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COMPOSITION AND SOURCES OF INFORMATION AND ANALYTICAL SUPPORT FOR AGRICULTURAL LAND VALUATION

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Abstract. *It is determined that in order to form a model for agricultural land valuation, it is necessary to use modern methods and tools, in particular, remote sensing, machine learning and artificial intelligence, big data analysis, geographic information systems (GIS), and agroscouting. It is established that the composition and sources of information and analytical support for such a model are crucial. We have determined that among the factors affecting the price and value of agricultural land, we should consider such indicators as environmental sustainability, crop yields, infrastructure development, cultivation technologies, production organisation, logistics, etc. The analysis of these factors and the results of the studies conducted indicate the need to use a large amount of data to ensure an accurate valuation of* *agricultural land. Taking into account these factors and the indicators presented in the study will make the assessment more comprehensive and objective, which, in turn, will facilitate informed decision-making in the field of land relations. It is established that the data available in the state registers do not allow for an objective determination of the value of agricultural land plots. It is also noted that the sources of information for obtaining quantitative and qualitative indicators should ensure their relevance, completeness, reliability and timeliness. The author provides a dynamic list of geoportals that are recommended to be used to obtain such information.*

Key words: *assessment of agricultural land, land market, geographic information systems, remote sensing, crop yields, environmental sustainability, soil fertility, soil productivity for crops*

Problem statement. The general trend in the state of land and land use in the agricultural sector of Ukraine indicates that the best agricultural land is almost constantly exposed to negative factors such as soil erosion, degradation, and urbanisation, where anthropogenic activities have a direct impact. Modern methods such as remote sensing, machine learning and artificial intelligence [1], big data analysis, geographic information systems, and agro-scouting [2] should be used to monitor, manage and evaluate agricultural land. These tools make it possible to assess and forecast the value of land plots with high accuracy. Using large amounts of data, complex nonlinear models can be built, in particular for expert assessment, assessing the risks of bankruptcy of agricultural enterprises, determining the value of property as collateral for obtaining loans and other administrative, planning, financial and economic tasks. The assessment of agricultural land will be used for making management decisions and developing land policy.

In order to achieve maximum efficiency, we propose to improve the methods of agricultural land valuation, taking into account modern technologies and models that allow for a more accurate and reliable determination of their value. These models require appropriate information and analytical support, which must meet high requirements for relevance, accuracy, completeness, reliability of data and information sources. It is also important to include new valuation factors that were not previously taken into account in traditional methods. For example, data on changing climate conditions, socio-economic changes in the region, and the use of satellite imagery to assess soil conditions and yields, etc. can be taken into account.

Analysis of the latest scientific research and publications. According to scientists [3], the information resource should be included in the unified system of land information in accordance with the current legislation of Ukraine - in the State Land Cadastre (SLC). The platform contains hundreds of geospatial and attribute modules and objects, such as Web, GIS, WMS, NSDI, relational databases, geoserver, analytical tools, spatial modelling, etc. A land valuation model can be developed on the basis of information from the SLC portal.

DeMers and others [4] in their study proposed the LESA (Land Evaluation and Site Assessment) model, which is a framework for combining several factors into an integrated assessment of a specific site for further agricultural use. Factors such as soil fertility and quality, soil productivity for growing crops, etc. are incorporated into a single valuation methodology, which allows for a more accurate determination of the value of agricultural land.

Pankiv Z., Kyrylchuk A., Bonishko O. [5] found that the restoration of private land ownership and the introduction of economic mechanisms for regulating land relations require not only data on the area and distribution of soils, but also the results of their qualitative assessment to develop measures for balanced land use. The main disadvantage of agricultural land valuation is the inconsistency of morphological features and physical and chemical properties of soils with current conditions, which calls into question the reliability of the bonitas and normative monetary valuation.

The author of [6] recommends conducting an inventory of non-current assets, including land plots, once every three years, with a breakdown by type of agricultural land: arable land, pastures, hayfields, forests, reservoirs, reserve lands, etc. At the same time, the availability of constituent documents, lease agreements, ownership rights or certificates and other documents confirming the ownership or use of land plots should be checked.

In our opinion, the relevance of obtaining information using modern methods and sources is undeniable, because with the passage of time and changes in the world, the efficiency and timeliness of obtaining reliable information for the formation of information and analytical support for the assessment of agricultural land are becoming extremely important.

The purpose of the study is to investigate the composition and sources of formation of information and analytical support for agricultural land valuation, and also to assess the prospects of their compliance with the modern requirements of land management science.

Materials and methods of scientific research. The study uses a comprehensive method of analysis that combines different approaches to obtain the most accurate and objective results. In particular, a systematic study of the content of information materials made it possible to analyse the available sources of data on crop yields, crop maps, current price offers for agricultural land sales, etc. In addition, a classification method was used to help structure the information by a number of key factors affecting the value of agricultural land. This method allowed us to divide the factors in the land valuation model into four main blocks.

Research results and discussion. Structurally, the agricultural land valuation model should include elements such as machine learning algorithms for analysing large data sets, methods for processing spatial information, and forecasting tools based on historical data and scenario analysis. In addition, mechanisms for automating data collection and analysis should be considered, which will significantly increase the efficiency and accuracy of the assessment. Geospatial technologies, such as remote sensing and GIS, have the necessary tools for land valuation. An important source of information on land cover types is remote sensing data, in particular satellite imagery, as it has advantages such as repeatability of real-time data, cost-effectiveness, wide area coverage, etc. compared to traditional methods, including aerial photography and ground surveys.

GIS is used to create spatial data layers, develop decision-making rules and land valuation. This is due to the fact that land valuation is seen as a multi-criteria decision-making task, and the quality of a site for a particular use depends not only on the values of environmental variables on the site, but also on its surroundings [7]. In creating a database, GIS is a valuable tool because it is used to collect field data, locate and update data.

An integrated approach to structuring the valuation model will allow for the internal division of the geosystem into its components and the identification of mechanisms and factors that will be involved in the process of calculating the value of agricultural land. It is worth noting that their value directly depends on land rent [8]. In more detail, in structural and functional terms, the factors affecting economic efficiency and land rent should be taken into account in the model of agricultural land valuation. We propose to differentiate these indicators into four main blocks, namely:

– nature, which is the basis for crop yields, including the following indicators: soil texture, humus content, photoactive radiation level, soil acidity level, precipitation, total temperatures per year, relief and microrelief, field configuration, climate change;

– production as a process of reproduction of material goods and production relations, which includes the following indicators: system of machines, crop rotation, fertilisation, plant protection, land reclamation, seed production and crop varieties, yield level, warehousing and logistics;

– non-productive sphere of activity and public infrastructure, which includes the following components, namely: indicators of price offers on the land market [9], administrative and economic expenses, commercial expenses, capital investments, repairs, working capital, investment, credit and insurance resources, and the financial condition of the enterprise;

– environmental sustainability of land, which involves determining the level of chemical, biological, physical, radioactive and thermal contamination of soils.

Equally important for the formation of the agricultural land valuation model is information and analytical support, in particular, data sources on the basis of which quantitative and qualitative indicators of the above factors can be obtained. One of such sources is the licensed version of the geoportal ‘UVECON’ (Fig. 1) [10], which is currently the most developed geographic information system for analysing offer prices and market coefficients in the Ukrainian real estate market. However, unfortunately, there is no publicly available data on the final price of land plots at which sale and purchase agreements are concluded, which is then reflected in extracts from the State Register of Real Property Rights.

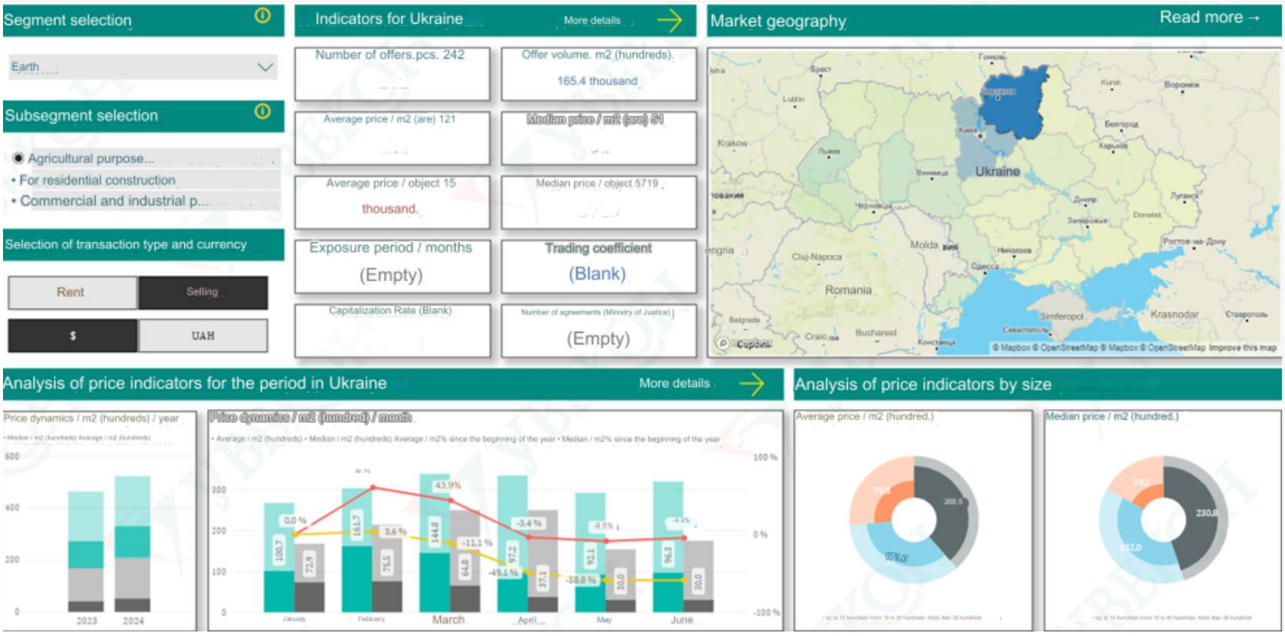

Figure 1. Dynamics of agricultural land indicators in the Chernihiv region

Source: [10]

Both off-the-shelf IT solutions such as ‘crop-monitoring’ and those developed by ourselves on the Google platform can be used as a source for identifying the main crops on satellite images [11]. It is worth noting that information on the main crops by region can also be found on specialised websites (Figs. 2, 3) [12, 13].

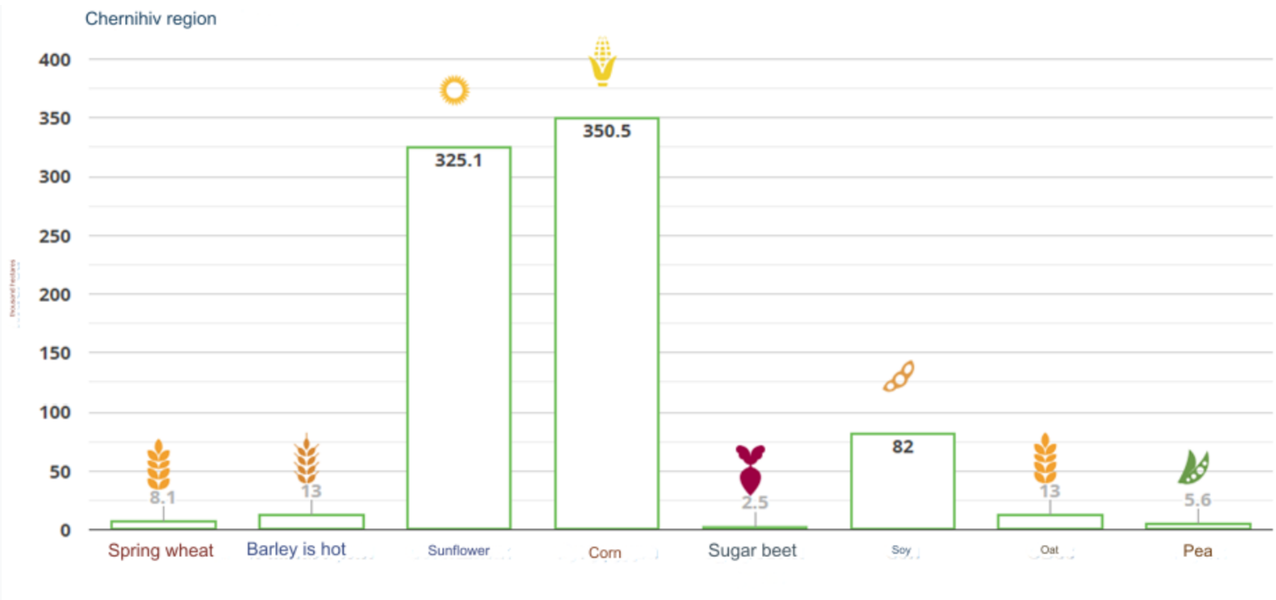

Figure 2. Crops ranking by sown area

Source: [12]

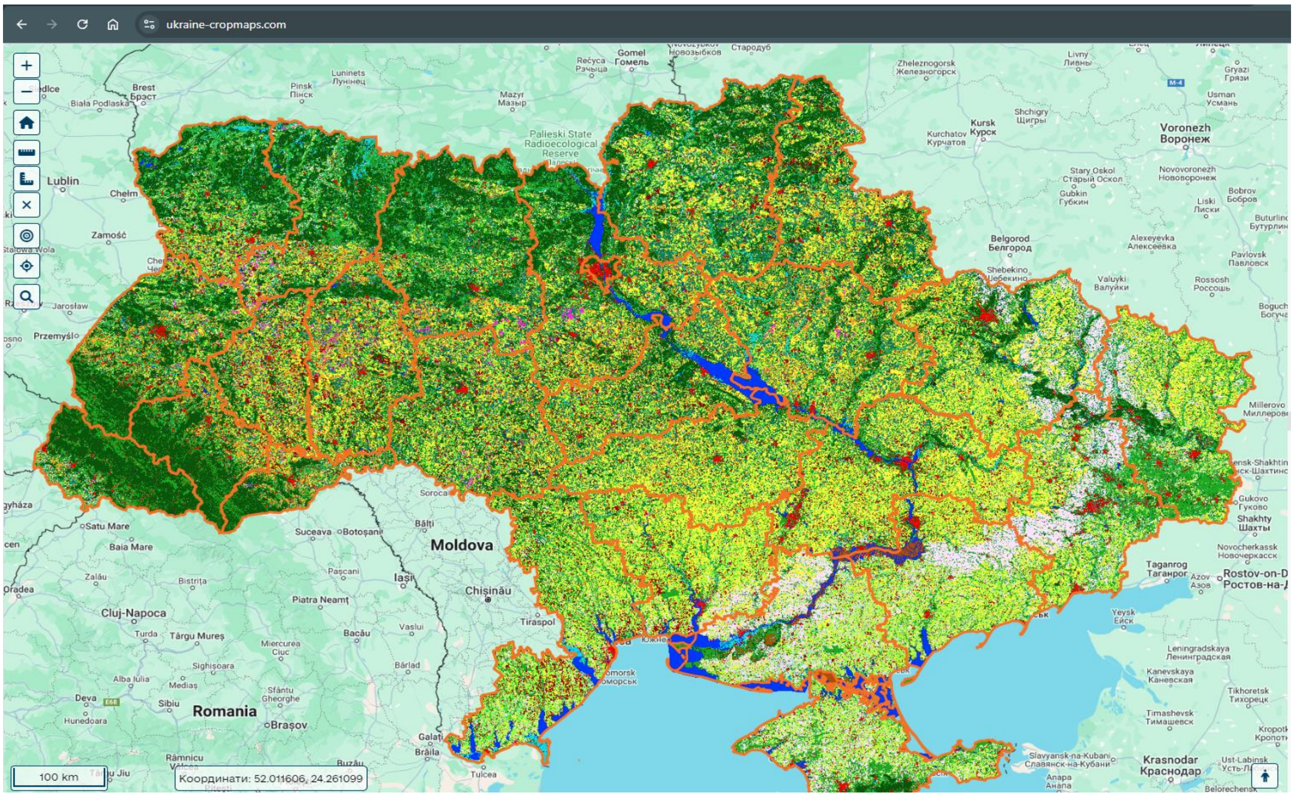

Figure 3. Map of crops in Ukraine

Source: [13]

It is also possible to determine the average yield in recent years for each crop using information resources [14] (Fig. 4) or based on data from the State Statistics Service of Ukraine [15]. Information on land plots from the State Land Cadastre is also equally important [16].

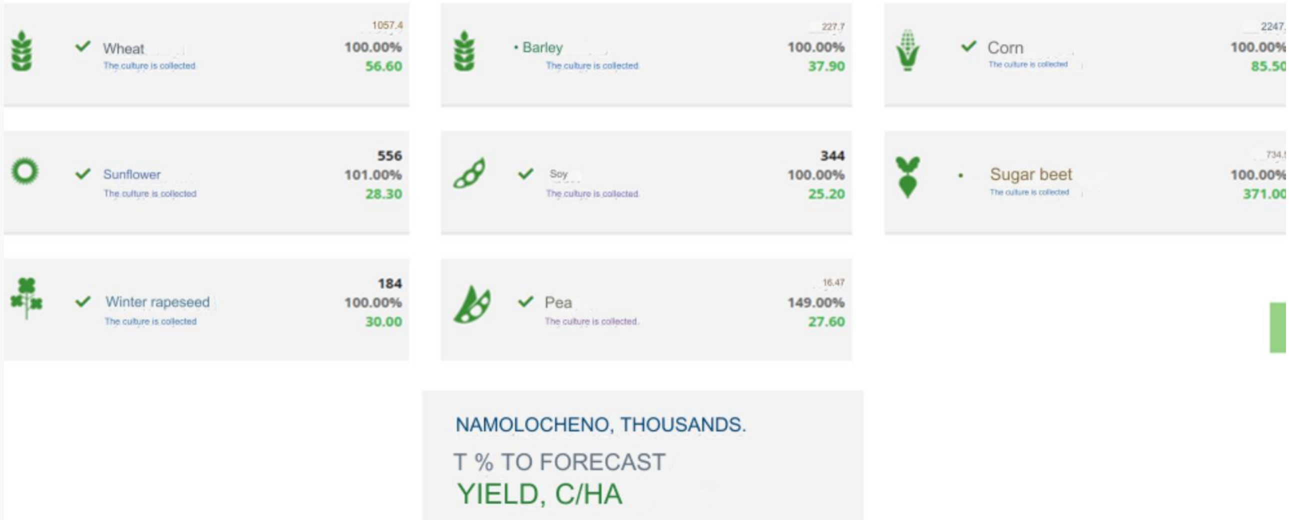

Figure 4. Crop yields in 2023 in Kyiv region

Source: [14]

As noted above, it is important to consider soil quality when developing a model for agricultural land valuation. Information on soil quality is available on many services, such as the Map of Ukraine [17], but the relevance of this data is questionable given the age of the research. At the same time, it is also worth considering the fact that the Resolution of the Cabinet of Ministers of Ukraine ‘On Approval of the Procedure for Monitoring of Land and Soils’ [18] is intended to improve the situation with soil quality monitoring, but even it states that monitoring is mandatory once every 20 years, which, given the general trend towards accelerated soil erosion and their actual condition today [19], when 43% of arable land is characterised by loss of humus and nutrients, 39% is over-compacted, 38% is silted, and 17% is subject to water erosion, is insufficient.

The above list of GIS platforms for the formation of information and analytical support is not exhaustive and can be expanded in the course of further research and in the final construction of the agricultural land assessment model.

Conclusion. Thus, the agricultural land valuation model is a multifunctional tool that ensures effective management both at the level of individual enterprises and at the state level, opening up prospects for further research and improvement of the methodological framework.

The valuation of agricultural land is of key importance in a wide range of economic and legal processes. One of the main areas of application is the calculation of transaction costs arising from the sale and purchase or lease of land plots. The value of land resources directly affects the level of investment, in particular, the decision-making process for financing agricultural and infrastructure projects related to the use of these lands. Accurately determining the value of land is critical to making informed decisions in investment planning, as it allows investors to more specifically predict the profitability of projects.

In our opinion, a more systematic approach to resolving any issues in Ukraine, including the valuation of agricultural land, is needed at the state level. Based on the analysis of the factors of the agricultural land valuation model, the most accurate results of determining the value of agricultural land require a large amount of data. The information available in state registers does not allow for an objective determination of the value of such land plots [20], while modern GIS solutions help to obtain the data necessary for the assessment.

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СКЛАД І ДЖЕРЕЛА ФОРМУВАННЯ ІНФОРМАЦІЙНО-АНАЛІТИЧНОГО ЗАБЕЗПЕЧЕННЯ ОЦІНЮВАННЯ ЗЕМЕЛЬ СІЛЬСЬКОГОСПОДАРСЬКОГО ПРИЗНАЧЕННЯ

Анотація. *Визначено, що для формування моделі оцінки земель сільськогосподарського призначення необхідно використовувати сучасні методи та інструменти, зокрема дистанційне зондування Землі (ДЗЗ), машинне навчання та штучний інтелект, аналіз великих даних (Big Data), геоінформаційні системи (ГІС), агроскаутинг. Встановлено, що склад і джерела інформаційно-аналітичного забезпечення для такої моделі мають вирішальне значення. Нами визначено, що серед факторів, які впливають на ціну та вартість земель сільськогосподарського призначення, слід розглядати такі показники, як екологічна стійкість, рівень урожайності сільськогосподарських культур, розвиток інфраструктури, технології вирощування, організація виробництва, логістика тощо. Аналіз цих факторів і результати проведених досліджень свідчать про необхідність використання великого обсягу даних для забезпечення точної оцінки земель сільськогосподарського призначення. Врахування зазначених факторів і показників, представлених у дослідженні, дозволить зробити оцінку більш комплексною та об'єктивною, що, у свою чергу, сприятиме прийняттю виважених рішень у сфері земельних відносин. Встановлено, що наявні в державних реєстрах дані не дозволяють об'єктивно визначити вартість земельних ділянок сільськогосподарського призначення. Також зазначено, що джерела інформації для отримання кількісних і якісних показників повинні забезпечувати їх актуальність, повноту, достовірність і своєчасність. Наведено динамічний перелік геопорталів, що рекомендується використовувати для отримання такої інформації.*

Ключові слова: *оцінка земель сільськогосподарського призначення, ринок земельних ділянок, геоінформаційні системи, дистанційне зондування Землі, урожайність культур, екологічна стійкість, родючість ґрунтів, продуктивність ґрунтів для вирощування сільськогосподарських культур.*