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Methodical aspects of determining strategic directions for the development of rural areas of amalgamated territorial communities

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► **Abstract.** The relevance of the study is to develop an economic and mathematical model for tactical and strategic planning of socio-economic development of rural areas of amalgamated territorial communities. The purpose of the study was to improve and apply methodological tools for determining strategic directions of development of rural territories of amalgamated territorial communities on the example of Vinnytsia region. The following methods were used: comparative analysis, statistical, tabular, graphical, calculation and design, abstract and logical. The proposed methodological tools and the algorithmic sequence of its practical implementation made it possible to identify structural and aggregate economic, social and environmental indicators of rural development of the amalgamated territorial communities, to model the relevant list of priority problems and to substantiate the directions of their minimisation. By modelling the strategic directions of rural development on the basis of a set of economic, social and environmental factors using the methodological tools of fuzzy set theory, it is established that the overall indicator of rural development in terms of the economic block is within the optimal rate of development (0.849), in terms of the dynamics of the share of investment in the agricultural sector of the economy – exceeds the satisfactory level (0.771), in terms of financial performance indicators it is reaching a threatening level (0.387). It has been established that the integral indicator of rural development in the social block is within the satisfactory rate (0.702), and according to indicators of the quality of life of the population, it is at a threatening pace (0.490). Accordingly, a monitoring rating of priority social problems of rural development that need to be addressed has been formed. It was determined that according to the dynamics of ecological calculation indicators; the general indicator for the environmental block is within the limits of a satisfactory rate of rural development (0.650). The modelled ranking of the priority problems of rural development are presented in the following sequence of their minimisation: economic – E_4, E_3, E_2, E_1; social – S_6, S_4, S_1, S_2, S_3, S_5; environmental – Ek_1, Ek_2. The practical results of the study make it possible to objectively assess the advantages, challenges and risks of rural development of the rural areas of the amalgamated territorial communities of Vinnytsia region, contribute to the prioritisation of solving economic, social and environmental problems and can be useful in regional management practice for the developing strategic directions for further intensification of community development

► **Keywords:** economic indicators; social indicators; environmental indicators; integral indicator; variational model; intensification of rural development

► Introduction

The amalgamation of neighbouring territorial communities in the course of the 2015-2020 decentralisation and territorial-administrative reform is aimed at transferring the functions to local self-government, which allows for the intensification of rural development. The concept of development of amalgamated territorial communities

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(ATC) is focused on agricultural production, self-organisation, local resources, infrastructure and investment attractiveness. It is important to develop an adaptive mathematical model for assessing and modelling strategic directions of rural development that takes into account economic, social and environmental indicators. This will help identify effective development vectors and ensure effective planning (Pietrzyk, 2022).

The issues of rural development efficiency, development of methodological tools for its measurement and modelling of forecast parameters of activation are the subject of research by many authors. In her research, O. Lazarieva (2019) proposes to use a set of indicators that characterise the efficiency of land use, namely: the level of provision of agricultural land, the dynamics of crop and livestock production per unit area, a set of profitability indicators and profitability of production of various types of agricultural products, etc. to assess the sustainable development of rural areas. The author notes that the use of these indicators will allow not only to identify the reasons for the inefficient use of the land resource potential of rural areas, but also to outline the priority areas for its stabilisation and further economic growth.

N. Khomyuk & N. Pavlikha (2019) propose a methodological toolkit that comprehensively combines the monitoring the level of rural development and developing strategic directions for its further activation. The main methodological approach proposed for analysing rural development is the toolkit for calculating an integral index, which systematically involves the selection and justification of the necessary array of quantitative and qualitative indicators. The authors propose to substantiate the strategic parameters of rural development by building a model of diversification of rural development with further indicative monitoring of its results.

A. Sava *et al.* (2020) propose to determine the strategic directions of rural development throw the development and practical processing of econometric models. In their study, the authors focused on measuring the correlation-regression relationship between the state of rural areas and structurally differentiated factor influence. It was established that factor combinations with a negative value of the regression coefficient have a stronger influence on the state of rural areas than factors with high positive values of the R2 indicator. In their opinion, the economic and mathematical modelling tools substantiated by the authors allow to identify a set of problems of rural development that need to be minimised and solved as a matter of priority.

K. Patytska *et al.* (2021) substantiated the methodology for determining the budgetary capacity of territorial communities. The authors identified the income component of the community budget as the basic indicator of the proposed methodology, which objectively reflects the current state and existing problems of its economy. The authors link the prospects for the development of amalgamate territorial communities with their budgetary capacity. In their opinion, structural monitoring of local budget revenues, analytical determination of the sources and features of their formation, measurement of the structure of the community's own income and the dynamics of their negative shifts will contribute not only to ascertaining the existing problems of filling local budgets, but also help to determine the real mechanisms of activation of rural development on the basis gradual strengthening of budgetary capacity.

N. Kondratenko *et al.* (2022) in their study define the leading role of digitalisation and its tools in the development of rural areas. The authors claim that the gradual introduction of digital technologies and the creation of an effective information and communication environment will contribute to the development of villages and increase the quality of life of their residents.

I. Semihulina *et al.* (2022) devoted their study to substantiating theoretical and methodological recommendations for the development of methodological support for the practical implementation of the programmer and -project approach to managing the spatial development of ATCs. The authors interpret the methodological support toolkit as a integral system that combines methodological techniques of organisational and project management.

A. Kolosov *et al.* (2022) devoted their study to identifying current realities of the socio-economic life of rural and urban communities in Ukraine. The factor structuring of existing social and economic problems, intensified by modern global challenges, allowed the authors to determine real opportunities and scenario approaches for stable existence and further development. The authors identified and revealed the content of the priority factors of the modern development of the country's rural and urban communities and systematised the positive and negative features of their manifestation.

T. Panchyshyn & M. Vdovyn (2023) propose to assess the level of sustainable development of territorial communities and regions by identifying a systematic set of components and indicators using a multidimensional ranking tool, taking into account stimulant and destimulant indicators. The practical implementation of this methodological approach allows to determine both the rating of the leading regions and the list of regions with the worst indicative values.

Studies focus on substantiating the methodological aspects of assessing rural development without developing appropriate methodological tools for determining the strategic directions of their further intensification. Thus, it is worth stating the need for further research, substantiation, generalisation and in-depth methodological and practical processing of existing scientific works. The purpose of the study was to create methodological tools for determining strategic directions of rural development and its comprehensive testing on example of ATCs of Vinnytsia region. In order this goal, the following tasks needed to be implemented: to substantiate the methodological tools for calculating indicators of rural development of ATC by factor groups; to determine the dynamics of economic, social and environmental calculated indicators of rural development; to carry out an indicative structuring of the priority problems of rural development in the Vinnytsia region's ATCs with further justification of the sequence of their minimisation.

▸Materials and methods

In the course of the study, a number of methods of scientific cognition were used. The method of comparative analysis was used for the structured formation of an array of calculation indicators of rural development for each

block of factors by dividing them by the maximum value. The tabular and graphical methods are used to visualise the results of the study. The statistical method was used to determine the arithmetic mean values for each calculated indicator according to the chosen structuring of factor groups of rural development of the ATCs of Vinnytsia region. The calculation and constructive method was used to determine the factor indicators and further structure the economic, social and environmental problems of rural development of the Vinnytsia region's ATCs. The abstract and logical method was used to substantiate the structural and logical sequence of the policy of minimising the totality of problems of rural development of the Vinnytsia region's ATCs and to formulate conclusions.

A conceptual feature of this study is an attempt to build a structured toolkit for strategic regulation of the development of rural areas of ATCs on the basis of fuzzy sets. A step-by-step algorithm for the formation of a variable model for enhancing the development of rural areas of ATCs is presented as follows.

The overall level of effectiveness of rural development of ATCs was identified in the form of a specific variable IR. The value of this variable indirectly depends on a structured set of economic, social and environmental factors. This dependence is illustrated in the form of the following formula:

$$IR = \phi(IR_e, IR_s, IR_{ek}), \quad (1)$$

where IR_e – a set of economic indicators (factors) of rural development, IR_s – a set of social indicators (factors) of rural development, IR_{ek} – a set of environmental indicators (factors) of rural development.

The block of economic indicators of rural development is tentatively structured into four factor groups:

- level of land availability E_1;
- level of entrepreneurial activity in rural areas E_2;
- the level of efficiency of the organisational and economic mechanism of management E_3;
- level of investment attractiveness and activity E_4.

Mathematically, the variable economic component is presented as follows:

$$IR_e = \phi(E_1, E_2, E_3, E_4). \quad (2)$$

In turn, the factor groups that structurally form the economic block of impact indicators can be described using the following mathematical tools.

$$E_1 = \phi(e_1, e_2, e_5, e_3, e_4), \quad (3)$$

where e_1 is the total land area per 1 person, ha; e_2 – area of agricultural land per 1 person; ha, e_3 – the level of agricultural land development; %, e_4 – is the ploughed rate of agricultural land, %; e_5 – indicator of agricultural land availability, ha per one rural resident.

$$E_2 = \phi(e_6, e_7, e_8, e_9, e_{14}), \quad (4)$$

where e_6 is the number of agricultural enterprises per 10,000 population, unit; e_7 – is the share of small enterprises, %; e_8 – is the number of enterprises in the agricultural sector, unit; e_9 – is the share of the total amount, %; e_{14} – is the share of agricultural production by households, %.

$$E_3 = \phi(e_{10}, e_{27}, e_{28}, e_{11}, e_{12}, e_{13}, e_{15}, e_{16}, e_{17}, e_{18}, e_{19}, e_{20}, e_{21}, e_{22}, e_{23}, e_{24}, e_{25}, e_{26}), \quad (5)$$

where e_{10} is the profitability of rural producers, %; e_{27} – financial results from ordinary activities before taxation per 1 person, thousand UAH; e_{28} – profit per 1 person, thousand UAH; e_{11} – indicator of employment in the agricultural sector, %; e_{12} – average monthly wage of agricultural producers, UAH; e_{13} – agricultural production per 1 person, thousand UAH; e_{15} – share of crop production, %; e_{16} – share of livestock products, %; agricultural production per 1 person, kg: e_{17} – cereals and legumes; e_{18} – sugar beet; e_{19} – sunflower; e_{20} – potatoes; e_{21} – vegetable crops; e_{22} – fruit and berry crops; e_{23} – meat (in slaughter weight); e_{24} – milk; e_{25} – eggs, pcs.; e_{26} – volume of products sold by agricultural producers per 1 person, thousand UAH.

$$E_4 = \phi(e_{29}, e_{30}), \quad (6)$$

where e_{29} is the volume of capital investments in agriculture per 1 person, thousand UAH; e_{30} – share of capital investments in the agricultural sector to total, %.

The block of social indicators of rural development tentatively structured by the following factor groups:

- level of demographic situation S_1;
- rural employment rate S_2;
- education level S_3;
- level of rural infrastructure development S_4;
- level of population welfare S_5;
- quality of life of the rural population S_6.

Mathematically, the variable social component is represented as follows:

$$IR_s = \phi(S_1, S_2, S_3, S_4, S_5, S_6). \quad (7)$$

The mathematical tools for identifying the structural components that form the social block of factors influencing the development of rural areas of ATCs are presented as follows:

$$S_1 = \phi(s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_{13}, s_{14}, s_{15}, s_{16}, s_{17}), \quad (8)$$

where s_1 is the total population of the ATC, thousands people; s_2 – share of the rural population, %; s_3 – average number of residents in 1 village, people; s_4 – the dynamics of the rural population per 1,000 people; s_5 – total fertility rate per 1 woman; s_6 – is the rural fertility rate, people; s_7 – is the rural mortality rate; s_{13} – number of registered marriages, units; s_{14} – per 1,000 population; s_{15} – number of registered divorces; s_{16} – per 1,000 population; s_{17} – ratio of marriages and divorces rates.

$$S_2 = \phi(s_8, s_{10}, s_{11}, s_9, s_{12}), \quad (9)$$

where s_8 is the economically active rural population (age group 15-70), thousands of people; s_9 – economically inactive rural population (age group 15-70), thousands of people; s_{10} – economic activity indicator, %; s_{11} – employment rate, %; s_{12} – unemployment rate, %.

$$S_3 = \phi(s_{18}, s_{19}, s_{20}, s_{21}, s_{22}, s_{23}, s_{24}, s_{25}, s_{26}, s_{27}), \quad (10)$$

where s_{18} is the percentage of children with kindergartens, %; s_{19} – in urban-type settlements, %; s_{20} – in villages, %; s_{21} – indicator of kindergartens provision per 100 places, %; s_{22} – in urban-type settlements; s_{23} – in the villages; s_{24} – number of people enrolled in educational institutions, thousands of people; s_{25} – in secondary education institutions; s_{26} – in vocational and technical education institutions; s_{27} – in higher education institutions.

$$S_4 = \phi(s_{28}, s_{29}, s_{30}), \quad (11)$$

where s_{28} is the number of libraries per 1 rural settlement, units; s_{29} – the number of club per 1 rural settlement, units; s_{30} – number of hospital beds per 10,000 thousand people, units.

$$S_5 = \phi(s_{31}, s_{32}, s_{33}), \quad (12)$$

where s_{31} is the consumer price index; s_{32} – average aggregate total monthly income of a rural household, UAH; s_{33} – the share of consumption of own subsidiary farm products in rural areas, %.

$$S_6 = \phi(s_{34}, s_{35}, s_{36}, s_{37}, s_{38}, s_{39}), \quad (13)$$

where s_{34} is the indicator of housing provision, m^2 per person; s_{35} – indicator of provision of dwellings in rural areas with water supply, %; s_{36} – is the indicator of hot water supply; s_{37} – is the indicator of sewerage; s_{38} – is the indicator of central heating; s_{39} – is the indicator of natural gas.

The last environmental factor component of the model of effective rural development is structured into two blocks – the level of atmospheric air and land resources Ek_1 and the level of investment support for environmental protection Ek_2.

The mathematical description of the environmental block for the development of rural areas of the ATC is presented in the form of the following formula:

$$IR_{ek} = \phi(Ek_1, Ek_2). \quad (14)$$

The block of environmental indicators of rural development is indicatively structured by the following factor groups.

The factor groups that structurally form the environmental component of the impact on the level of rural development will be presented using the following mathematical tools.

$$Ek_1 = \phi(ek_1, ek_2, ek_3, ek_6, ek_7), \quad (15)$$

where ek_1 – emissions of harmful substances that pollute the atmosphere as a result of the functioning of sectoral components of agricultural production, % of total harmful emissions; ek_2 – emissions of carbon dioxin into the atmosphere as a result of the functioning of sectoral components of agricultural production, % of total harmful emissions; ek_3 – indicator of the level of forest reproduction (ratio of planting areas to the volume of deforestation), %; ek_6 – share of fertilised area with organic fertilisers, %; ek_7 – share of fertilised area with mineral fertilizers, %.

$$Ek_2 = \phi(ek_4, ek_5), \quad (16)$$

where ek_4 is the level of investment activity of capital investments in environmental protection, % of total capital investments in agriculture development; ek_5 – the level of current investment activity in environmental protection, % of total capital investments.

The next stage of the algorithm for substantiating a variable model for enhancing the development of rural areas of ATCs is the structured formation of appropriate arrays of calculation indicators for each block of factors. The indicators are calculated for each indicator in the retrospective of the study by dividing them by the maximum value using the following formulas:

$$ne_{ij} = \frac{e_{ij}}{e_{max\,ij}}, \quad (17)$$

where ne_{ij} is the calculated indicator of the i-th indicator of the economic block in the j-th year.

$$ns_{ij} = \frac{s_{ij}}{s_{max\,ij}}, \quad (18)$$

where ns_{ij} is the calculated indicator of the i-th indicator of the social block in the j-th year.

$$nek_{ij} = \frac{ek_{ij}}{ek_{max\,ij}}, \quad (19)$$

where nek_{ij} is the calculated indicator of the i-th indicator of the environmental block in the j-th year.

It was used the arithmetic mean values for each calculated indicator for further modelling. Accordingly, the further tools for calculating the values of the indicators of rural development of ATCs according to the selected indicative structuring of factor groups are as follows (Table 1).

Table 1. Toolkit for calculating rural development indicators of ATCs by factor groups

Function of factor groups of indicators	Calculation formula
Block of economic indicators	
$E_1 = \phi(e_1, e_2, e_5, e_3, e_4)$	$E_1 = \sqrt[5]{\prod_{i=1}^{5} ne_{imv}}$
$E_2 = \phi(e_6, e_7, e_8, e_9, e_{14})$	$E_2 = \sqrt[5]{\prod_{i=1}^{5} ne_{imv}}$
$E_3 = \phi(e_{10}, e_{27}, e_{28}, e_{11}, e_{12}, e_{13}, e_{15}, e_{16}, e_{17}, e_{18}, e_{19}, e_{20}, e_{21}, e_{22}, e_{23}, e_{24}, e_{25}, e_{26})$	$E_3 = \sqrt[18]{\prod_{i=1}^{18} ne_{imv}}$
$E_4 = \phi(e_{29}, e_{30})$	$E_4 = \sqrt[2]{\prod_{i=1}^{2} ne_{imv}}$
Block of social indicators	
$S_1 = \phi(s_1, s_2, s_3, s_4, s_5, s_6, s_7, s_{13}, s_{14}, s_{15}, s_{16}, s_{17})$	$S_1 = \sqrt[12]{\prod_{i=1}^{12} ns_{imv}}$
$S_2 = \phi(s_8, s_{10}, s_{11}, s_9, s_{12})$	$S_2 = \sqrt[5]{\prod_{i=1}^{5} ns_{imv}}$
$S_3 = \phi(s_{18}, s_{19}, s_{20}, s_{21}, s_{22}, s_{23}, s_{24}, s_{25}, s_{26})$	$S_3 = \sqrt[9]{\prod_{i=1}^{9} ns_{imv}}$

Table 1, Continued

Function of factor groups of indicators	Calculation formula
$S_4 = \phi(s_{28}, s_{29}, s_{30})$	$S_4 = \sqrt[3]{\prod_{i=1}^{3} ns_{imv}}$
$S_5 = \phi(s_{31}, s_{32}, s_{33})$	$S_5 = \sqrt[3]{\prod_{i=1}^{3} ns_{imv}}$
$S_6 = \phi(s_{34}, s_{35}, s_{36}, s_{37}, s_{38}, s_{39})$	$S_6 = \sqrt[6]{\prod_{i=1}^{6} ns_{imv}}$
Block of environmental indicators	
$Ek_1 = \phi(ek_1, ek_2, ek_3, ek_6, ek_7)$	$Ek_1 = \sqrt[5]{\prod_{i=1}^{5} nek_{imv}}$
$Ek_2 = \phi(ek_4, ek_5)$	$Ek_2 = \sqrt[2]{\prod_{i=1}^{2} nek_{imv}}$

Source: developed by the authors

The next stage of the modelling algorithm is the process of streamlining the set of calculated indicators by constructing maps of the values of the relevant economic, social and environmental indicators of rural development of the ATCs of Vinnytsia region. Accordingly, to rank arrays of indicators by economic, social and environmental blocks, it is advisable to use the following evaluation scale (Table 2).

Table 2. Ranking tools for rural development indicators in ATCs

Scoring limits	Characteristics of the level of rural development
0.000-0.300	Critical level
0.301-0.500	Threatening level
0.501-0.700	Satisfactory growth rates
0.701-0.900	Optimum growth rates
0.901-1.000	High level of development

Source: developed by the authors

The empirical basis of the study is the data of the Main department of statistics in Vinnytsia region (n.d.), Official website of the State Statistics Service of Ukraine (n.d.), information materials of Strategy of balanced regional development of the Vinnytsia region until 2027 (2024).

▸ Results and Discussion

The results of the practical development of the proposed methodological tools are the following array of fuzzy data transformed into calculated indicators of rural development by economic block (Table 3).

Table 3. Dynamics of economic calculation indicators of rural development of ATCs in Vinnytsia region, 2017-2022

Characteristics of the indicators	Indicator designation	2017	2018	2019	2020	2021	2022	e_{mv}
Level of land availability								
Total land area per 1 person, ha;	e_1	0.961	0.970	0.980	0.989	1.000	0.973	0.979
Area of agricultural land per 1 person; ha,	e_2	0.962	0.970	0.979	0.989	1.000	0.972	0.979
Level of agricultural land development; %,	e_3	1.000	0.999	0.999	0.999	0.999	0.999	0.999
Ploughed rate of agricultural land, %;	e_4	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Indicator of agricultural land availability, ha per one rural resident.	e_5	0.954	0.968	0.982	1.000	0.975	0.957	0.973
Level of entrepreneurial activity in rural areas								
Number of agricultural enterprises per 10,000 population, units	e_6	0.784	0.838	0.892	0.851	0.784	0.830	0.830
Share of small enterprises, %	e_7	0.996	0.992	0.987	0.987	1.000	0.992	0.992
Number of enterprises and other registered participants in the agricultural sector, units	e_8	0.918	0.897	0.892	0.868	0.829	0.881	0.881
Share of the total amount, %	e_9	0.917	0.889	0.875	0.847	0.847	0.868	0.874
Share of agricultural production by households, %	e_{14}	1.000	0.891	0.830	0.894	0.762	0.823	0.867
Level of efficiency of the organisational and economic mechanism of management								
Profitability of rural producers, %	e_{10}	0.572	0.439	0.233	0.364	1.000	0.534	0.524
Indicator of employment in the agricultural sector, %	e_{11}	0.915	0.933	0.965	1.000	0.927	0.921	0.943

Table 3, Continued

Characteristics of the indicators	Indicator designation	2017	2018	2019	2020	2021	2022	e_{mv}
Average monthly wage of agricultural producers, UAH	e_{12}	0.530	0.679	0.833	0.873	0.972	1.000	0.815
Agricultural production per 1 person, thousand UAH	e_{13}	0.827	0.923	0.942	0.810	1.000	0.817	0.887
Share of crop production, %	e_{15}	0.976	1.000	0.921	0.858	0.958	0.981	0.949
Share of livestock products, %	e_{16}	0.763	0.714	0.845	1.000	0.798	0.752	0.812
Agricultural production per 1 person, kg:								
Cereals and legumes	e_{17}	0.726	0.887	0.899	0.614	1.000	0.556	0.780
Sugar beet	e_{18}	0.891	1.000	0.625	0.648	0.746	0.777	0.781
Sunflower	e_{19}	0.716	0.805	0.852	0.786	1.000	0.778	0.823
Potatoes	e_{20}	0.960	0.981	0.948	1.000	0.836	0.934	0.943
Vegetable crops	e_{21}	0.930	0.896	0.893	0.854	1.000	0.993	0.928
Fruit and berry crops	e_{22}	0.698	1.000	0.712	0.675	0.835	0.718	0.773
Meat (in slaughter weight)	e_{23}	0.462	0.513	0.677	0.703	0.700	1.000	0.676
Milk	e_{24}	1.000	0.978	0.914	0.883	0.829	0.778	0.897
Eggs, pcs.	e_{25}	0.993	0.973	1.000	0.940	0.767	0.668	0.890
Volume of products sold by agricultural producers per 1 person, thousand UAH.	e_{26}	0.542	0.629	0.678	0.638	1.000	0.751	0.706
Financial results from ordinary activities before taxation per 1 person, thousand UAH	e_{27}	0.297	0.276	0.193	0.159	1.000	0.397	0.387
Profit per 1 person, thousand UAH	e_{28}	0.316	0.320	0.221	0.248	1.000	0.526	0.438
Level of investment attractiveness and activity								
Volumes of capital investments in agriculture per 1 person, thousand UAH	e_{29}	0.954	1.000	0.836	0.633	0.672	0.905	0.833
Share of capital investments in the agricultural sector to total, %	e_{30}	1.000	0.689	0.645	0.560	0.576	0.807	0.713

Source: calculated by the authors according to the Main department of statistics in Vinnytsia region. (n.d.)

It was determined that the level of development of rural territories of the ATCs of Vinnytsia region is identified as high according to the average calculated indicators in the factor group "Level of provision with land resources". Thus, all component indicators of this group exceed the level of 0.900. The typology of rural development by the level of entrepreneurial activity in rural areas of the region is generally recognised as optimal. Almost all indicators that form this factor group by economic block are in the range of 0.830-0.881. The only exception is the indicator of the share of small enterprises; the calculated indicator is 0.992 and corresponds to a high level of rural development.

The indicators that form the factor group "The level of effectiveness of the organisational and economic mechanism of management" in their majority, also meet the limits of the optimal development rates, which once again confirms that the agricultural sector of economy of Vinnytsia region' has been and remains one of the most powerful components of the agrarian potential of country. The exception from the entire array of normalised indicators of this factor group is indicators of financial results from ordinary activities and net profit per person – 0.387 and 0.438, respectively.

In terms of the total volume of capital investments in agriculture in the Vinnytsia region, the level of rural development can be defined as optimal, and in terms of the dynamics of the share of investments in the agrarian sector of the economy – as satisfactory. The above trends are demonstrated on the corresponding map of economic indicators of rural development in the Vinnytsia region's ATCs (Fig. 1).

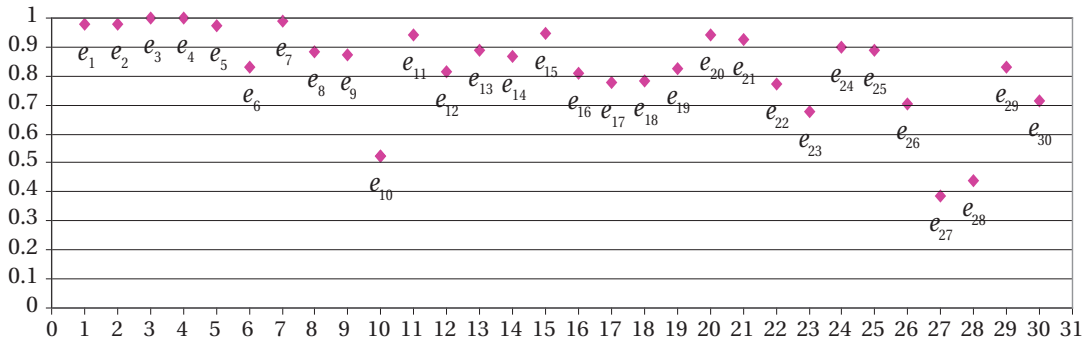

Figure 1. Map of values of indices of economic indicators of rural development of ATCs in Vinnytsia region
Source: compiled by the authors

Thus, it is clearly shown most economic indicators correspond to the typology of the optimal level of rural development. It is determined that the overall indicator of the rural development for the economic block is 0.849, but the values for the factor groups of the economic block vary from a minimum of 0.756 (E_3) to a maximum of 0.986 (E_1) (Table 4). Based on the research and the existing dynamics of the calculated values of economic indicators, a monitoring rating of priority problems of rural development that need to be addressed has been formed.

Table 4. Indicative structuring of the economic problems of rural development in the Vinnytsia region

Name and code of the structural indicator	Indicator code	Monitoring rating of priority problems of rural development
Level of land availability E_1 0.986	e_1	The need to introduce an effective mechanism for the economic use of land
	e_2	
	e_5	Availability of agricultural land in the territories
	e_3	The need to introduce the mechanisms for an effective land use system
	e_4	Ensuring an appropriate level of agro technological discipline and improving soil fertility
Level of entrepreneurial activity in rural areas E_2 0.905	e_6	Ensuring effective regulation of rural entrepreneurship
	e_7	Increasing the liberalisation of the socio-economic policy for small and medium-sized agribusiness in the rural areas
	e_8	Introduce effective mechanisms for cooperation between government and business
	e_9	Activation of the business environment
	e_{14}	Legal regulation and development of mechanisms of entrepreneurial activity of the rural population
Level of investment attractiveness and activity E_4 0.771	e_{29}	Creating a favourable investment climate
	e_{30}	Implementation of investment projects aimed at ensuring the production of high added products
Level of efficiency of the organisational and economic mechanism of management E_3 0.756	e_{10}	Implementation of effective mechanisms for managing the economic activity of rural commodity producers
	e_{27}	Increasing the financial capacity of communities
	e_{28}	Implementation of areas of empowerment in the process of community resource management
	e_{11}	Ensuring employment of the rural population
	e_{12}	Introduction of the policy of stable growth of living standards of the rural population
	e_{13}	Increasing the level of innovative development of rural producers
	e_{15}	Structural optimisation of sectoral production in the agricultural sector
	e_{16}	
	e_{17}	Stabilisation of production and gradual increase in agricultural output and sales Ensuring that agricultural enterprises enter the foreign market Development of organic production and markets for the niche crops Implementation of effective mechanisms for resource, technological and innovative support of agricultural producers
	e_{18}	
	e_{19}	
	e_{20}	
	e_{21}	
	e_{22}	
	e_{23}	
	e_{24}	
	e_{25}	
	e_{26}	
The overall rural development indicator for the economic block is 0.849		

Source: developed by the authors

It is quite clear that if one practically understand and consider the mechanism of development of the rural territories of ATCs through the plane of the identified indicators, the algorithm of prioritisation of solving economic problems should gradually move from the index with the lowest value to the highest. Based on the definition of an array of indicators, systematisation and calculation of structural indicators, the priority of economic problems of rural development in the ATCs of Vinnytsia region can be presented as follows (Fig. 2).

Thus, the starting point for achieving the strategic goals of optimal rates of rural development is the priority improvement of the investment climate, followed by the development and implementation of measures aimed at improving the efficiency of the organisational and economic mechanism of economic activity of all ATCs. It is worth noting that the financial capacity of communities is strongly mediated by the activity and efficiency of business entities operating on their territory, which are the main taxpayers to local budgets. Therefore, further

activation of the business environment of ATCs is one of the key aspects of solving the problems of rural development.

In turn, the policy of minimising the economic problems of rural development in ATCs is impossible without improving the mechanisms of resource use, optimising land use and land relations. A similar algorithmic scenario was used to model and identify social problems of rural development.

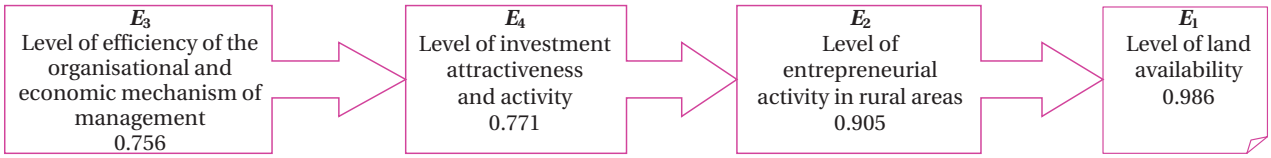

Figure 2. Structural and logical sequence of the policy of minimisation economic problems of rural development in ATCs of Vinnytsia region

Source: compiled by the authors

Practical testing of the proposed methodological modelling tools allowed us to form the following array of fuzzy data, which was transformed into dynamic series of rural development indicators by social block (Table 5). The calculations have established that, according to the factor group "level of the demographic situation", the level of development of the rural territories of the ATCs of Vinnytsia region is identified as optimal according to the average calculated indicators. However, there is considerable variability in the components of the indicators of this group. Thus, the population indicators of the region's ATCs meet the characteristics of a high level development, but the estimated indicators of population growth, fertility and mortality are identified as satisfactory. The typology of rural development by the level of employment of the rural population of the Vinnytsia region's ATCs is generally recognised as optimal.

Table 5. Dynamics of social calculated indicators of rural development of ATCs in Vinnytsia region, 2017-2022

Characteristics of the indicators	Indicator designation	2017	2018	2019	2020	2021	2022	s_{mv}
Level of demographic situation								
Total population of the ATC, thousands people	s_1	0.978	0.969	0.960	0.950	0.940	0.954	0.959
Share of the rural population, %	s_2	0.918	0.912	0.908	0.903	0.895	0.906	0.907
Average number of residents in 1 village, people	s_3	0.794	0.783	0.773	0.760	0.746	0.769	0.771
Dynamics of the rural population per 1,000 people	s_4	0.768	0.696	0.679	0.670	0.548	0.620	0.664
Total fertility rate per 1 woman	s_5	0.853	0.794	0.758	0.757	0.714	0.754	0.772
Rural fertility rate, people	s_6	0.807	0.717	0.664	0.653	0.629	0.674	0.691
The rural mortality rate	s_7	0.859	0.841	0.841	0.824	0.777	0.807	0.825
Number of registered marriages, units	s_{13}	0.774	0.724	0.761	0.514	0.659	0.654	0.681
Per 1,000 population	s_{14}	0.750	0.713	0.750	0.513	0.663	0.648	0.673
Number of registered divorces	s_{15}	0.690	0.602	0.669	0.776	0.745	0.701	0.697
Per 1,000 population	s_{16}	0.676	0.575	0.639	0.742	0.697	0.667	0.666
Ratio of marriages and divorces rates	s_{17}	0.739	0.609	0.739	0.565	0.696	0.646	0.666
Rural employment rate								
Economically active rural population (age group 15-70), thousands of people	s_8	0.732	0.749	0.761	0.781	0.784	0.762	0.761
Economically inactive rural population (age group 15-70), thousands of people	s_9	0.708	0.722	0.733	0.765	0.765	0.734	0.738
Economic activity indicator, %	s_{10}	0.797	0.812	0.827	0.849	0.845	0.824	0.826
Employment rate, %	s_{11}	0.814	0.830	0.841	0.847	0.854	0.829	0.836
Unemployment rate, %.	s_{12}	0.652	0.674	0.682	0.580	0.617	0.599	0.634
Education level								
Percentage of children with kindergartens, %	s_{18}	0.817	0.841	0.866	0.878	0.854	0.852	0.851
In urban-type settlements, %	s_{19}	0.887	0.907	0.959	0.979	0.969	0.945	0.941
In villages, %	s_{20}	0.627	0.640	0.640	0.653	0.613	0.629	0.634
Indicator of kindergartens provision per 100 places, %	s_{21}	1.000	0.991	0.937	0.910	0.847	0.920	0.934
In urban-type settlements	s_{22}	1.000	1.000	0.933	0.904	0.859	0.925	0.937
In the villages	s_{23}	0.848	0.828	0.788	0.768	0.677	0.761	0.778

Table 5, Continued

Characteristics of the indicators	Indicator designation	2017	2018	2019	2020	2021	2022	s_{mv}
Number of people enrolled in educational institutions, thousands of people	s_{24}	0.794	0.806	0.802	0.832	0.777	0.800	0.802
In secondary education institutions	s_{25}	0.691	0.710	0.723	0.732	0.730	0.720	0.718
In vocational and technical education institutions	s_{26}	0.682	0.641	0.601	0.591	0.616	0.628	0.627
In higher education institutions	s_{27}	0.806	0.801	0.743	0.706	0.589	0.711	0.726
Level of rural infrastructure development								
The number of libraries per 1 rural settlement, units	s_{28}	0.572	0.571	0.570	0.567	0.565	0.543	0.564
The number of club per 1 rural settlement, units	s_{29}	0.686	0.685	0.672	0.685	0.664	0.644	0.673
Number of hospital beds per 10,000 thousand people, units	s_{30}	0.857	0.825	0.818	0.783	0.751	0.709	0.790
Level of population welfare								
The consumer price index	s_{31}	0.876	0.908	0.967	0.962	0.911	0.796	0.903
Average aggregate total monthly income of a rural household, UAH	s_{32}	0.598	0.632	0.890	0.894	0.977	0.829	0.803
The share of consumption of own subsidiary farm products in rural areas, %	s_{33}	0.913	0.913	0.722	0.722	0.713	0.790	0.795
Quality of life of the rural population								
The indicator of housing provision, m^2 per person	s_{34}	0.896	0.908	0.924	0.941	0.949	0.927	0.924
Indicator of provision of dwellings in rural areas with water supply, %;	s_{35}	0.254	0.268	0.276	0.283	0.287	0.276	0.274
indicator of hot water supply	s_{36}	0.282	0.284	0.291	0.291	0.296	0.290	0.289
indicator of sewerage	s_{37}	0.310	0.320	0.332	0.337	0.337	0.329	0.327
indicator of central heating	s_{38}	0.573	0.584	0.584	0.586	0.583	0.582	0.582
indicator of natural gas	s_{39}	0.854	0.856	0.863	0.863	0.861	0.860	0.860

Source: calculated by the authors according to the Main department of statistics in Vinnytsia region. (n.d.)

Most of the indicators that structurally form this group of indicators are in the range of 0.738-0.836. As expected, the calculated value of the unemployment rate was much lower – 0.634, which corresponds to a satisfactory level of development. The factor group of social indicators of rural development "level of education" corresponds to the optimal type of rural development, both in terms of preschool and school education and all levels of vocational education.

The indicators that form the factor group "Level of population welfare" also correspond to the values of optimal development rates and in the range of 0.795-0.903. According to the indicators of the quality of life of the population, the level of development of the ATCs rural areas can only be identified as threatening. The indicators of water supply and sewerage in rural areas remain extremely low – 0.274 and 0.327, which generally corresponds to a critical level of rural development. According to indicators of the state of rural infrastructure, the level of development of the rural territories of the Vinnytsia Region can be identified as satisfactory (calculated indicators in the range of 0.564-0.790). Relevant trends in the dynamics and average values of social indicators of the rural development in the Vinnytsia Region's ATCs are shown on the corresponding map (Fig. 3). The map of values shows that the vast majority of social indicators correspond to the typology of satisfactory and optimal level of development. The calculations have established that the integral indicator of rural development for the social block is 0.702, but the values for the factor groups of the social block vary from a minimum of 0.490 (S_6) to a maximum of 0.828 (S_5). Thus, 4 of the 6 factor groups of social indicators correspond to the optimal level of development (S_1, S_2, S_3 and S_5), the level of development of rural areas is recognised as satisfactory, and according to the quality of life indicators (S_6) – as threatening.

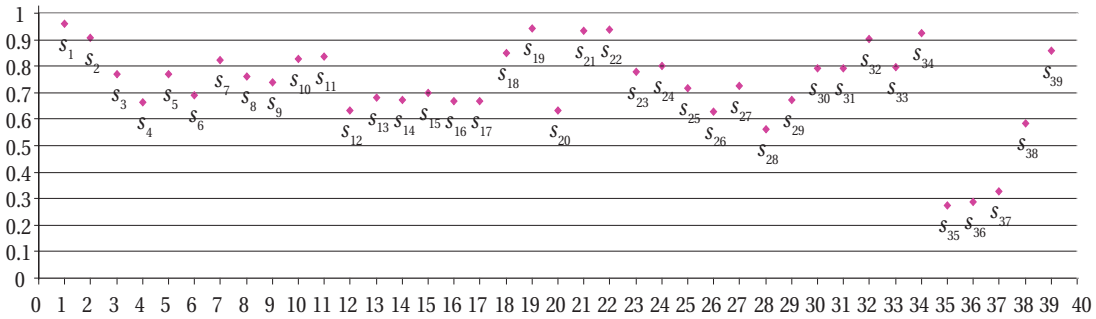

Figure 3. Map of values of social indicators of rural development in the Vinnytsia region's ATCs
Source: compiled by the authors

The monitoring rating of priority social problems of rural development that need to be addressed can be presented as follows (Table 6). Based on the practical implementation of the algorithmic stages of systematisation and calculation of structural indicators, the priority of solving social problems of rural development in ATCs of Vinnytsia region can be presented in the following sequence (Fig. 4).

Table 6. Indicative structuring of social problems of rural development in ATCs of Vinnytsia region

Name and code of the structural indicator	Indicator code	Monitoring rating of priority problems of rural development
Level of demographic situation S_1 0.742	s_1	Implementation of measures to preserve the number of rural population Reduction of territorial disparities in population by increasing the accessibility of social infrastructure facilities for rural residents
	s_2	
	s_3	
	s_4	Developing a socio-economic policy to promote fertility and optimise solutions to the problem of rural population ageing
	s_5	
	s_6	
	s_7	Socio-economic measures to reduce mortality and extended life expectancy of the rural population
	s_{13}	Implementation of the policy of promoting family development
	s_{14}	
	s_{15}	
	s_{16}	
	s_{17}	
Rural employment rate S_2 0.755	s_8	Developing a favourable business environment to increase rural employment
	s_{10}	Gradual expansion of employment areas
	s_{11}	Promoting self-employment in the services, retail and other sectors
	s_9	Implementation of measures to address socio-economic problems and minimise unemployment
	s_{12}	
Education level S_3 0.787	s_{18}	Implementation mechanisms to improve the efficiency of the education network Ensuring that canteens in rural schools meet HASSP requirements Modernisation of the heating system in educational institutions Improving the level of bomb shelters in educational institutions Solving the problem of physical and moral deterioration of technical elements of rural schools and other educational institutions Reducing of inter-district imbalances in education development
	s_{19}	
	s_{20}	
	s_{21}	
	s_{22}	
	s_{23}	
	s_{24}	
	s_{25}	
	s_{26}	
	s_{27}	
Level of rural infrastructure development S_4 0.669	s_{28}	Improvement of the transport system and road infrastructure Reducing inter-regional imbalances in the health care and culture development Strengthening the equipment of medical institutions with modern medical equipment Strengthening the material and technical support of cultural institutions
	s_{29}	
	s_{30}	
Level of population welfare S_5 0.828	s_{31}	Implementation of effective measures to overcome the problem of poverty and strengthen social protection
	s_{32}	Raising the income level of the rural population
	s_{33}	Optimisaton of the system of state aid to military families and vulnerable groups
Quality of life of the rural population S_6 0.490	s_{34}	Solving the problem of housing supply Development of communal infrastructure in local communities
	s_{35}	
	s_{36}	
	s_{37}	
	s_{38}	
	s_{39}	
The overall rural development indicator for the social block is – 0.702		

Source: developed by the authors

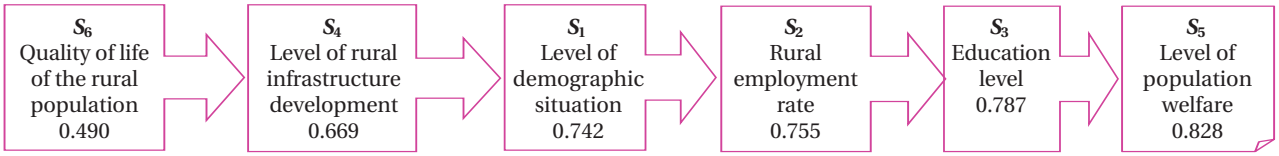

Figure 4. Structural and logical sequence of the policy of minimising social problems of rural development in the Vinnytsia region
Source: compiled by the authors

Based on the modelling, it is considered it appropriate to state that the achievement of the strategic goals of rural development in the social bloc requires constant work aimed at the formation and further development of rural infrastructure, the development of effective mechanisms for increasing the level of income and population quality life, improving social protection, quality of education and stabilising the demographic situation of the region's ATCs. According to the proposed modelling algorithm, the calculated array of fuzzy data characterising the level of rural development according to environmental criteria is presented in Table 7.

Table 7. Dynamics of environmental calculation indicators of rural development of ATCs in Vinnytsia region, 2017-2022

Characteristics of the indicators	Indicator designation	2017	2018	2019	2020	2021	2022	ek_{mv}
Level of atmospheric air and land resources								
Emissions of harmful substances that pollute the atmosphere as a result of the functioning of sectoral components of agricultural production, % of total harmful emissions	ek_1	0.513	0.864	0.671	0.642	0.887	0.723	0.717
Emissions of carbon dioxin into the atmosphere as a result of the functioning of sectoral components of agricultural production, % of total harmful emissions	ek_2	0.696	0.889	0.471	0.464	0.508	0.560	0.598
Indicator of the level of forest reproduction (ratio of planting areas to the volume of deforestation), %	ek_3	0.851	0.846	0.583	0.509	0.629	0.667	0.681
Share of fertilised area with organic fertilizers, %	ek_6	0.300	0.300	0.650	0.583	0.650	0.481	0.494
Share of fertilised area with mineral fertilisers, %	ek_7	0.688	0.687	0.685	0.707	0.682	0.696	0.691
Level of investment support for environmental protection								
Level of investment activity of capital investments in environmental protection, % of total capital investments in agriculture development	ek_4	0.522	0.582	0.462	0.326	0.908	0.598	0.566
Level of current investment activity in environmental protection, % of total capital investments	ek_5	0.821	0.788	0.854	0.930	0.607	0.763	0.794

Source: calculated by the authors according to the Main department of statistics in Vinnytsia region. (n.d.)

It has been determined that the level of rural development of the ATCs of Vinnytsia region is identified as satisfactory to the factor group "Level of the state of atmospheric air and land resources" by the average calculated indicators. It should be noted that all the component indicators of this group are within the range of 0.494-0.717. In turn, the typology of the development of rural areas of the ATCs by the level of investment support for environmental protection is also recognised as satisfactory. Thus, the share of capital investments in environmental protection remains low and corresponds to a threatening level of development. The above trends are illustrated on the corresponding map of environmental indicators (Fig. 5).

Thus, almost all environmental indicators correspond to the typology of a satisfactory level of rural development. It has been determined that the overall indicator of rural development for the environmental block is 0.650, and the values for the factor groups of the environmental block have a slight variation – 0.631(Ek_1) 0.670 (Ek_2). The corresponding monitoring rating of priority environmental problems that require gradual optimisation can be presented as follows (Table 8).

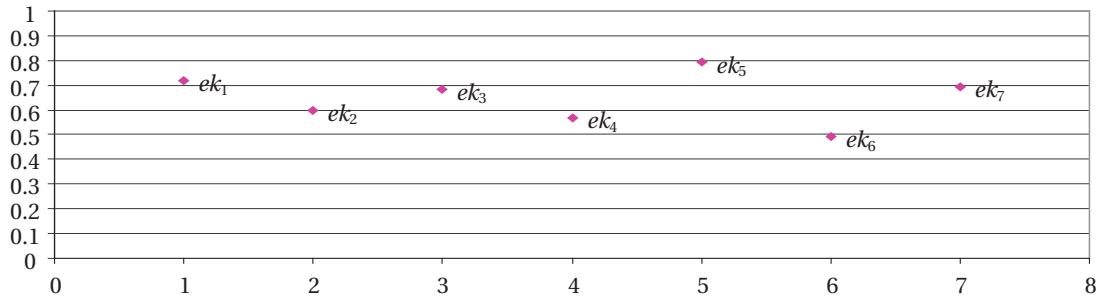

Figure 5. Map of the values of indices of environmental indicators of rural development of ATCs of Vinnytsia region
Source: compiled by the authors

Table 8. Indicative structuring of environmental problems of rural development in the ATCs of Vinnytsia region

Name and code of the structural indicator	Indicator code	Monitoring rating of priority problems of rural development
Level of atmospheric air and land resources Ek1 0.631	ek_1	Compliance with environmental requirements in the course of economic activity of rural producers
	ek_2	Reduction air pollution
	ek_3	Reducing the level of land and water pollution
	ek_6	Rationalisation of land use
	ek_7	Optimisation of economic and production use of agricultural lands
Level of investment support for environmental protection Ek2 0.670	ek_4	Introduce a policy of promote investment in environmental protection measures
	ek_5	
The overall rural development indicator for the environmental block is – 0.650		

Source: developed by the authors

Accordingly, the result of the final stage of modelling the intensification of rural development in Vinnytsia ATCs according to environmental criteria is the following sequence of solving the identified problems (Fig. 6).

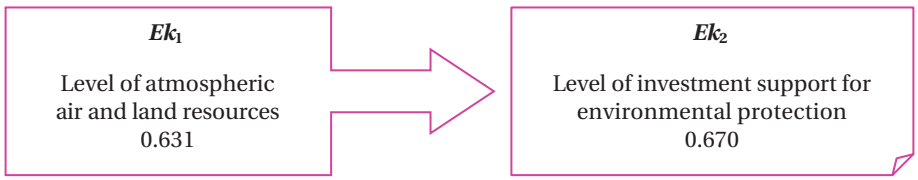

Figure 6. Structural and logical sequence of the policy of minimising environmental problems of rural development in the Vinnytsia region
Source: compiled by the authors

The development of the rural areas of ATCs is simply impossible without an effective solution to the environmental problems, the development of an effective regional policy to reduce air pollution, rationalisation of land use and the intensification of investment mechanisms aimed at environmental protection.

It is worth agreeing with the opinion of A. Sava (2018) that the methodological aspects of assessing the level of socio-economic development of rural areas and substantiating the priority directions of their development are identified with the selection of a set of relevant indicators, the application of methodological techniques for calculating integrated indicators and the corresponding construction of a rating of economic, social and environmental problems that need to be addressed. The objective practice of researching the level of rural development is not based on some stable, universal tools and algorithm. It has been established that scientific and practical recommendations are developed and constantly improved, the main purpose of which is to optimise the processes of forming arrays of indicators and indicators in a differentiated way to substantiate specific projects, plans, programs and strategies.

Y. Ivanov *et al.* (2022) also focused on the development of methodological aspects of substantiating the directions of development of territorial communities. The methodological approach proposed by the authors is based on indicators of resource availability, management and financial capacity of communities and is an algorithm for the sequential development and practical testing of a set of methodological approaches: analysis of resource availability, implementation of priority problems and further development modelling based on the fuzzy set method.

It worth agreeing with the authors that the spatial development of territorial communities structuredly implies the availability of natural, production, labour and other

resources, the effective use of which leads to their stable functioning and gradual development. In turn, the justification, development and practical implementation of effective mechanisms for their effective use are the way to stable functioning and gradual development of rural areas. It worth fully supporting the authors opinion that the main drivers of the gradual and stable development of territorial communities are mechanisms of self-sufficiency, self-management and self-financing adapted and flexible to modern challenges of socio-economic realities.

I. Ksonzhyk *et al.* (2021) devoted their study to the practice of sustainable development of rural territorial communities in European countries. The authors focused their attention on practical concepts of development, investigated the relationship between the existing patterns of implementation of the principles and the final target indicators of the effectiveness of rural development and justified the model of their effective achievement. One can fully agree with the authors that the plane of scientific research in the prism of theoretical and methodological levers for substantiating the conceptual foundations of the development of territorial communities is objectively based on the synergistic trinity of economic, social and environmental indicators with the mandatory condition of applying a spectrum of innovations and energy technologies.

A significant contribution to the study of the problems of methodical substantiation of rural development prospects was made by Y. Liu *et al.* (2022), who substantiation theoretical and methodological assessment of the effectiveness of China's rural revitalization directions. The authors focused on the construction and definition of a set of indices to assess the effectiveness of rural revitalisation strategies in China, differentiating them by factors affecting the quality of the material and spiritual life of the rural population.

F. Mantino (2021) studied the systematization of mechanisms explaining local and rural development in European countries. The author identified a tangible differentiation between the realities of local development in countries and the institutional vision of various international organizations and national (regional) authorities. It is worth supporting the author's research results, embodied in the proposed integrated theoretical and methodological approach, according to which local development processes are identified with the synergistic influence and interrelationship of three objective components – systems of local resources, networks, institutional support and enabling policy.

F. Poggi *et al.* (2018) link the realities of effective intensification of the development of rural areas in Portugal with the development and expansion of renewable energy. The authors methodically substantiated and practically determined the emergence of a functional dichotomy between the preservation of lands with a powerful agricultural potential and the practice of expanding sources and increasing the production of renewable energy in rural areas. It is worth agreeing that the adoption of management decisions aimed at ensuring efficient, balanced and ecologically economical management of agricultural production will be of strategic importance.

A. Veveris & A. Puzulis (2019) studied the significance role of the LEADER approach in rural development in Latvia. The authors analysed the methodological and practical tools and quantitative results of the LEADER approach implementation in Latvia and other European countries for the period 2014-2020. The main conclusion is that this approach shows good results, contributes to the activation of local activities of rural communities and has strategic prospects in the future.

M. Flaga & M. Wesołowska (2018) studied the objective unfavourable socio-economic problems of the rural areas of the eastern regions of Poland. The authors determined the destructive impact of socio-demographic problems on the level of development of peripheral rural areas of Poland. The authors analysed changes in population growth and its components (natural movement and migration), population structure, as well as individual indicators of the quality and living conditions of residents. The result of the conducted research is the conclusion the objective consequences of population change, the progressive aging of society, the decline of villages and social infrastructure have a negative impact on the future development of the region.

The results of Chinese researchers Z. Yin *et al.* (2021) are quite interesting for the methodology of enhancing rural development. The authors consider rural area from the perspective of a multifunctional approach as a natural, economic and social complex. The researchers calculated and characterised rural productive, living and environmental (PLE) functions at a grid scale of 300×300 m, and established a system of relevant assessment indices. The use of the ISO uncontrolled cluster classification tool allowed us typify rural areas by the areas of further intensification of rural development: environmental protection, employment and residence, recreation and development potential. It is worth supporting the authors' opinion that the practical significance of the study can become a source of decision-making on the delimitation of rural production, life and environmental space and the development of spatial planning.

K. Tae-Hwa & Y. Seung-Ryong (2016) devoted their study to the methodological and practical aspects of the analysing the current state of rural development processes in Vietnam and substantiating the directions for its activation. In their study, the authors use the developed methodological tools – the construction of the Rural Development Index (RDI). It is worth agreeing with the authors that this methodical approach and the practical results of its implementation should be used to establish medium- and long-term visions and strategies for rural development policy in Vietnam.

M. Biczkowski (2020) devoted his research to the activation and substantiation of the possibilities of rural development of ATCs of Poland. As a methodological tool, the author used the LEADER approach and determined its impact on increasing the mobilisation the existing resource potential of rural communities. The research has established that increasing the number of initiatives launched at the expense of the European Union, a combination of investment actions with social projects contributes to the intensification of rural development.

B. Hennebry & T. Stryjakiewicz (2020) devoted their study to the methodical justification and practical measurement of the existing differentiation in the level and

dynamics of rural development in two completely different countries – Austria and Portugal. As a methodological tool, the authors developed and proposed an index to measuring the "structural strength" of rural regions. The practical implementation of this theoretical and methodological approach allowed to build a rating of regions with weak rural development and identified a set of problems that need to be addressed. It is reasonable to agree with the authors that this index is a more holistic indicator of socio-economic development than the traditional gross domestic product (GDP) per capita.

The result of this study was the development and practical testing of a methodical approach to researching the process of socio-economic development of rural areas. Unlike the existing ones, this methodical approach comprehensively covers the algorithm for structuring the mathematical model of socio-economic effective development, which is based on the tools for calculating relevant indicators by factor groups, constructing the fields of their values, indicative structuring of priority problems and determining the sequence of their solution. Once a clear priority has been set for addressing economic, social and environmental problems, it is imperative to develop a strategic mechanism for rural development that can synergistically combine the relevant capabilities of public administration and local self-government.

Conclusions

The conceptual result of the study is the formation of a variable model for enhancing the development of rural areas of the ATCs, based on the proposed methodological tools for structuring and identifying relevant economic, social and environmental indicators. In the course of mathematical transformation of arrays of fuzzy data characterizing the dynamics of economic, social and environmental components of rural development into comparable calculation indicators with their further structuring into factor groups, it is determined that the overall indicator of rural development in the economic block is 0.839. It has been established that in terms of land resources provision, the level of development of rural territories of the ATCs of Vinnytsia region recognised as high with a mark of 0.986. By the level of entrepreneurial activity, investment attractiveness and efficiency of the organizational and economic mechanism of management, the development of rural areas of the region is identified as optimal with values of 0.905, 0.771 and 0.756, respectively.

The integral indicator of rural development for the social block is 0.702, which is on the verge of a satisfactory level. The determined values of the indicators by factor groups of the social block range from a minimum of 0.490 (quality of life of the rural population) to a maximum of 0.828 (level of well-being of the population). It was found that 54% of social indicators correspond to the optimal level of rural development, 33% – to the satisfactory, 8% – to the critical and threatening, and only 5% – to the high level. It was established that the environmental indicators correspond to the typology of the satisfactory level of rural development of ATCs with the level of the corresponding general indicator of 0.650.

The development and practical implementation of the proposed economic and mathematical model for modelling the strategic directions of rural development of the ATCs, taking into account economic, social and environmental factors, allows objectively assessing the problems of rural development of the Vinnytsia region and determining priorities for their solution. The results of the study contribute to the formation of algorithms for minimizing these problems and the justification of strategic directions for the activation of community development. This creates prerequisites for further research on the effectiveness of territorial transformations in rural areas.

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Conflict of interest

None.

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Методичні аспекти визначення стратегічних напрямів розвитку сільських територій об'єднаних територіальних громад

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Анотація. Актуальність дослідження полягає в розробці економіко-математичної моделі для тактичного та стратегічного планування соціально-економічного розвитку сільських територій об'єднаних територіальних громад. Метою дослідження було вдосконалення та практичне застосування методичного інструментарію для визначення стратегічних напрямів розвитку сільських територій об'єднаних територіальних громад на прикладі Вінницької області. Було використано такі методи: порівняльного аналізу, статистичний, табличний, графічний, розрахунково-конструктивний, абстрактно-логічний. Запропонований методичний інструментарій та алгоритмізована послідовність його практичної реалізації дозволили визначити структурні та сукупні економічні, соціальні та екологічні індикатори розвитку сільських територій об'єднаних територіальних громад, змоделювати відповідний перелік пріоритетних проблем та обґрунтувати напрями їх мінімізації. Моделюванням стратегічних напрямів розвитку сільських територій на сукупності економічних, соціальних та екологічних факторів із використанням методичного інструментарію теорії нечітких множин встановлено, що загальний індикатор розвитку сільських територій за економічним блоком перебуває в межах оптимального темпу розвитку (0,849), за динамікою частки інвестицій в аграрний сектор економіки – перевищує задовільний рівень (0,771), за індикаторами фінансових результатів набуває загрозливого рівня (0,387). Встановлено, що інтегральний індикатор сільського розвитку за соціальним блоком знаходиться в межах задовільного темпу (0,702), а за показниками якості життя населення – загрозливого (0,490). Відповідно сформовано моніторинговий рейтинг першочергових соціальних проблем сільського розвитку, які потребують свого вирішення. Визначено, що за динамікою екологічних розрахункових індикаторів загальний індикатор за екологічним блоком перебуває в межах задовільного темпу розвитку сільських територій (0,650). Змодельовані рейтинги першочергових проблем сільського розвитку представлено у наступній послідовності політики їх мінімізації: економічних – E_4, E_3, E_2, E_1; соціальних – S_6, S_4, S_1, S_2, S_3, S_5; екологічних – Ek_1, Ek_2. Практичні результати дослідження дозволяють об'єктивно оцінити переваги, виклики та ризики розвитку сільських територій ОТГ Вінницької області, що сприяє визначенню пріоритетів у вирішенні економічних, соціальних та екологічних проблем і може бути корисним у регіональній управлінській практиці для розробки стратегічних напрямів розвитку громад

Ключові слова: економічні індикатори; соціальні індикатори; екологічні індикатори; інтегральний показник; варіативна модель; активізація розвитку сільських територій