Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 20, Issue 2, 2020
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASSESSMENT OF INFLUENCE OF SPATIAL ORGANIZATION OF THE TERRITORY ON ECONOMIC EFFICIENCY OF AGRARIAN ENTERPRISES

Oleksii SHKURATOV[1], Olha DOROSH[2], Olesia GORODYSKA[3], Oleksandr PATIYUK[1],

[1]Institute of Land Management of National Academy of Agrarian Sciences of Ukraine, 37 Vasylkivska St., 03022, Kyiv, Ukraine, Phone: +380445219289, Mobile: +380982824994, E-mails: shkuratov_ai@ukr.net, landukrainenaas@gmail.com
[2]National University of Life and Environmental Sciences of Ukraine, 17 Vasylkivska Str., Kyiv, 03040, Phone: +380442580525; E-mail: dorosholgas@ukr.net
[3]State Agrarian and Engineering University in Podilia, 13 Schevchenko Str., 32300, Kamianets-Podilskyi, Ukraine, Phone: +380384925218, Mobile: +380967412196, E-mail: olesya_pv@ukr.net

Corresponding author: shkuratov_ai@ukr.net

Abstract

The article substantiates the need for analysis of the mutual influence of agricultural production and spatial organization of the territory when planning economic activity. By means of correlation and regression analysis, the factors of spatial organization of the territory that have the strongest influence on the economic efficiency of agricultural production are selected, using agrarian enterprises in the Kyiv region of Ukraine as an example. As an performance indicator of the economic efficiency of agrarian enterprises, the volume of gross agricultural output (in constant prices of 2010) is proposed. For the analysis of factor signs, the following indicators were used: coefficient of ecological stability of the territory; slope coefficient; land use size; level of agricultural cultivation of the territory. As a result, economic and mathematical dependences of changes in gross agricultural output from the above factors are obtained. For a more detailed analysis of the influence of significant factors on the indicator of economic efficiency, a linear multiple regression model was constructed. The proposed equations for the dependence of indicators of economic efficiency and spatial organization of the territory make it possible to adjust environmental and economic indicators in the process of spatial planning of agrarian enterprises. In order to identify the dependence of the spatial parameters of the organization of the territory of agrarian enterprises and the effectiveness of their functioning, we have grouped the farms of the studied region according to the size and level of ecological stability of the territory.

Key words**:** *spatial, organization, territory, economic efficiency, assessment, agricultural, enterprises*

INTRODUCTION

The current state of agriculture in Ukraine is characterized by an increase in anthropogenic pressure on the environment, accompanied by disturbances in the ecological and economic balance and a decrease in the efficiency of agrarian production as a whole. These trends are largely a consequence of the development of the agricultural sector without taking into account the negative environmental consequences in recent years under the influence of market reforms during modern land and agricultural reforms. In this regard, the problem of increasing the efficiency of agricultural production through its greening, starting with the organization of the rational use of natural resources as fixed assets, is of particular relevance. The final result of agricultural production depends on many natural factors, one of the most important is the spatial nature of agroecosystems, which characterizes the environment and conditions of agricultural production, and also plays a decisive role in the development of rural areas. At the same time, an unbalanced land use structure and ecological imbalance of the land fund significantly worsen the efficiency of land use and protection, the natural ability of soil cover to self-repair, and lead to depletion of the species diversity of the flora and fauna of landscapes.

However, one can single out the positive influence of individual spatial factors on the

efficiency of agricultural production, in particular, an increase in the level of plowing (that is, a change in the landscape structure) increases the area of arable land, and hence the increase in gross output per unit of agricultural land.

A distinctive feature of the spatial organization of the territory of agrarian enterprises is the achievement of an optimal ratio between arable land, meadows, forests and water areas, an increase in the diversity of crops on the land area, the introduction of adaptive crop rotation and their differentiated placement [5; 6; 8].

In recent years, in scientific circles more and more attention has been paid to the study of the organization of the territory of agricultural enterprises on an agrolandscape basis, since agrolandscapes, as the only component of nature, work on agricultural lands. The agrolandscape approach aims to develop mechanisms for the formation of sustainable agrolandscapes by adverse natural phenomena and anthropogenic stress, as well as resource-saving technological approaches to the processing of crops. At the same time, the greatest efficiency in applying this approach can be achieved if it is implemented within the framework of an integrated scientifically based system of agricultural nature management, which allows optimizing the set of environmental elements of the territorial structure of agrolandscapes and economic conditions of agricultural production [2, 4]. Therefore, in modern economic conditions, balanced agricultural production is difficult to imagine without environmental and economic justification and rational spatial organization of land use.

In particular, Dissart J. and Vollet D. in their work [2, p. 568] investigated the influence of a number of agrolandscape factors of land use organization on the efficiency of agricultural activities. The representative of the agroecological direction of economic research Harashchenko T. [3] systematized the spatial factors of agricultural production and analyzed their influence on the formation of land use. However, despite the rather comprehensive study of these problems, the structural formation of land use and the organization of the territory of agrarian enterprises remain controversial. In this aspect, conclusions from Hutsuliak H. and Hutsuliak Yu. are "noteworthy that increasing the economic efficiency of any agrarian enterprise is impossible without solving ecological and landscape problems" [4, p. 18].

In general, the spatial organization of the territory is aimed at improving the quality of land use, which is manifested in their balance, the formation of a stable and balanced state within the agroecosystems of agrarian enterprises. However, under the current market conditions of management, the primary goal of the functioning of any enterprise is to obtain the maximum amount of profit. Therefore, there is a need to identify the influence of the spatial organization of the territory on the efficiency of managing agrarian enterprises.

MATERIALS AND METHODS

One of the most difficult tasks in the process of organizing the territory is to determine the necessary environmental measures that should be applied to improve the general ecological condition of agrolandscapes and ensure the stability of agricultural land. The existing indicators for determining the stability of the territory, in our opinion, do not give a complete picture of the implementation of these measures, but generally evaluate this or that environmental aspect. Given this, we propose to calculate indicators characterizing the potential possibilities of the effectiveness of agrolandscapes, taking into account the environmental conditions and the anthropogenic potential of the territory.

To assess the influence of spatial factors on the economic efficiency of agrarian enterprises, we propose to establish the relationship between spatial and economic indicators by evaluating various calculated and statistical data. It is recommended that economic and mathematical methods of analysis be used to identify the relationship between factor and resulting indicators, in particular, correlation and regression analysis [14, p. 127]. This analysis provides the identification of the main factors of dependence, reflecting a quantitative assessment of the degree of connection between the factors.

Studies were conducted on statistical indicators of agrarian enterprises in the Kyiv region of Ukraine and the calculated values [13]. Among the spatial parameters during the evaluation, the following indicators were considered [1, 6, 7, 10]: coefficient of ecological stability of the territory; slope coefficient; land use size; level of agricultural cultivation of the territory. These indicators, in our opinion, reflect the general spatial characteristics of land use by enterprises. The gross agricultural output per 100 ha of agricultural land was selected as the resulting indicator, which, in our opinion, most characterizes the efficiency of agrarian production.

Using correlation and regression analysis, we established a relationship between indicators characterizing the factors of spatial organization of the territory and the volume of gross agricultural output per 100 hectares of agricultural land, which are described by the linear equation:

$$y = ax + b, \quad (1)$$

y - the volume of gross agricultural output per 100 hectares of agricultural land;
x - the factors of spatial organization of the territory;
a, b - constant coefficients of a linear equation.

RESULTS AND DISCUSSIONS

Indicators of mathematical dependencies of changes in gross agricultural output from the studied spatial factors, namely, correlation and determination coefficients, constant coefficients of the linear equation (a, b) are shown in Table 1.

Table 1. The values of regression coefficients of the influence of factors of spatial organization of the territory on the gross agricultural output in agrarian enterprises of the Kyiv region, 2008-2018

Index	Constant coefficients of the linear equation		Correlation coefficient	Determination coefficient
	a	b		
Coefficient of ecological stability of the territory	-942.6	748.58	-0.75	0.56
Slope coefficient	-213.11	592.46	-0.81	0.66
Land use size	0.368	73.6	0.83	0.69
Level of agricultural cultivation of the territory	8.817	-306.0	0.84	0.71

Source: formed by the author according to The Main Department of Statistics in Kyiv region.

The closest relationship for analyzed factors is observed between volume of gross agricultural output and level of agricultural cultivation of the territory. According to linear regression, the Pearson correlation coefficient (0.84) shows strong and direct relationship between them. The determination coefficient (0.71) indicates that 71% of cases of all changes in volumes of gross agricultural output are due to changes in level of agricultural cultivation of the territory, that is, the selection accuracy in the regression equation is sufficient. Linear regression demonstrates (with a 71% probability) that an increase in level of agricultural cultivation of the territory per 1% corresponds to an increase in gross agricultural output by 8.817 thousand UAH per 100 hectares of agricultural land.

The close relationship between the indicators of development of the territory and the volume of gross agricultural output is explained by the extensiveness of agricultural production due to an increase in arable land and as a result of increased crop yields. Indeed, as a result of the increase in arable land and sown areas, the efficiency of agricultural activity increases, however, domestic and foreign practice shows [5, 10, 15] that extensive production not only leads to excessive depletion of soils and loss of their fertility, but also leads to a decrease in productivity or even loss in the future.

For a more detailed analysis of the influence of these factors (with the exception of less influential ones) on the gross agricultural output, a linear multiple regression model was constructed. The results showed the existence

of a close relationship between factor and effective traits (correlation coefficient R = 0.83). The resulting regression equation has the form:

$$y = 141.9 – 106.2x_1 + 0.192x_2 + 2.89x_3, \quad (2)$$

y - volume of gross agricultural output per 100 hectares of agricultural land;
x_1 - slope coefficient;
x_2 - land use size;
x_3 - level of agricultural cultivation of the territory.

The value of the coefficient of determination (0.69) indicates that 69.0% of the variation of the dependent variable is due to the factors introduced into the correlation model and the rest to other factors that are not taken into account.

In the process of organizing agricultural land use, it is important to improve and rationalize the management model – a specific algorithm for implementing methods and methods for ensuring each specific land use. The indicated model in the system of objective management assessment using a clear distinction between the effects of objective and subjective factors on the productivity of agricultural production allows us to identify promising areas for increasing production efficiency and to provide comparisons of certain economic indicators.

It is also worth noting that the high rate of development of labor tools and technologies in agriculture, along with an increase in the anthropogenic pressure on the environment, makes it difficult to identify an objective correlation between extended and economic indicators. This is due to the expansion of innovative agricultural technologies, crop varieties, the use of the latest organic and mineral fertilizers, the improvement of tillage methods, agricultural equipment, the use of chemical pest control agents, the organization of land conservation activities, etc.

This is of particular importance for agriculture, since this sector of social production, like no other, is closely linked to living and non-living objects of the environment. Therefore, in modern conditions, the state of the environment depends to a large extent on ensuring the greening of agricultural production, during which the introduction of environmental and legal requirements in all stages of agricultural activity [11, 15].

Features of the rational spatial organization of the territory are caused by established norms on the interdependence of agricultural activity and a particular territory, the formation of the best ratios of the production structure and the corresponding territorial distribution, and improvement of production conditions, which in turn affect the economic efficiency of agro-granting [9, 12].

Table 2. The impact of farm size on the performance indicators of agrarian enterprises of the Kyiv region, 2018

Indicator	Groups of agrarian enterprises by area of land, ha			
	less than 100	101-1,000	1,001-2,000	more than 2,000
Number of enterprises	1,328	418	234	142
including farming	1,036	114	69	2
The average area of agricultural land, ha	38	627	1,518	3,554
The concentration of agricultural land in the group, %	4.3	22.4	30.3	43
Coefficient of ecological stability of the territory	0.15	0.18	0.23	0.22
Plowed territory, %	96.1	92.7	72.5	73.2
The proportion of eroded land, %	31.1	29.2	25.4	25.1
Yields of cereals and legumes, c/ha	51.2	58.1	68.3	70.2
The proportion in the structure of commodity agricultural products,%:				
crop products	81	93	69	63
livestock products	19	7	27	37
The volume of gross agricultural output (in constant prices of 2010)	1,180.7	1,343.1	1,581.3	2,069.3
including crop products	754.4	956	1,182.8	1,347.5
including livestock products	426.3	387.2	398.6	721.8
Profitability of production	38.5	42.7	44.3	47.2
Profitability of enterprise	23.5	21.6	18.6	18.3

Source: formed by the author according to The Main Department of Statistics in Kyiv region.

The analysis of the influence of farm size on the performance indicators of agrarian enterprises on the example of the Kiev region showed that, despite the significant fragmentation of agricultural land, there is a concentration of these lands in groups of enterprises with an area of more than 1,000 hectares, as well as an increase in farm size (Table 2).

This situation, in turn, was formed due to the existence of the so-called law of the predominance of a larger farm over a smaller one, which is displayed in the real plane due to an increase in the level of economic efficiency

of the functioning of an agrarian enterprise with an increase in its area.

In order to identify the dependence of the spatial parameters of the organization of the territory of agrarian enterprises and the effectiveness of their functioning, we carried out groupings of farms in the Kiev region by the coefficient of ecological stability of the territory.

Table 3. The impact of spatial parameters of the organization of the territory on the performance indicators of agrarian enterprises of the Kyiv region, 2018

Indicator	Groups of agrarian enterprises by coefficient of ecological stability of the territory			
	less than 0.15	0.16-0.25	0.26-0.35	more than 0.35
Number of enterprises	1,426	398	191	107
including farming	1,103	91	27	-
The average area of agricultural land, ha	196	863	1,129	2,869
The concentration of agricultural land in the group, %	24.4	30.0	18.8	26.8
Coefficient of ecological stability of the territory	0.14	0.19	0.27	0.36
Plowed territory, %	95.4	89.7	74.4	68.2
The proportion of eroded land, %	33.2	28.7	23.4	18.7
Yields of cereals and legumes, c/ha	48.2	64.1	71.3	66.2
The proportion in the structure of commodity agricultural products,%:				
crop products	76	95	65	62
livestock products	34	5	35	38
The volume of gross agricultural output (in constant prices of 2010)	1,380.7	1,643.8	1,490.5	2,109.3
including crop products	954.4	1,056.6	1,082.3	1,347.5
including livestock products	426.3	587.2	408.2	761.8
Profitability of production	30.4	48.7	40.3	46.2
Profitability of enterprise	21.5	18.6	21.7	23.3

Source: formed by the author according to The Main Department of Statistics in Kyiv region.

Systematization of agrarian enterprises in the Kiev region in the context of four groups are presented in Table 3.

Determination of the influence of spatial factors on the economic efficiency of agrarian enterprises gives an opportunity to adequately respond to the system of management of agrarian nature management in order to ensure the solution of environmental problems.

The effectiveness of capital investments in the formation of rational land use is determined, given the differentiation of the economic effect of land management measures.

For example, in the process of land transformation, the invested funds are returned in the form of an increase in net income from the developed land or more intensive land use, and when arranging the territory, crop rotation, investing in the construction of field mills, expanding the transport infrastructure due to the reduction of production or fixed costs.

CONCLUSIONS

In general, the organization of the territory of agrarian enterprises using spatial parameters is required to reproduce the practical implementation of design decisions on land management of agrarian enterprises, taking into account environmental requirements that should be declared in on-farm land management projects. Given the data obtained as a result of the analysis of the influence of the organization of the territory on the economic efficiency of agrarian enterprises, it was determined that the development of directions for their sustainable development should be based on priority tasks, taking into account the relationship between agrolandscape parameters and economic indicators.

It was determined that the role of these spatial parameters in the formation of indicators of economic efficiency of agrarian production of enterprises is different. Therefore, it is very important to determine the degree of influence of individual factors on the efficiency of enterprises in agrosector using scientifically based methods and approaches.

REFERENCES

[1]De Olde, E.M., Moller, H., Marchand, F., McDowell, R.W., MacLeods, C.J., Sautier, M., Halloy, S., Barber, A., Benge, J., Bockstaller, C., Bokkers, E., De Boer, I.J.M., Legun, K., Le Quellec, I., Merfield, C., Oudshoorn, F.W., Reid, J., Schader, C., Szymanski, E., Sørensen, C.A.G., White head, J., Manhire, J., 2017, When experts disagree: the need to rethink indicator selection for assessing sustainability of agriculture. Environment, Development and Sustainability, 19(4):1327–1342.

[2]Dissart, J., Vollet, D., 2011, Landscapes and territory-

specific economic bases. Land Use Policy, 28:563–573.
[3]Harashchenko, T., 2013, Ekoloho-ekonomichna otsinka vplyvu ahrolandshaftnoi orhanizatsii terytorii na efektyvnist silskohospodarskoho vyrobnytstva [Ecological-economic assessment of the impact of the agro-landscape organization of the territory on the efficiency of agricultural production]. Balanced Nature Using, 4:26–30.
[4]Hutsuliak, H., Hutsuliak, Yu., 2018, Kontseptualni zasady systemnoi orhanizatsii silskohospodarskykh landshaftiv [Conceptual foundations of systematic organization of agricultural landscapes]. Balanced Nature Using, 1:17–21.
[5]Kanash, O.P., 2014, Do pytannia pro ekoloho-ekonomichnu optymizatsiiu vykorystannia zemel', uporiadkuvannia uhid' ta obgruntuvannia sivozmin (On the issue of ecological and economic optimization of land use, landscaping and crop rotation). Zemleustrij i kadastr, 1:3–11.
[6]Kolmykov, V.F., Kazakevich, V.I., 1998, Vliyanie prostranstvennykh ekologicheskikh faktorov na rezultaty proizvodstvennoy deyatelnosti selskokhozyaystvennykh predpriyatiy [The influence of spatial environmental factors on the results of production activities of agrarian enterprises]. Vestsi Natsyyanalnay akademii navuk Belarusi: Seryya agrarnykh navuk [Maintain the National Academy of Sciences: Series of Agrarian Sciences], 2:54–58.
[7]Popescu, A., 2013, Considerations on utilized agricultural land and farm structure in the European union. Scientific Papers: Series Management, Economic Engineering in Agriculture and Rural Development, 13 (4):221–225.
[8]Primdahl, J., Kristensen, L., Busck, A., 2013, The farmer and landscape management: different roles, different policy approaches. Geography Compass, 7(4):300–314.
[9]Robertson, G.P., Swinton, S.M., 2005, Reconciling agricultural productivity and environmental integrity: a grand challenge for agriculture. Frontiers in Ecology and the Environment, 3:38–46.
[10]Shkuratov, O., Chudovska, V., 2019, Methodical approach to assessment of risk of environmental safety in the agricultural economy sector. AgroLife Scientific Journal, 8 (1):142-149.
[11]Shkuratov, O., Hreshchuk, H., Lobanova, O., 2018, Forecast scenarios of development of the internal consumer market of organic products in Ukraine. Scientific Papers: Series Management, Economic Engineering in Agriculture and Rural Development, 18 (4):303-310.
[12]Swaffield, S.R., 2014, Sustainability practices in New Zealand agricultural landscapes under an open market policy regime. Landscape Research, 39:190–204.
[13]The Main Department of Statistics in Kyiv Oblast, 2019, "Silske hospodarstvo Kyivskoi oblasti: 2018. Stat. zbirnyk" [Agriculture of the Kyiv region 2018. Statistical yearbook], Holovne upravlinnia statystyky u Kyivskii oblasti, Kyiv, Ukraine, 168.
[14]Volkov, S., Tverdovsky, L., 1991, Workshop on economic and mathematical methods and modeling in land management. Moscow, Agropromizdat, 256.
[15]Zanten, B., Verburg, P., Espinosa Goded, M., Gomez Y Paloma, S., Galimberti, G., Kantelhardt, J., Kapfer, M., Lefebvre, M., Manrique, R., Piorr, A., Raggi, M., Schaller, L., Targetti, S., Zassada, I., Viaggi, D., 2013, European agricultural landscapes, common agricultural policy and ecosystem services: a review. Agronomy for Sustainable Development, 34:309–325.