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MONITORING OF LAND USE AT THE REGIONAL LEVEL: THEORETICAL PROVISIONS AND FEATURES OF IMPLEMENTATION

The article identifies problematic aspects of the formation and implementation of land use monitoring at the regional level. As a result of the analysis of theoretical provisions, the author's definition of monitoring of land use of amalgamated territorial communities is proposed, and the main directions of its implementation are determined.

Keywords: *monitoring of land use, united territorial communities, regional level, geoinformation systems.*

Introduction

Today's realities are quite unstable in their manifestations. This is primarily due to the full-scale invasion of Ukraine, the consequences of the pandemic, the emergence and further growth of imbalances in the social, financial, and economic spheres, and the negative impact on the domestic economy. In turn, the active implementation of local government reform focuses on the comprehensive and complete development of territorial communities as the primary element of decentralisation in Ukraine. All of this contributes to the formation of absolutely new relations within society between territorial communities and the state, between individual citizens and local governments. In these relationships, local territorial bodies have a broad range of powers to form, manage, and use land plots [1].

Ukraine has introduced a regulatory and legal framework to ensure the development of land relations of united territorial communities. In particular, the Law of Ukraine 'On the Voluntary Association of Territorial Communities' singles out the territorial peculiarities of the formation and use of lands of local communities. The order of the Cabinet of Ministers of Ukraine 'Issue of transfer of state-owned agricultural land plots into communal ownership of united territorial communities' established the procedure for transferring state-owned agricultural land into communal ownership of united territorial communities. It is worth noting the increase in the number of ATC in recent years. However, their creation and functioning are influenced to a certain extent by the central bodies of state power and certain contradictions between regional institutions and united territorial communities. Thus, the application of modern monitoring tools to ensure the development of land relations is an urgent issue [2].

Literature Review

There are no unified approaches to determining land use monitoring of united territorial communities in

existing scientific research. In particular, monitoring is characterised as constant observation of the state of natural, technical, and social processes to ensure assessment, control, and forecasting [3]. Pozniak E. V. focused on the organisational and legal directions regarding the definition of land use monitoring [4].

Dorozhynska O. V. and Hladovska T. M. share the presented point of view [5]. In the system of implementation of monitoring procedures, the components of the information support of ground monitoring of lands are defined as follows: soil quality indicators; indicators of expert assessment of land; crop status indicators; information about the biological potential of lands; data on agrochemical soil changes; the impact of socioeconomic changes on the development of land relations; information about labour, material and technical, investment, and innovation resources in different categories of farms.

Remote land monitoring: the results of aerial sounding of the land with the indication of the geographical coordinates of the land plots; indicators of spatial agrometeorological observations; indicators of environmental norms; modernisation of old and formation of new topographic maps; updating of digital information on agricultural development of the territory.

Land relations: changes in the register of rights to immovable property located on land plots and agreements with it; observation of the dynamics of the conclusion of lease agreements with gradation according to the term of use; data on sown areas of crops and areas of perennial plantations; monitoring of the number of landowners and land users who received the State Act on the right to private land ownership and the norms of land areas for profitable management by categories of farms in different natural and climatic zones; control of targeted use of agricultural land; determination of access to owner-master plots and data on land parcels bordering them [6, 7].

Distinguishing the presented theoretical provisions, we can note that some studies characterise monitoring through the prism of the formation and use of the

functional areas of its design: determination of the tasks of the land monitoring system and requirements for the information necessary for their implementation; creation of an organisational structure for land monitoring; development of a project of a network of regime observations of monitoring objects and development of the procedure for conducting these observations; development of technology for obtaining and transmitting data, providing information to consumers; creation of a system for checking the received information for compliance with the initial requirements and revising, if necessary, the monitoring system [8].

The regulatory and legal support is used for the formation and application of monitoring. The former is created and implemented through the relevant institutions: the Centre of the State Land Cadastre, the Derzhkomzem, the Ministry of Environmental Protection of Ukraine, and the State Environmental Inspection [9].

To control the use of land by local communities, the point of view of experts, members of the financial monitoring group of the Central Office of Reforms under the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine, who highlighted new opportunities for the presented process, deserves special attention. By the Law of Ukraine 'On Amendments to Certain Legislative Acts of Ukraine on Solving the Issue of Collective Land Ownership, Improving the Rules of Land Use in Massifs of Agricultural Land, Preventing Raiding and Stimulating Irrigation in Ukraine', specific features of the use of ATC lands affecting monitoring are highlighted.

Specific features of land use monitoring of united territorial communities have been determined through [10]:

- directions of use and disposal of land plots located in the massif of agricultural land, including forest shelterbelts (agricultural land plots intended for personal peasant farming, located in the massif of agricultural land, that their owner or land user can also use for conducting commercial agricultural production without changing the purpose of such land plots);

- rights and obligations of landowners and tenants using land plots;

- identified peculiarities of leasing state or communal land plots under field roads designed for access to land plots (carried out under the condition of ensuring free access of all landowners and land users to their land plots for their intended use);

- areas of the use of land by enterprises of united territorial communities (the scope of rights of enterprises in the use of land plots is specified, and the distribution of lands collectively owned by the enterprise is performed following the Law of Ukraine 'On the procedure for allocating in kind (on-site) land plots to owners of land shares (pai)', foreclosure on a land plot may be executed by a court decision based on the claims of creditors only

if the debtor has no other property that can be subject to foreclosure);

- revealed peculiarities of establishing easements for the implementation of land reclamation measures (owners, land users of reclaimed lands or other persons have the right to demand the establishment of land easements to ensure the construction, maintenance, and operation of engineering infrastructure objects of reclamation systems, in particular for: construction and placement of pipelines (irrigation, drainage, drainage-moistening, collector-drainage), hydro-technical structures and pumping stations, protective dams, observation networks, other structures and objects that are components of the corresponding meliorative system; passages, driveways, as well as transportation of construction and other materials through the land plot for the construction and operation of pipelines (irrigation, drainage, drainage-moistening, collector-drainage), hydro-technical structures and pumping stations, protective dams, observation networks, other engineering infrastructure objects of the corresponding meliorative system; movement (relocation) of mobile engineering infrastructure objects in accordance with its technological properties in order to ensure, according to the results of the inventory of the massif of agricultural land, information about such massif and the land plots located in it);

- revealed peculiarities of the use of unallocated and unclaimed land plots [11];

- specific features of the use and disposal of lands remaining in the collective ownership of a collective agricultural enterprise, an agricultural cooperative, or an agricultural joint-stock company;

- defined features of the acquisition and realisation of the right to lease land plots located in an array of agricultural land (owners and lessees of agricultural land plots located in an array of agricultural land, for the period of validity of the lease agreement, may exchange their rights to use the land plots by mutually entering into lease agreements or subleases of the respective plots; lessees of land plots are obliged to notify the lessor in writing of the exchange of land use rights belonging to them within five days from the date of state registration of the sublease; a person who owns the right to use a substantial part of the agricultural land array shall have the right to lease other agricultural land plots located in such an array, and, if other land plots are under lease, to sublease them, provided that they are transferred to the owner (lessee) for use (lease, sublease) of another land plot located in the same massif, for the same term and under the same conditions, if, due to the overlap, non-use of such land plots creates obstacles to the rational use of the land plots used by this person);

- defined features of the formation of rights to use other land plots (the term of the lease (sublease) must not exceed the term of the user acquisition of the land plot

under the contract concluded in exchange; the amount of rent (sublease payment) must correspond to the rent (sublease payment) under the contract concluded in exchange; the lessee does not have a pre-emptive right to purchase the leased land plot in case of its sale; the lessee (sublessee) is not entitled to the compensation by the other party to the contract for the costs of improving the leased land plot, to renew the lease (sublease) for a new term in case of objections from the other party to the contract; in case of absence of access to the land plot, the right to which is transferred in exchange, from the edge of the massif, the person who owns the right to use a substantial part of the agricultural land massif shall be obliged to provide land user with the right of passage to such a land plot under the conditions of free land easement; in case several land plots belonging to the same person are leased (subleased) to a person who owns the right to use a substantial part of the agricultural land massif, the land plots, the right of use of which is transferred in exchange, must be connected by common boundaries);

– revealed peculiarities regarding the inventory of the agricultural land array (inventory of the agricultural land array if the preliminary normative monetary valuation of the land plots in this array was not carried out within five years before the day of the decision by the authorised body to conduct such inventory) [12];

Electronic systems are essential for monitoring land use of united territorial communities. Among them are electronic services, contactless public services, the formation of electronic services, and online access to electronic registers.

The analysis of the Development Programmes of some united territorial communities revealed that the focus is on the features and directions of land use. At the same time, the importance of procedures for monitoring and implementation of strategic directions is decreasing. As a result of the analysis of theoretical provisions, the authors have proposed a definition of monitoring the use of lands of united territorial communities, which is a system consisting of spatial, urban planning, ecological, and investment provision of lands of united territorial communities, determined based on evaluation procedures by applying analytical, expert methods, mathematical modelling, and tools of geoinformation systems. It aims to characterise the existing state of land use of the ATC, identifying disproportions in the system of land relations and establishing prospects for their development.

Aim and Objectives

The aim of the study is the formation and implementation of theoretical and practical provisions regarding the definition of land use monitoring at the regional level. Several objectives are solved to achieve the goal: systematisation of theoretical provisions on the definition of land use monitoring of united territorial

communities as integral institutional components of regional development; formation of tools for monitoring land use at the regional level.

Discussion of Results

To monitor land use of united territorial communities, we proposed the formation of a quantitative basis, which is created by applying the method of integral assessment of the level of land use.

Methods for determining the integrated assessment of land use of local communities include the following steps:

- 1) determination of spatial, urban planning, socioeconomic, and ecological characteristics of the use of lands of ATC; formation of relevant local factors;
- 2) formation of general indicators of the use of land of local territorial communities;
- 3) construction of a multi-level system of indicators for the integrated assessment of the use of lands of ATC;
- 4) assessment of local factors using quantitative and qualitative methods;
- 5) development of mathematical models for evaluating the generalising factors of land use of united territorial communities;
- 6) evaluation of generalising factors using the geometric mean method;
- 7) construction of an integral model for the evaluation of land use of ATC;
- 8) determination of weighting coefficients taking into account the relevant stimulants;
- 9) evaluation of the integral indicator of the use of land of local ATC;
- 10) interpretation of the obtained results;
- 11) formulation of scientifically based recommendations and supervision for the efficient use of land plots of ATC.

A multi-level system of indicators of land use of ATC was built. It consists of local, generalising, and integral levels. The development of mathematical models for estimating the generalising factors of the use of land of local ATC is carried out using the geometric mean method:

$$G_1 = \sqrt[5]{G_{11} \cdot G_{12} \cdot G_{13} \cdot G_{14} \cdot G_{15}}, \quad (1)$$

$$G_2 = \sqrt[7]{G_{21} \cdot G_{22} \cdot G_{23} \cdot G_{24} \cdot G_{25} \cdot G_{26} \cdot G_{27}}, \quad (2)$$

$$G_3 = \sqrt[6]{G_{31} \cdot G_{32} \cdot G_{33} \cdot G_{34} \cdot G_{35} \cdot G_{36}}, \quad (3)$$

$$G_4 = \sqrt[7]{G_{41} \cdot G_{42} \cdot G_{43} \cdot G_{44} \cdot G_{45} \cdot G_{46} \cdot G_{47}}. \quad (4)$$

The proposed general model for evaluating spatial, urban, socioeconomic, and environmental indicators is as follows:

$$G_i = \sqrt[n]{\prod_{j=1}^n G_{ij}}, \quad (5)$$

where n – number of factors, relative unit;

i – value of spatial, urban planning, socioeconomic, and ecological indicators, relative unit;

j – number of spatial, urban planning, socioeconomic, and ecological indicators, relative unit.

An integrated model for assessing the level of the use of land of ATC was developed based on the application of generalising spatial, urban planning, socioeconomic, and ecological indicators and weighting factors:

$$G_i = \sqrt[n]{\prod_{j=1}^n G_{ij} W_j^{(p)}}, \quad (6)$$

where G – integrated indicator of land use of united territorial communities, resp. unit;

$W^{(p)}$ – weighting coefficients characterising the degree of influence of spatial, urban planning, socioeconomic, and ecological indicators on the integral factor of land use of ATC, resp. unit.

The evaluation of the weight coefficients is conducted taking into account the relevant stimulants. The next stage of the application of the proposed method is the determination of the integral indicator of land use of united territorial communities, which creates an informational and quantitative basis for the development of scientifically based recommendations for the formation and application of monitoring. Of particular importance is the interpretation of the obtained results, where the results of the assessment of the level of land use of ATC are determined considering spatial, urban planning, socioeconomic, and environmental support. The development of scientifically based recommendations for the formation and implementation of monitoring to increase the efficiency of the use of lands of ATC is carried out on the basis of the results of an integral

assessment, its forecasting, mathematical modelling, and the creation of geoinformation support [13].

Thus, the local factors of the use of lands of ATC were determined by applying expert methods, making it possible to form a quantitative basis for an integral assessment in the context of the formation of monitoring procedures.

Taking into account the fact that all local indicators are evaluated according to the scale where the best ones were given the highest points, an integral evaluation of land use indicators of united territorial communities by region of Ukraine was performed based on partial indicators of the stimulator coefficients:

$$K_i^{(p)} = \frac{G_i^{(p)} - G_{min}^{(p)}}{G_{max}^{(p)} - G_{min}^{(p)}}, \quad (7)$$

where $G_{min}^{(p)}$, $G_{max}^{(p)}$ – respectively, the smallest and largest ones among the generalised values of the indicators $G_i^{(p)}$.

The integral indicator of assessment of local factors of land use of united territorial communities should be introduced considering weighting factors, which we propose to determine according to the following algorithm:

$$w^{(p)} = \frac{\sqrt[n]{\prod_{i=1}^n G_i^{(p)}}}{\sum_{p=1}^n \sqrt[n]{\prod_{i=1}^n G_i^{(p)}}}, \quad (8)$$

where p – number of the group of local indicators (spatial, urban planning, socioeconomic, environmental); N – number of regions; n – number of groups of local indicators.

The results of the evaluation of the stimulator coefficients (3) and the integral indicator (3.6) of land use of united territorial communities by regions of Ukraine are presented in Fig. 1.

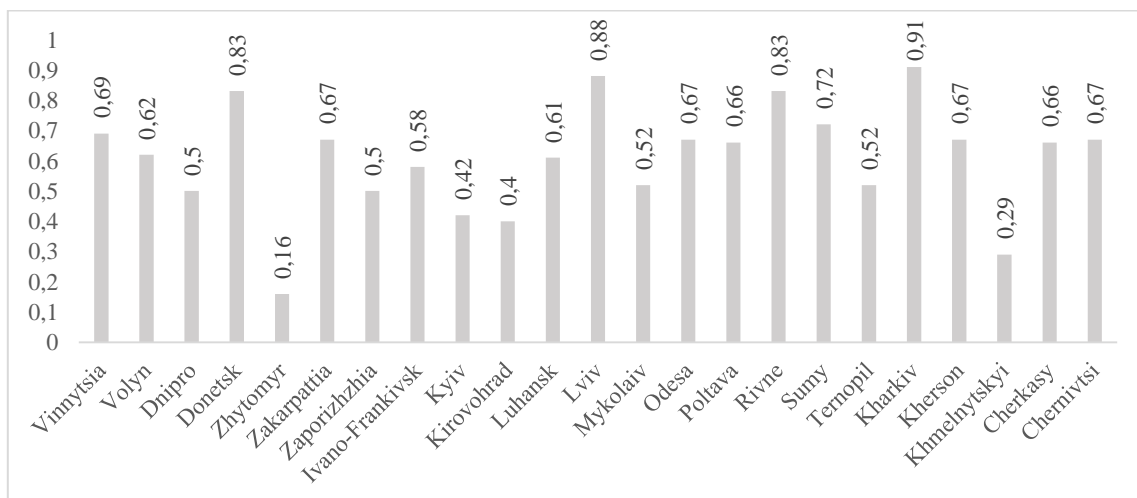


Fig. 1. The results of the evaluation of the stimulator coefficients and the integral indicator of the use of land of ATC by regions of Ukraine, resp. unit

Thus, our research has obtained the following results, which indicate that the use of land by local communities in different parts of Ukraine varies. The Mykolaiv, Zhytomyr, Kherson, and Sumy regions are characterised by fairly high rates of land use by local communities. Ternopil, Volyn, Vinnytsia, Zaporizhzhia, Dnipro, Lviv, Rivne, Poltava, Khmelnytskyi, Chernihiv, and Chernivtsi regions are characterised by an average level. It is also worth noting the regions where the level of land use remains low. These include the Cherkasy region and Zakarpattia. It would also be appropriate to note that recent years have been characterised by positive changes and improved indicators of land use by local communities in different regions of Ukraine in the areas of economic, social, urban planning, and environmental protection. Monitoring and control are necessary tasks for local communities to perform, as they will further improve the quality of land use.

Mathematical models were built to monitor land use of united territorial communities. The mathematical model that reproduces the influence of the integral indicator of the level of land use monitoring of united territorial communities on the gross regional product index determined per unit of area is as follows:

$$y_x = 0,516 \cdot x + 0,502 . \quad (9)$$

The mathematical model, according to which the dependence of the factor of the gross regional product per unit area on the generalising indicators of land use of ATC is established, takes the form:

$$y_x = 0,051 \cdot x_1 + 0,655 \cdot x_2 - 0,026 \cdot x_3 + 0,011 \cdot x_4 - 1,449 . \quad (10)$$

The comparison of the constructed regression models leads to the conclusion that to improve the quality of the model, it is necessary to take into account all generalising factors that affect the result. A comparison of the correlation coefficients of 0.8895 (for multiple regression) and 0.6206 (for linear regression) shows that the joint influence of the generalising factors of the use of land of ATC by 88.9% causes changes in the indicator of the gross regional product per unit area of the regions. The separate impact of each of the generalising factors reduces their value in the context of the formation of the gross regional product per unit area.

The analysis of the coefficients of multiple regression allows us to state that the factor of change of the gross regional product per unit of area has the greatest influence on the group of urban planning indicators of the use of land of united territorial communities. The group of socioeconomic indicators had a negative impact on the indicator of changes in the gross regional product per unit area, which indicates their inverse influence. Among other reasons for this situation, it is possible to point out

the greatest statistical consistency of urban planning indicators and the lowest statistical consistency of socioeconomic indicators of the use of land factor of united territorial communities by region of Ukraine.

Based on the data obtained, we can state that the growth of the regional product per unit area is due to the increase in the integral indicator of the use of land of united territorial communities in the different parts of Ukraine. In the context of ensuring the development of the regions, the increase in the efficiency of the use of lands of ATC is of great importance. This process is implemented through the development and application of monitoring tools, the basis of which are the results of the assessment of the integral indicator of land use, its mathematical modelling, and the formation of geoinformation support [14].

For the development of monitoring procedures, strategic development models presented in [15–20] are considered.

Conclusions and Proposals

Therefore, to develop and implement the ATC land use monitoring from the obtained values of the integral indicator and the presentation of its data by region, it is proposed to build geo-information support. This provision is formed through the development of GIS maps with the values of integral indicators of the use of land of united territorial communities by region, which systematically determines the regional features of land use of ATC, considering their spatial, urban planning, socioeconomic, and ecological characteristics.

The application of integral indicators of land use of united territorial communities is done based on the proposed stages with the construction of a scheme for the distribution of data of integral indicators by region and determination of the geodatabase structure. The proposed geoinformation support for monitoring land use of ATC is defined as a necessary component of the scientifically proven and substantiated recommendations for the formation and implementation of monitoring to improve the efficiency of land use in the context of creating conditions for regional development.

We proposed directions for the development of the monitoring of land use in united territorial communities based on the implementation of the integral evaluation method, the results of mathematical modelling of land use factors, and their impact on the gross regional product per unit area. A quantitative basis for monitoring the use of land of ATC has been formed. The directions of growth of the integral indicator of the use of land of united territorial communities through the increase of spatial, urban planning, socioeconomic, and ecological factors have been determined.

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МОНІТОРИНГ ВИКОРИСТАННЯ ЗЕМЕЛЬ НА РЕГІОНАЛЬНОМУ РІВНІ: ТЕОРЕТИЧНІ ПОЛОЖЕННЯ ТА ОСОБЛИВОСТІ РЕАЛІЗАЦІЇ

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Територіальні громади, їх підтримка та розвиток є важливими елементами децентралізації, яка за останні роки стала значним прогресивним явищем у діяльності органів влади. Саме тому низка реформ місцевого самоврядування спрямована на розвиток та вдосконалення цих територіальних громад на муніципальному рівні. У статті визначено проблемні аспекти формування та впровадження моніторингу використання земель на регіональному рівні. У результаті аналізу теоретичних положень запропоновано авторське визначення моніторингу використання земель об'єднаних територіальних громад та визначено основні напрями його реалізації. Визначено проблемні аспекти формування та впровадження моніторингу використання земель на регіональному рівні. Мета дослідження – сформулювати та реалізувати теоретичні та практичні положення щодо визначення моніторингу землекористування на регіональному рівні. Для досягнення поставленої мети вирішуються такі завдання: систематизація теоретичних положень щодо визначення моніторингу землекористування об'єднаних територіальних громад як важливої інституційної складової регіонального розвитку; формування інструментарію моніторингу використання земель на регіональному рівні. Запропоноване геоінформаційне забезпечення моніторингу використання земель визначено як необхідну складову науково обґрунтованих рекомендацій, а також різноманітних видів моніторингу для підвищення якості використання земель у контексті створення умов для регіонального розвитку. Запропоновано напрями розвитку моніторингу використання земель в об'єднаних територіальних громадах на основі впровадження методу комплексної оцінки, результатів математичного моделювання факторів використання земель та їх впливу на валовий регіональний продукт на одиницю площі. Сформовано кількісну основу моніторингу використання земель.

Ключові слова: моніторинг використання земель, об'єднані територіальні громади, регіональний рівень, геоінформаційні системи.