and special meaning in the conditions of the post-war period in Ukraine, as it is a stable source of income for local self-government bodies. That is why the taxation of land plots should be based on the determination of the market value of the property.

RESULTS AND DISCUSSION

For effective monitoring and implementation of land protection measures, it is necessary to

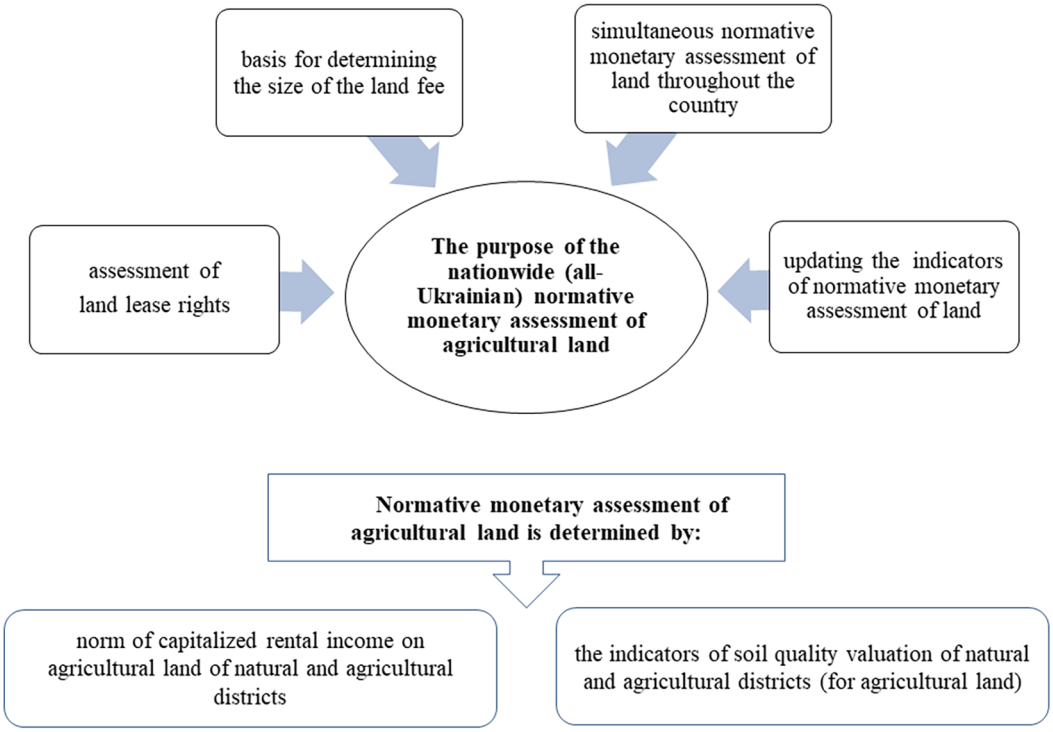

Figure 1. Methodology for determining the normative assessment of agricultural land in Ukraine

have reliable data on soil valuation. The system of agricultural land use since the nineties of the last century in Ukraine led to significant losses in the quality of land resources. The data of soil quality valuation is important information for the state land cadaster, which should ensure highly efficient use of land resources aimed at increasing soil fertility and land productivity.

One of the elements of information support for the monetary assessment of agricultural land plots is soil valuation data. The current method of soil valuation is based on soil properties, which characterize only their potential fertility. In this method, the main criteria for soil valuation are the content of humus and physical clay, as well as the depth of the humus horizon. Modification criteria adjust the soil valuation of eroded, silty, acidic, and other low productive soils using correction coefficients (Methodology, 1992). The main purpose of the comparative valuation of land is to determine the criteria of natural, artificial, and potential soil fertility for rational land use.

The indicators that are the basis for determining the value of agricultural land plots in the Kyiv region were analyzed (Figure 2). In all-natural and agricultural districts of the studied region, a directly proportional dependence of the norm of capitalized rental income (calculated based on the Methodology on the average soil quality valuation score was revealed (KMU, 2021).

Thus, in the Skvyrsky natural and agricultural district, the normative monetary value was UAH 37,950.08 per 1 hectare, and the average soil quality valuation score in this district was 55 for arable land, which is the highest value of this indicator in the Kyiv region. That proves the objectivity of the norms presented in the current methodology of normative monetary assessment of land plots. The results of the analysis of the indicators (that form the soil quality valuation score) confirm the necessity of improving the soil quality valuation methodology. Humus is a source of nutrition for both plants and microorganisms; it provides energy for soil processes as an accumulator of solar energy, which is necessary for the vital activity of crops. Figure 3 shows the dependence of the average soil quality valuation score of natural and agricultural districts on humus content.

Since the generalization of fertility indicators of agro-production groups of soils makes it impossible to obtain reliable data for the cadastral system, the entire set of main soil quality

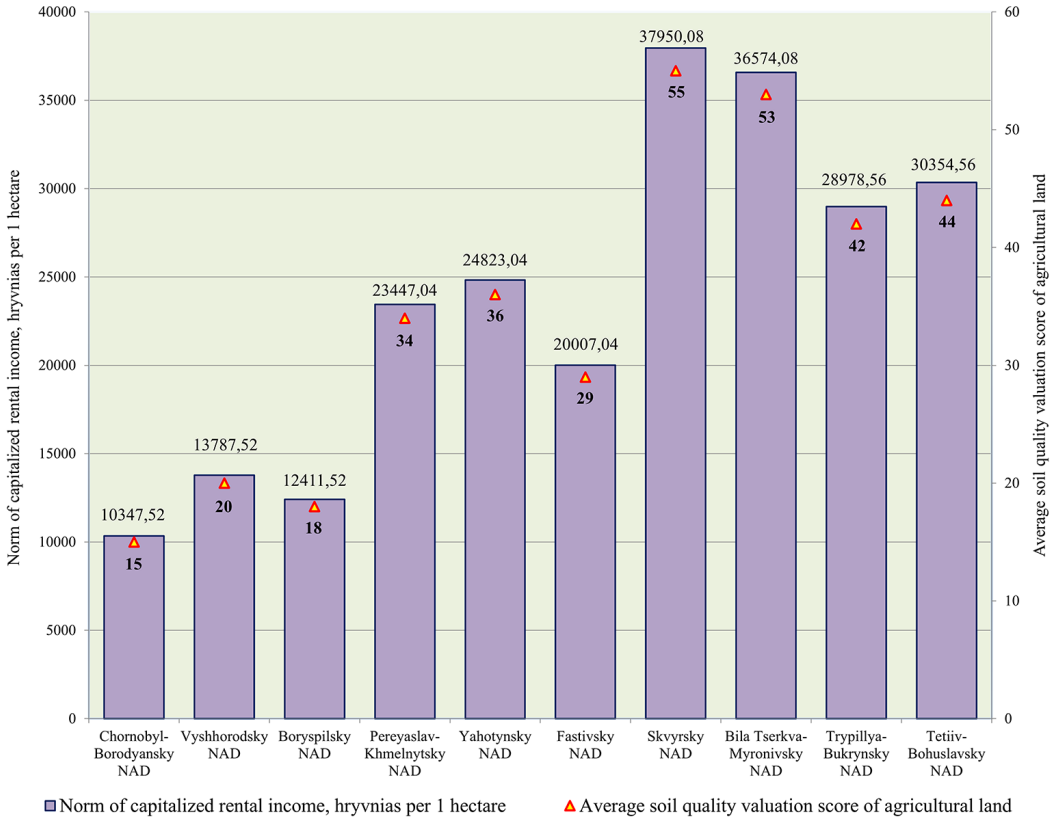

Figure 2. Impact of soil quality valuation score on the monetary value of 1 hectare of arable land

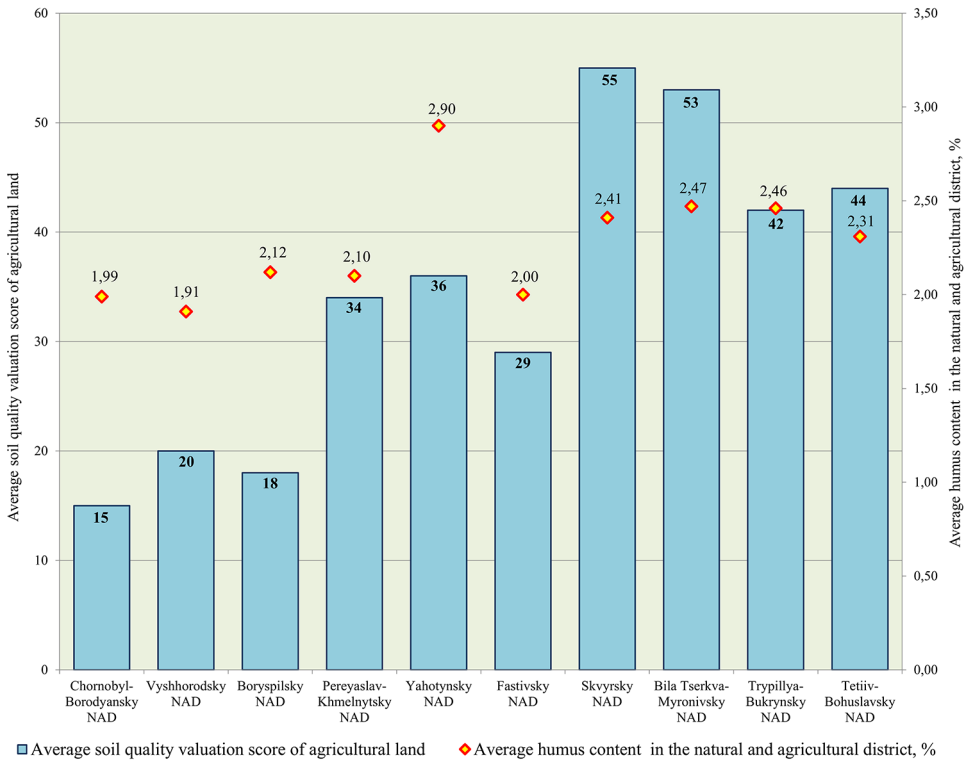

Figure 3. Dependence of the soil quality valuation score on the main soil quality valuation criterion

valuation criteria needs a detailed study. For this purpose, we conducted a research on the dependence of the soil quality valuation score on the humus content of the agro-production groups of soils in each of the natural and agricultural districts using soil quality valuation scales. The results of this research are presented in Figure 4.

The methods of soil quality valuation proposed in Ukraine were developed using different diagnostic features, but in each method one of the most important criteria is the humus content. That's why, in our research the average soil quality valuation score was determined by the humus content in agricultural soil groups (Grading of soils of Ukraine, 1993; Siriy et al., 1995; Medvedev, 2011). Land productivity is determined by soil fertility, namely its ability to ensure crop yield. Fertility of soil is formed in the process of its formation and characterized by a combination of physical, biological, and chemical soil properties. Balyuk, (2017) notes the relevance of reliable information about the soil cover of Ukraine, obtaining new knowledge about the interaction of natural and anthropogenic factors of soil formation, and productive and ecological soil functions and its resource potential (Balyuk at al., 2017).

The correlation coefficient between these indicators ranges from 0.8743 to 0.9376. It is important to adhere to a single methodological approach to soil quality valuation based on the classical method when adding some diagnostic indicators that reflect the consequences of anthropogenic impact (Yakovyshyna, 2020). Smaga, (2012) believes that the use of only the main soil quality valuation criteria (humus horizon capacity, content of humus, and physical clay in the arable layer) without taking into account other fertility factors makes it impossible to obtain objective soil quality valuation scores. He also recommends, in addition to the specified indicators, to use the content indicators of basic nutrients in the topsoil, especially phosphorus and potassium.

By the current methodology, the depth of the humus horizon is the main soil quality valuation criterion, according to which the soil quality valuation score is determined by comparison with the reference soil. The correlation regression analysis of this indicator and the average soil quality valuation score proved a weak dependence, but we cannot claim that this indicator is ineffective. Therefore, a set of indicators for determining soil quality valuation scores of agro-production groups of soils requires a special study. The established dependencies between the basic indicators of soil quality valuation confirm that when assessing land resources within territorial units,

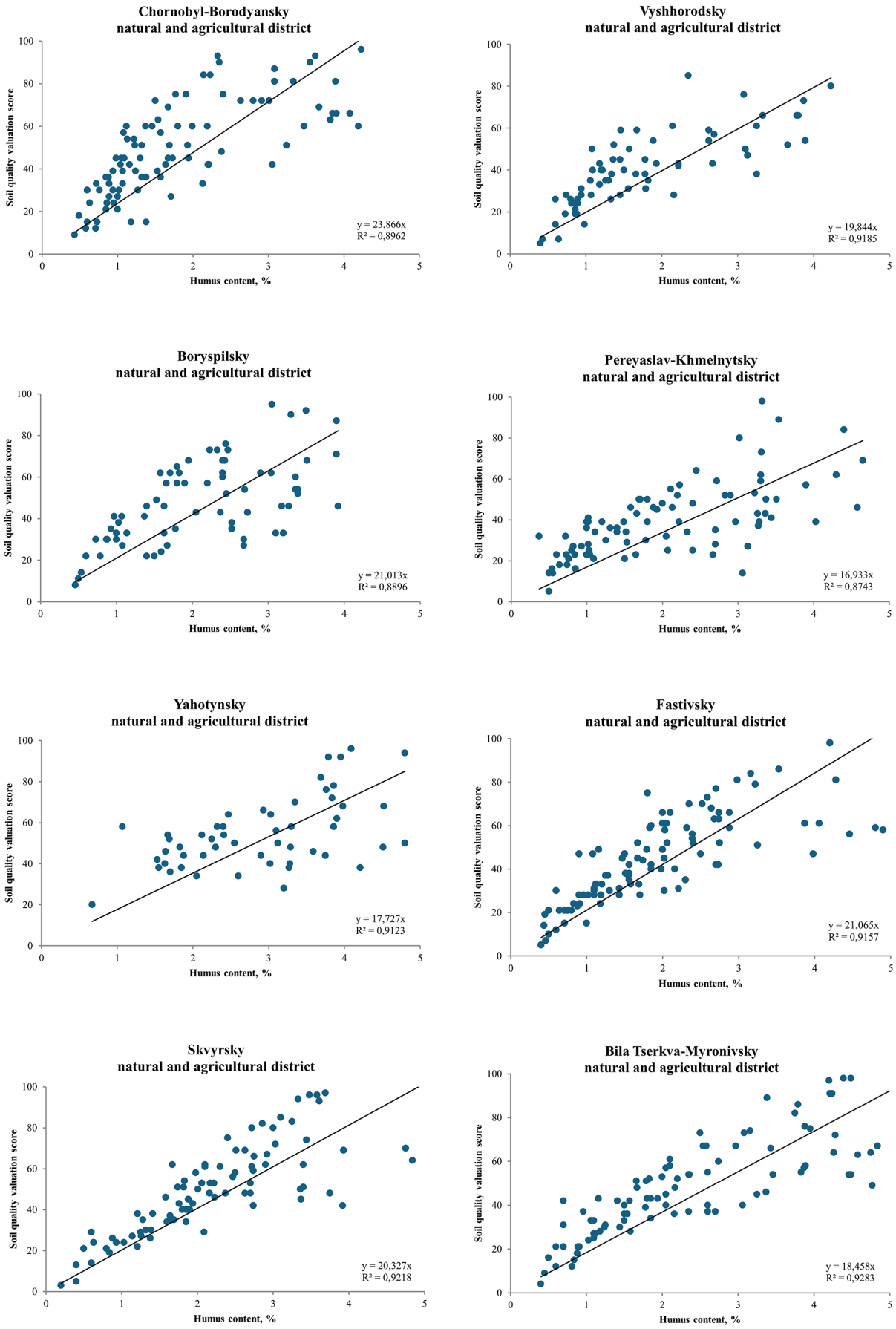

Figure 4. Dependence of soil quality valuation scores on humus content in natural and agricultural districts of Kyiv region

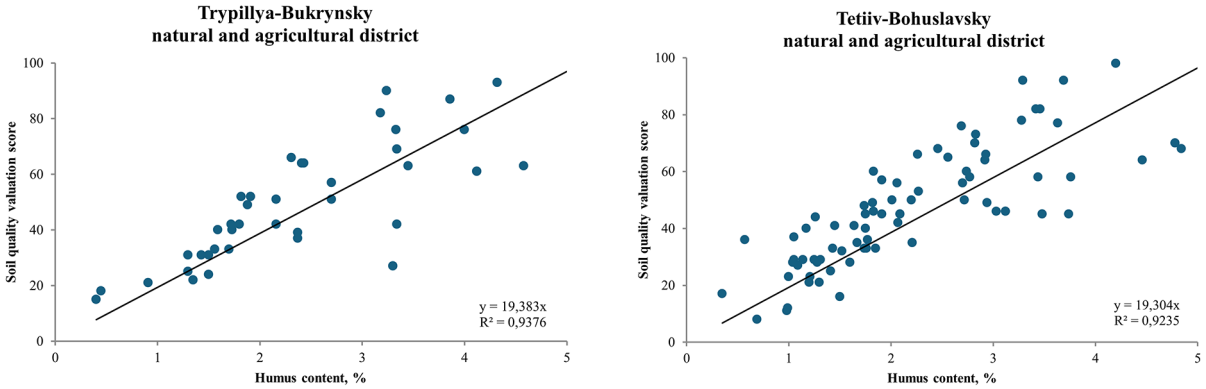

Figure 4. Cont. Dependence of soil quality valuation scores on humus content in natural and agricultural districts of Kyiv region

soil quality valuation has an important scientific and practical significance in the conditions of land market formation.

CONCLUSIONS

As a result of the research, the objective role of soil quality valuation in determining the normative monetary assessment of land plots in the Kyiv region in individual natural and agricultural districts was established. The dependence of the norm of capitalized rental income (from UAH 10,347.52 per 1 hectare to UAH 37,950.08 per 1 hectare) on the average soil quality valuation score (from 15 to 55) in natural and agricultural areas was established. The highest value of the indicator, which is the basis of the normative monetary valuation of the land plot in the Skvyrsky natural and agricultural district, with an average credit score of 55. A direct-proportional dependence of the norm of capitalized rental income on the average soil quality valuation score in natural and agricultural districts was determined. The highest value of the indicator, which is the basis of the normative monetary assessment of a land plot, was in the Skvyrsky natural and agricultural district, having the average soil quality valuation score of 55. That confirms the objectivity of the normative indicators presented in the new universal methodology for determining the normative monetary assessment of land plots.

It was also specified that humus content, as one of the three main soil quality valuation criteria, affects the average soil quality valuation score. It is confirmed by the correlation coefficients (from 0.8743 to 0.9376) and regression equations. Taking into account the great diversity of the soil cover, the difficulty of conducting large-scale soil surveys in modern conditions (the conditions of the war in the country and subsequent post-war reconstruction), the most objective indicators that are directly related to the value of the land are singled out. It is confirmed by the correlation coefficients (from 0.8743 to 0.9376) and regression equations. Studies on the assessment of agricultural land plots based on soil quality valuation are considered promising, not only for providing proper taxation but also for preserving land productivity, ensuring sustainable development, and protecting the natural environment.

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