Development of GIS for assessment of soil potential of Polissya of Ukraine

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SUMMARY
The article presents GIS for assessing the agricultural potential of the Polissya of Ukraine, the use of which allowed for the territorial differentiation of soil cover by the presence of particularly valuable soil groups, to establish the value of the overall assessment, as well as the assessment of the potential of growing winter wheat and potatoes. Developed on the basis of the developed GIS complex of mapping schemes assessment of soil potential of Polissya Ukraine, allowed to locate territories with the highest values. According to the List of especially valuable soil groups, the place of significant distribution of especially valuable soil groups of national and regional importance was established and territorially separated on the map. It is shown that the main agricultural potential of the study area is concentrated in the Central and Left Bank Polissya. The largest areas of soil with a score of 37 to 57 points and above are concentrated in the central and eastern parts of Polissya, which indicates the significant investment potential of these territories. According to the results of the arable land bonitet scale, maps with accurate depictions of Polissya districts, which are most suitable for winter wheat and potato cultivation, were constructed.
Introduction

It is known that the agrarian sector for the Ukrainian state has always been one of the priority areas of both foreign and domestic economic development of the country, because the issues of organization of production and support of food provision for the individual state are relevant at all times. Ukraine is a country with strong agro-industrial potential and huge prospects for agricultural development. It has favorable climatic conditions and quality land resources, the presence of which indicates the possibility of effective development of agricultural production. The agrarian sector is an important strategic sector of the Ukrainian national economy, ensuring food security and food independence of Ukraine (Mikhailov A., 2016).

The modern development of agricultural production requires the introduction of modern technologies for the collection and processing of information necessary to solve production and management problems. Many of these problems can be solved with tools and approaches to geographical information systems (GIS) and approaches to data collection, processing, analysis and display (Solovyov, 2013). In almost any field of activity information is presented in the form of maps, plans, diagrams (Shevchenko and Byliavskiy S, 2013).

Soil resources play a significant role. In agriculture, the most important is the use of land as the main means of production and labor, which addresses the issue of food security for society. At the same time, soils determine the nature of the natural diversity of flora and fauna as a reliable resource for restoring the ecological situation. In addition, it is well known that in the investment attractiveness of any region, information on the assessment of soil and resource potential is important.

The value of land as a major means of production in agriculture is directly determined by the level of soil fertility, which is known to be defined as their ability to meet the needs of plants for nutrients, water and air and other necessary factors of life. Also, soil fertility as one of the most integral soil ecological functions that provides for the formation of plant biomass is characterized by considerable spatial variability (Smaga, 2012).

A comprehensive analysis shows that the decline in soil fertility in Ukraine is linked to both natural factors and human production activities. They are clearly interconnected and the main ones are: soil erosion, dehumidification, negative nutrient balance, soil contamination with heavy metals, pesticide and mineral residues, radionuclides, biological diversity, compaction and agriculture (Panas, 2015).

Considering the fact that in the near future it is envisaged to enter the agricultural land market, to carry out scientific researches and to obtain cartographic information on the territorial distribution of especially valuable soil groups in the regions of Polissya of Ukraine, it is proving to be quite relevant. In view of the above, the creation of GIS for the assessment of agricultural potential allows agricultural producers to provide primary information on the potential for expanding production and investment of investment resources.

The aim and goals

The following tasks are set in the work: development of GIS for estimation of agricultural potential of soils of Polissya of Ukraine and creation of cartographic material with reflection of territorial distribution of especially valuable soils.

Methods of investigation

As a cartographic basis for the development of GIS "Assessment of Agropotential of Polissya of Ukraine" was conducted on the basis of the Soil Map of Ukraine (authors: M.I. Polupan, V.B. Solovey, V.A. Velichko); scale 1: 1 430 000. ArcView GIS 3.1 and Arc GIS 10x software was selected for the development of GIS and creation of mapping schemes based on agro-industrial grouping of soils and assessment of the agricultural potential of the Polissya area.
Polissya Soil Grouping was conducted according to the “List of Soil Agro-Production Groups” (Annex 5 to the Procedure for Maintenance of the State Land Cadastre, approved by the decree of the Cabinet of Ministers № 1051 of 17.10.2012) and the List of especially valuable soil groups (order of the State Committee of Ukraine for Land Resources № 245 of 06.10.2003) (List of agricultural production groups of soils, List of particularly valuable soil groups).

Assessment of agricultural potential and development of thematic mapping schemes was carried out on the scale of arable land bonitet points developed by the Institute of Land Management of the National Academy of Sciences of Ukraine (1993) (Scale of bonitet point of arable land soils of Chernihiv region).

**Results of investigations**

The territory of the Ukrainian Polissya was chosen as the object of the study, with an approximate area of 113.5 thousand km² (19% of Ukraine's area) (Ukrainian Polissya). The natural conditions of the Ukrainian Polissya are characterized by: flat terrain with wide swampy river valleys, positive moisture balance, predominance of sod-podzolic and swamp soils and high level of groundwater. Up to 70% of the wetlands of Ukraine are in Polissya. Significant moisture led to the development of podzolic and marsh soil processes and formation of meadow, marsh and forest vegetation (Ukrainian Polissya).

At the initial stage of GIS development, individual soils were assigned to groups close to agronomic properties and fertility levels - agro-production groups with further mapping scheme construction (Figure 1). It is known that agro-industrial grouping of soils is an amalgamation of individual contours of species and varieties of soils into large groups (arrays) with close agronomic properties and fertility levels, for which similar agricultural uses and agro-technical measures are possible (Grouping of agricultural groups of soils). On the basis of soil testing, the standards of land productivity are calculated and indicators of economic and monetary valuation of land are determined.

![Figure 1 Map of the agricultural production groups of soils of Polissya and significant distribution of especially valuable soils. The location of the soil cover with compact distribution of particularly valuable soil groups is shown in red.](image)

In total, 12 agricultural soils, including particularly valuable soils, were identified cartographically in the territory of Polissya. Studies have shown that the area and territorial distribution of particularly valuable land has a clear geographical pattern. According to the developed map, the presence of especially valuable soil groups in the Polissya region is increasing in the direction from West to East Polissya (Figure 1). The isolated sections of soil cover are naturally concentrated in the parts from the Polissya to the Forest-Steppe zone.

Location aforementioned areas on the border of two climatic zones significantly enhances agricultural
producers on a wide range of growing crops, typical for Polissya and forest-steppe Ukraine. The use of more fertile soils can receive better products at relatively lower costs. Reducing production costs makes it possible to concentrate resources agribusiness investment and promote their development. On the basis of the bonitet points for the production of basic crops in Polissya, a map of the agricultural potential value was constructed (Figure 2).

![Figure 2 Map of the magnitude of the agricultural potential in terms of the score of bonitet points (without ecological coefficient).](image)

The assessment of peat and peat-swamp soils was performed on the basis of scores of forage lands (pastures). According to the results of the conducted research, the main agricultural potential of the research area is concentrated in the Central and Left-Bank Polissya. Most of the soils with a score of 37 to 57 points and higher are also concentrated in the central and eastern parts of Polissya, which indicates the significant investment potential of these territories. The development of the GIS made it possible to create charts according to the values of the bonitet points of the individual, most important for Polissya crops. Winter wheat and potatoes, which have high yields on fertile loamy and podzolic soils, are strategically important and widespread. Wheat is one of the first crops grown many years ago. It still deserves a leading position in the food rankings in about 50 countries. Ukraine is also on this list and is a powerful producer and exporter of this grain (Grain production in Ukraine). In recent years, the yield of winter wheat on relatively poor Polissya soils, due to the use of intensive cultivation technologies, has been quite high. In 2018, 26-27 million tons of wheat were grown in Ukraine (Grain production in Ukraine). Even with poor soil cancellation, potatoes have always made significant profits for farmers. In recent years, the largest potato crop is provided by sandy soils with good air access and sufficient moisture. As of October 1, 2019, Ukraine produced 19.96 million tons of potatoes (Potato yield). The state concentrates more than 6% of the world’s (15% European) potato crop, ranking fourth in the world (Potato production in Ukraine). On a scale of arable land bonitet points, a map was constructed regarding winter wheat and potato cultivation. The developed cartographic material makes it possible to clearly identify the regions of Polissya with the greatest agropotential of these crops. Winter wheat is grown more rationally in the Central and Left-Bank Polissya, where more soils with higher humus content are concentrated. Whereas potato cultivation is more profitable in the Central Polissya of Ukraine.

**Conclusions**

So, as a result of the estimation of the agricultural potential of the soils of the Polissya zone of Ukraine, it was established that the main most valuable agricultural land resource of our state is concentrated in the Central and Left-Bank Polissya.

The largest territories with especially valuable groups of soils of national and regional importance are territorially distributed in the central and eastern parts of Polissya.

It is established that the main agricultural potential of the study area is concentrated in the Central and
Left-Bank Polissya. The largest areas of soil with a score of 37 to 57 points and above are concentrated in the central and eastern parts of Polissya, which shows the considerable investment potential of these territories.

Despite the relatively low fertility of the soil, the results of an assessment of their agricultural potential for the production of the main strategic crops of the Polissya region - winter wheat and potatoes have led to the conclusion that there is considerable potential for this.

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