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# Rural development in Stavropol Krai: Assessment based on statistics and local perception

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**Abstract**

The article classifies rural territorial entities using the systems approach, which is based on identifying their key subsystems — natural, social, and economic. The study aims to develop and implement a procedure for creating a multi-aspect assessment range of rural development levels relying on the combined use of multivariate statistical analysis and the computational and expert comparison of objective and subjective structured information. The grouping of rural territorial entities carried out on this basis is intended to identify a pattern representing their targeted development, taking into account both the existing social and economic situation in the territory and its perception by the population. Methodological approaches to classify territorial rural units according to their level of rural development usually lack a systemic perspective and a subjective dimension to include the rural inhabitant perspectives. Using only expert opinions does not allow it to be reflected adequately enough. The comparison between the objective and subjective assessments of the natural, social, and economic conditions of rural territorial entities serves as the basis for identifying three groups of development patterns. Results were obtained through the combined application methods — cluster analysis and multidimensional scaling. The first one was used for an objective ranking of municipal districts in the region using official statistical data, while the second method was used for structuring the rural survey results. The main study result is the procedure for the multi-aspect grouping of rural areas, which enables the objective and subjective assessment of their key subsystems — economic, social, and natural — to be integrated into a single assessment tool. Its application helps establish a range of general patterns representing rural development. The study results can be used in the creation and updating of object- and subject-differentiated programs for the development of rural territorial entities.

*Keywords:* rural areas of Russia, rural development, multi-aspect grouping, cluster analysis, multidimensional scaling, development patterns.
*JEL classification:* R13, R23, R58.

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## 1. Introduction

An implementation analysis of projects for engineering infrastructure development under the program for integrated rural development in 2018–2020 revealed the distortion of provided data in over 30% of Russian regions.[1] This fact has a negative impact on the effective use of budget funds, as well as reducing the effectiveness of the state rural development policy. The lack of complete data often leads to the failure of ongoing projects to meet the needs and problems of rural areas (Cherdantsev and Shakleina, 2016; Voroshilov, 2021). The inability to use available analytical tools and/or their insufficient capacity to provide adequate assessment generates unnecessary problems in rural development management, even in the presence of adequate information. The acquisition of quality data on the rural development level depends on the selected research method, its resource support, and the ability to use it by applying it to the issues under consideration. The relevance of designing and appropriately using new assessment methods is attributed to the high heterogeneity of rural development processes both within Russia and its regions (Liu et al., 2022; Leontieva, 2010). This problem is also relevant in a broader international context (Dong et al., 2022; Wang et al., 2023).

Three approaches are most common in assessing the social and economic development of rural areas. The first one relies on the use of a system of indices (indicators). Its universality consists in the capability of identifying the structure of the rural regional system (Wang et al., 2023), selecting and adapting groups of indicators to regional problems and their specifics (Kurochkina et al., 2021), as well as assessing the potential for rural development through the indicators of land use, industrial production, and rural standard of living (Dong et al., 2022). The selection of indicators is in general arbitrary without a comprehensive systemic approach to rural development.

The second approach involves ranking rural territories via a rating-based assessment of their social and economic development levels. The basic algorithm for producing a rating involves determining indicators and the impact of associated factors, as well as selecting a data processing method and rating group boundaries. A key step in rating-based assessment consists in selecting the structure and list of input data. For example, Cherdantsev and Shakleina (2016) performed an analysis of rural development using 60 indicators, which, in our opinion, is excessive because it complicates the analysis and interpretation of its results. Conversely, other authors narrow the number of used indicators, limiting them only to certain fields characterizing rural development (Voroshilov, 2021; Golubeva et al., 2014; Parkhomov, 2021). Despite the obvious advantages of rating-based assessment, its arbitrary character and the limitation of used statistical data often prevent a quality analysis of differences in the levels of rural development.

[1] Report on the results of the expert analytical work "Analysis examining the impact of measures designed to develop housing construction and engineering infrastructure on the level of rural development implemented in 2018–2019 and in the past period of 2020 under the State Program for Development of Agriculture and Regulation of Markets of Agricultural Products, Raw Materials, and Foodstuffs and the State Program of the Russian Federation Integrated Rural Development" (approved by the Board of the Accounts Chamber of the Russian Federation as of January 26, 2021).

These problems can often be resolved through the use of the third approach — typological. The typology of rural areas constitutes an essential tool in demonstrating the heterogeneity and changes in their development. For example, in the typology of rural areas in Northeast China, the authors presented spatial differentiation through external factors, inner capacity, and area interaction with the environment (Liu et al., 2022). Grouping by spatial geographic and demographic characteristics (Naumov et al., 2021; Agibalov, 2022) as well as the sustainability of social and economic development (Nikitina, 2019) allows rural areas to be differentiated and their heterogeneity to be visualized. However, typological approaches provide no means to forecast future rural development, which limits their application in the development of relevant programs.

The approaches often used in assessing rural development have common disadvantages: use of knowingly incomplete statistical data that frequently fail to reflect the current condition of rural areas at the level of municipalities, and even more, of settlements. Thus, it makes impossible to carry out dynamic assessments in order to create a realistic future image of the territories.

Our study aims to develop and implement a procedure for creating a multi-aspect assessment range of rural development relying on the combined use of multivariate statistical analysis and comparison of objective and subjective information about rural territorial entities to identify a pattern of rural development. The procedure for conducting an objective and subjective assessment of conditions in rural areas presented in the article can provide a means to create high-quality and targeted programs for their development. The obtained results could be used for grounding agricultural policy.

## 2. Materials and methods

The study proposes an original methodological framework to evaluate the conditions of rural development in low-order administrative territorial units, such as municipalities. An integrated approach was used, combining the analysis of qualitative and quantitative data.

The assessment of social and economic rural development was conducted using data on Stavropol Krai, a region characterized by a primarily rural (agriculture-based) economy. The region is located in the south of Russia and has abundant natural resources for agricultural development and favorable climatic conditions for human life in rural areas. The share of rural population in the region significantly exceeds the national average: 40.7% as compared to Russia as a whole — 25.2%. The choice of this region is due to the constant population growth that is not typical for most territories of Russia as well as the strategic importance of the development of agricultural sector for the country in conditions of ensuring food independence. The agrarian specificity of Russia's southern regions suggests the relevance of the problems of rural development, where, in fact, commercial agriculture is concentrated.

The study took place from 2022 to 2023. In 2022, a social study was conducted in the form of a survey among rural residents of the region. The questionnaire survey was realized via an anonymous format with mandatory notification of respondents about the study aims and how the survey results would be used.

Also, during this period, the required statistical data for 2021 on socio-economic situation of rural areas in Stavropol Krai was collected.

### *2.1. Subject matter of the survey and sampling*

Rural residents from 26 municipal and urban districts (furthermore districts) of Stavropol Krai participated in the survey. The inclusion criteria of the respondents in the study were not defined: they were selected using the structured sampling method.

For the survey, three to five rural settlements were selected in each municipality with small, medium, and large number of dwellers. The sociological survey included from 100 to 300 rural residents who live in the selected rural settlements of Stavropol Krai. The total number of participants amounted to 3,660. Since it was essential to track the opinions of different age groups in the working-age population, rural residents aged from 18 to 70 years, who voluntarily decided to participate in the study, were invited to take part in the survey. Gender was not considered as a variable.

The age structure of respondents from rural households was as follows: aged from 18 to 30 years — 23.1%, from 31 to 59 (64) years — 65.8%, 60 (65) and older — 11.1%. This sample structure matches with the regional age structure of the rural population.

Of those surveyed, 12.0% were employed in agriculture, 19.9% — in other sectors of rural economy (except for the public sector), 50.8% — in the public sector, 6.6% were students, 6.4% were non-working pensioners, and 4.3% were unemployed.

### *2.2. Materials*

*List of questions.* The survey was conducted using a questionnaire that was based on a list of questions compiled by the Federal Scientific Center for Rural Economy and Social Rural Development — All-Russian Research Institute of Rural Economy (Shagaida et al., 2019). The specialists of the Institute worked out this list in 2004 to conduct a survey among rural residents of Russia. Subsequently, the list was revised. We used the 2018 version of the questionnaire, adapted for the purposes of our study.

The questions in the questionnaire can be grouped as follows:

(1) standard of living and economic well-being;
(2) employment problems;
(3) migration attitudes;
(4) housing conditions;
(5) development of social infrastructure;
(6) social and economic problems;
(7) interaction with authorities;
(8) fields of rural development;
(9) general information about the respondent.

The questionnaire used the following types of questions:

- radio choice questions;
- check box questions;
- open-ended questions;
- 5-point rating scale questions.

*Questionnaire survey and interview.* Survey data were collected in two ways: structured one-to-one interview; the list of questions converted into a Google Form for easy collection of information that was distributed to respondents.

*Statistical data.* The study used the indicators of municipal statistics for 2021 that were grouped according to the main subsystems characterizing rural areas: economic (including rural economy), social (demographics, standard of living), and natural (use of natural resources).[2]

### *2.3. Instruments and methods*

Rural areas constitute complex natural, social, and economic subsystems; therefore, it is necessary to use a large number of indicators to study them. In order to implement the systems approach, the study uses indicators within the three main subsystems of rural areas: natural, social, and economic. The list of used indicators is not exhaustive. Depending on the aims and capabilities of the study, the composition of variables may change.

The multidimensional assessment of rural areas was conducted using cluster analysis and multidimensional scaling (Soshnikova et al., 1999). The multidimensional scaling of districts in Stavropol Krai was performed to compare their configuration, obtained using cluster analysis, with the structured rural opinion — "perception space" of the economic, social, and natural situation in the corresponding rural areas. This approach provides a means to determine the areas of their social and economic development, taking into account both its current level and rural opinion. The study also employed the methods of comparison, grouping, and computational and expert analysis.

## 3. Procedure

Using available statistical data, we selected indicators that adequately describe the functioning of rural areas in the region in terms of the specified subsystems. In order to ensure the comparability of rural areas, relative variables were used.

The clustering of districts in Stavropol Krai was carried out to determine their positions relative to average regional indicators and to identify their groups in terms of rural development in 2021. A general flowchart illustrating the algorithm behind the procedure for the multi-aspect grouping and the selection of rural development patterns is presented in Fig. 1. It comprises the following stages:

(1) Primary data collection using survey results and the statistical database. Supplementing statistical data characterizing the condition of rural areas with the rural survey results improves the reliability of the primary rural development assessment.

(2) Generalization of data in two datasets;

(3) Selection of input and calculation of relative indicators; their grouping by the three subsystems of rural areas (Table 1).

(4) Cluster analysis performed for the districts of the region (total of 26 in Stavropol Krai) according to nine variables (on the basis of statistical data)

[2] Database containing the indicators of municipal units see https://26.rosstat.gov.ru/main_indicators (in Russian).

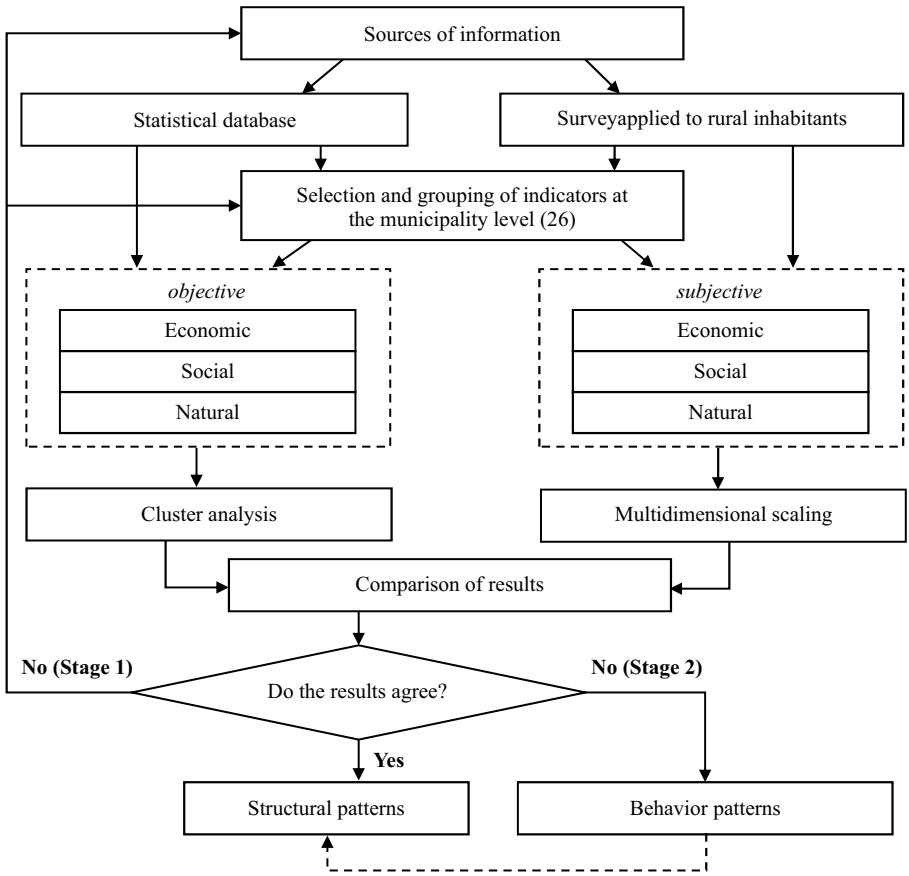


**Fig. 1.** Flowchart illustrating the algorithm behind the procedure for the multidimensional assessment of conditions in rural development.

*Source:* Compiled by the authors.

having standard values. To assess the homogeneity of clusters, the coefficients of variation for the studied indicators were calculated.

(5) Multidimensional scaling of the districts in the region using the survey results.

The number of dimensions was selected using the scree test (Fig. 2). On its basis, it can be concluded that both two-dimensional and three-dimensional spaces can be used. The latter option is selected here due to its higher informative value. Besides, the three-dimensional configuration of rural opinion in the corresponding districts of Stavropol Krai does not contradict the two-dimensional configuration.

The configuration of respondents' opinions in 26 districts of Stavropol Krai in the three-dimensional space Dimension 1, Dimension 2, and Dimension 3 is presented in Fig. 3. The rural survey was conducted in order to reveal opinions on problems of various nature faced by rural residents. In this connection, the majority of responses characterize the severity of problems: a higher response rate indicates a worse situation in a certain area in the district. Thus, a higher value of the district coordinate on the scale implies a higher percentage of respondents who reported problems in the sphere represented

by the (characteristic) variables reflecting the essence of the scale, i.e., greater severity of these problems. This factor was taken into account by the authors in the interpretation of the study results.

**Table 1**
Input data for the multi-aspect assessment of rural areas in the region.

| Subsystem | Indicators using statistical database | Indicators using survey data |
|---|---|---|
| Economic | 1. Shipped own-produced goods; performed works and services per person, thousand rubles<br>2. Amount of investment in fixed capital (excluding public funds) per person, thousand rubles<br>3. Share of the district in the agricultural output of the region, total for 2021, % | 1. Proportion of respondents who indicated "no initial capital and insufficient state support" as a significant reason for not starting their own business in relation to total respondents, % by municipality<br>2. Proportion of respondents who chose "rise in prices of goods and services" as one of the main problems of their area, %<br>3. Proportion of respondents who reported losing their job that year, % |
| Social | 1. Proportion of young people aged between 18 and 34 in the total population, %<br>2. Index of average monthly wages of company employees (except for small businesses), in % of 2021 to 2020<br>3. Migration gain / loss of population from rural areas for the year (+/–), people | 1. Proportion of respondents who reported that they plan to leave the settlement in the near future, %<br>2. Proportion of respondents who chose "low salary" as one of the main problems of their area, %<br>3. Proportion of respondents who reported social infrastructure problems as the main reason for moving from a rural area, % |
| Natural | 1. Proportion of agricultural land in the total area of the district, %<br>2. Provision of rural residents with agricultural land, ha/person<br>3. Agricultural output per ha of agricultural land, thousand rubles/ha | 1. Proportion of respondents who indicated "ecological situation and state of the environment" as one of the main problems in their area, %<br>2. Proportion of respondents who do not consider agricultural development a priority sphere for the region, %<br>3. Proportion of respondents who reported "climate" as one of the main reasons for moving from the rural area, % |

*Source:* Compiled by the authors.

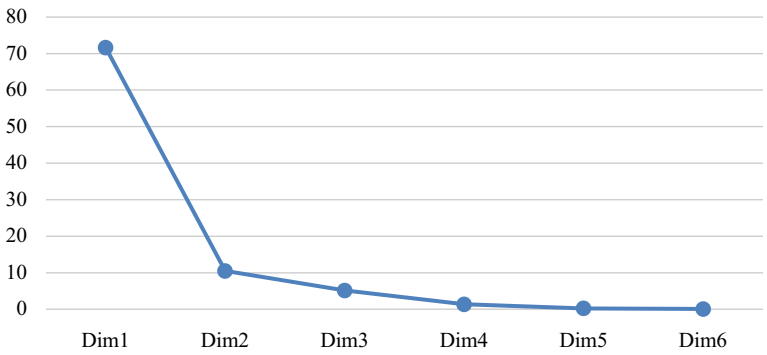


**Fig. 2.** Scree plot (conventional units; c.u.).

*Source:* Authors' calculations.

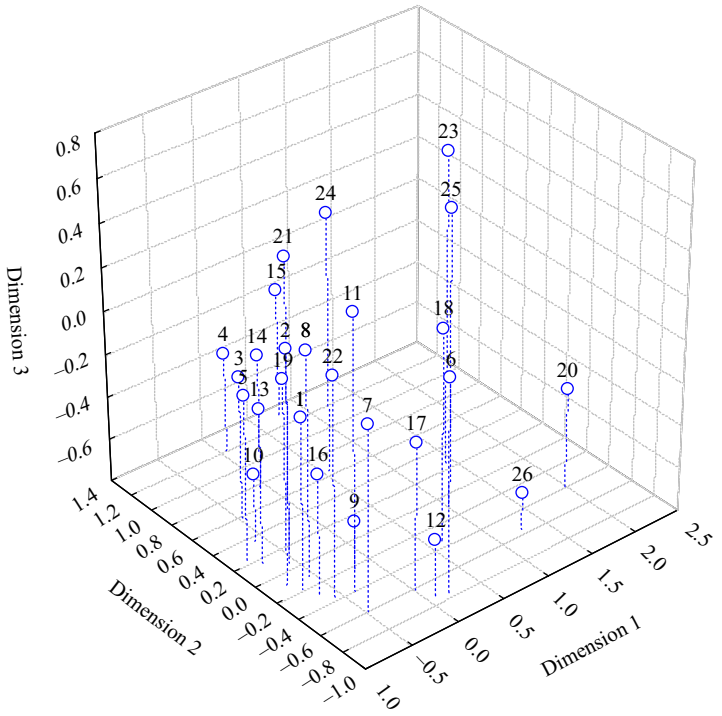


**Fig. 3.** Configuration of respondents' opinions in three-dimensional space.

*Note:* 1 — Alexandrovsky Municipal District (MD), 2 — Andropovsky MD, 3 — Apanasenkovsky MD, 4 — Arzgirsky MD, 5 — Blagodarnensky Urban District (UD), 6 — Budyonnovsky MD, 7 — Georgiyevsky UD, 8 — Grachyovsky MD, 9 — Izobilnensky UD, 10 — Ipatovsky UD, 11 — Kirovsky UD, 12 — Kochubeyevsky MD, 13 — Krasnogvardeysky MD, 14 — Kursky MD, 15 — Levokumsky MD, 16 — Mineralovodsky UD, 17 — Neftekumsky UD, 18 — Novoalexandrovsky UD, 19 — Novoselitsky MD, 20 — Petrovsky UD, 21 — Predgorny MD, 22 — Sovetsky UD, 23 — Stepnovsky MD, 24 — Trunovsky MD, 25 — Turkmensky MD, 26 — Shpakovsky MD.
*Source:* Authors' calculations.

The success of multidimensional scaling is determined by the possibility of selecting the "correct name" for the scales, i.e., content identification. The study of rural areas as complex systems implies analyzing a large number of variables that affect them. Rural employment, provision and quality of social infrastructure, income level, migration attitudes, and natural conditions cannot be considered separately as these factors are correlated with each other to a different extent. Since the use of factor analysis in this case would not be quite correct, we adopted multidimensional scaling which does not exclude the multicollinearity of indicators. However, this fact raises the possibility that the same variable may affect different aspects of the problem under study. This is reflected in the interpretation of obtained scales: Dimension 1, Dimension 2, and Dimension 3.

The procedure for interpreting the essence of scales consists of the following steps.

The first step means arranging the districts with indicators in the ascending order of their scaled values on Dimension 1, Dimension 2, Dimension 3.

The second step involves determining the degree of correlation between each of the nine indicators and each of the three scales. A higher value of the positive

correlation coefficient indicates a closer one-way relationship between this indicator and the Dimension.

The third step consists in visually assessing the correspondence of changes in characteristic variables to the position of the district on the scales.

The fourth step involves using multiple regression to assess the effect produced by the values of each variable defining the scale on the corresponding district coordinates for each of the three Dimensions.

The fifth step includes selecting indicators that represent the scale and its interpretation.

1. Grouping districts using the results of cluster analysis, followed by their division into segmented groups using the results of multidimensional scaling.

2. Comparison of two multidimensional (cluster and scaling) groupings of rural areas. The comparison was conducted by determining the difference between the position numbers of the districts in the ranked clusters and their place in the ordered groups according to the scaling results. This procedure allowed three groups of districts to be identified.

3. Identification of groups including the development patterns of districts by comparing their objective and subjective assessments:

- structural patterns for districts exhibiting minor position deviations in both groupings;
- behavior patterns for districts exhibiting significant positional discrepancies.

## 4. Data analysis

The survey results of rural residents were processed to obtain the required indicators using the SPSS Statistics software. The analytical part of the study was based on combining two methods of multivariate statistics: cluster analysis and multidimensional scaling. Cluster analysis is a multivariate classification method, i.e., it is useful for recognizing similarities between units and creating homogeneous groups. Multidimensional scaling is a multivariate method for reducing dimensions and ordering units in a space of two or more dimensions. It could be used for classification purposes, but the power of the method is the ordering of units considering several variables, where the distance represents similarities, among them (Soshnikova et al., 1999).

In the first stage, the rural areas of 26 municipal districts in Stavropol Krai were grouped according to nine (standard) indicators (see item 3 of the procedure) via *k*-means clustering using the STATISTICA software. In determining the number of clusters, cluster distributions were analyzed for different numbers of clusters ranging from three to seven. As a result, it was decided to use five clusters, which was justified by their quantitative composition and the expert analysis of their homogeneity.

The second stage involved conducting the multidimensional scaling of districts in Stavropol Krai according to the standard survey indicators. The scaling was carried out using the STATISTICA software by calculating the corresponding Euclidean distances. As a result, the distribution of districts was obtained within the three Dimensions.

The validity of the used procedure, including the interim and final results of its application, is based both on monitoring the use of multivariate statistical methods and verification expert analysis.

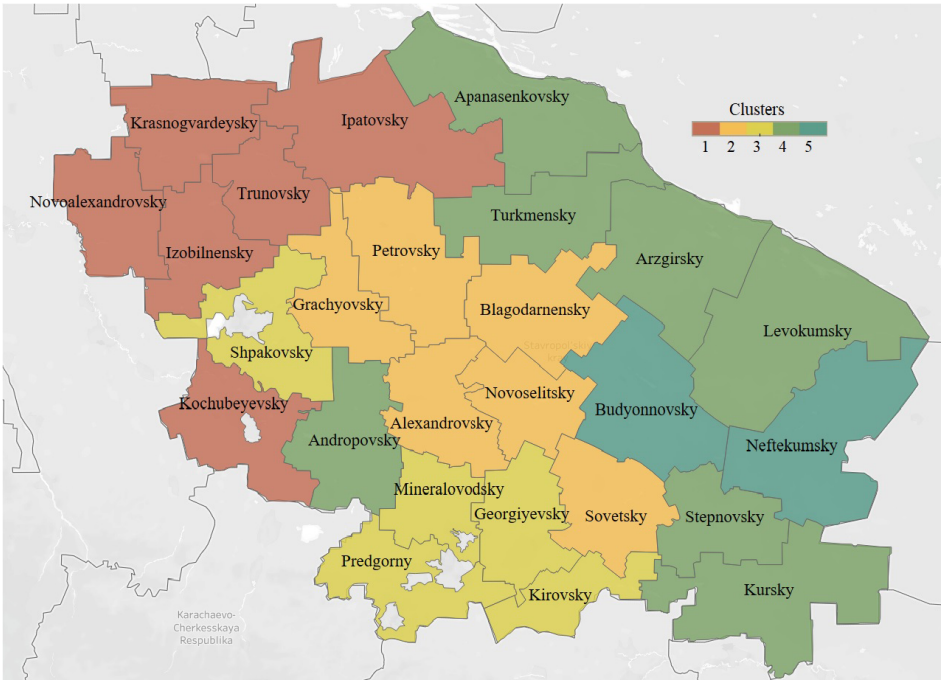


**Fig. 4.** Spatial representation showing the cluster distribution of districts in Stavropol Krai.
*Source:* Compiled by the authors.

## 5. Results

### *5.1. Cluster analysis of rural areas in Stavropol Krai*

The distribution across clusters is quite uniform, with only one cluster comprising two districts while the rest include from five to seven districts. The average distance from the center of the cluster ranges from 0.12 to 0.22, indicating the grouping quality. Fig. 4 shows the cluster distribution of rural areas in Stavropol Krai on the basis of statistical data.

The validity of the obtained cluster distribution is also confirmed by the geography of Stavropol Krai. Almost all municipalities in the first cluster belong to a favorable climate zone characterized by a humid climate. The second cluster consists of districts situated in the central part of the region belonging to an arid zone. Districts comprising the third cluster are located near large urban agglomerations and are characterized by relatively favorable natural and climatic conditions. The fourth cluster primarily includes districts from arid and extremely arid zones (except for Andropovsky Municipal District). Spatial remoteness from the city affects the social and economic development of the districts included in the fourth cluster. The fifth cluster, which is the smallest one, includes two dominantly industrial districts of Stavropol Krai.

The assessment and ranking of clusters by the level of rural development was based on comparing each of the nine average cluster indicators with their average values for Stavropol Krai (Table 2). The composition of clusters and their characterization are presented in Table 3.

**Table 2**
Average values of indicators for Stavropol Krai.

| Indicator | Value |
|---|---|
| Index of average monthly wages of company employees (except for small businesses), in % 2021 to 2020 | 108.38 |
| Share of young people aged between 18 and 34, % | 20.91 |
| Migration gain / loss of population from rural areas for the year (+/–), people per 1,000 rural residents | –3.64 |
| Amount of investment in fixed capital (without public funds) per person, thousand rubles | 41.82 |
| Shipped own-produced goods, performed works and services per person, thousand rubles | 178.42 |
| Share of the district in the agricultural output, % | 3.85 |
| Share of agricultural land in the total area, % | 52.23 |
| Availability of agricultural land for rural residents, ha/person | 3.24 |
| Agricultural output per ha of agricultural land, thousand rubles/ha | 92.41 |

*Source:* Authors' calculations.

The first cluster stands out against the general background, with its average indicators higher than the regional averages in eight out of nine variables. The districts comprising this cluster contribute over 40% to regional agricultural output. The first cluster leads in the amount of investment in fixed capital and the efficiency of agricultural production while exhibiting migration loss of the rural population and, consequently, the lowest proportion of young people living in rural areas.

The second cluster is characterized by positive migration rate of the rural population and a high value of the average monthly wage. Its contribution to the production of agricultural products is significant (19.9%). However, the values of 5 out of 9 indicators are lower than the regional average. It can be noted that the volume of investments per person is almost 4 times less than the average regional value.

The contribution to agricultural production of the third cluster is close to the value of this indicator of the second one. However, it differs significantly in other indicators. For example, this cluster is characterized by a high value of negative migration rate of the rural population as well as the lowest value of the provision of rural residents with agricultural land.

Despite the highest percentage of young people, the fourth cluster exhibits low values for six out of nine indicators as compared to regional averages. This cluster contains the highest number of districts; however, it ranks penultimate in terms of contribution to agricultural output. Although the migration rate in the fourth cluster is better than on average in Stavropol Krai, the negative trend of rural population outflow persists.

The fifth cluster includes only two districts. This fact is attributed to their industrial profile, which is confirmed by the highest possible indicator of shipped goods, works, and services (three times higher than the regional average). However, the indicators of social and natural subsystems significantly lag behind regional average values, as evidenced by the minimum percentage of agricultural land and the maximum decline in rural population.

Taking into account the objectivity of comparing the indicators with the regional average and the agricultural focus of most districts in Stavropol Krai (differentiation according to the contribution to agriculture), this computational and expert approach to ranking clusters seems entirely appropriate.

**Table 3**
Results of cluster analysis examining the districts of Stavropol Krai according to municipal statistics.

| Cluster No. | District | Average cluster indicators | | | | | | | | | | | Variation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Index of average monthly wages of company employees (except for small businesses), in % 2021 to 2020 | Proportion of young people aged between 18 and 34, % | Migration gain / loss of population from rural areas for the year (+/-), people per 1,000 rural residents | Amount of investment in fixed capital (without public funds) per person, thousand rubles | Shipped own-produced goods, performed works and services per person, thousand rubles. | Share of the district in the agricultural output, % | Proportion of agricultural land in the total area, % | Provision of rural residents with agricultural land, ha/person | Agricultural output per ha of agricultural land, thousand rubles/ha | Contribution of the cluster to the agricultural output of the region, % | Distance from the center of the cluster | Economic | Social | Natural |
| 1 | Izobilnensky, Ipatovsky, Kochubeyevsky, Krasnogvardeysky, Novoalexandrovsky, Trunovsky | 110.9 | 19.4 | −2.2 | 139.3 | 279.5 | 6.8 | 67.4 | 4.1 | 133.9 | 41.0 | 0.22 | high | low | average |
| 2 | Alexandrovsky, Blagodarnensky, Grachyovsky, Novoselitsky, Petrovsky, Sovetsky | 110.9 | 19.9 | 1.5 | 11.3 | 148.6 | 3.3 | 58.0 | 3.9 | 75.2 | 19.9 | 0.14 | high | low | low |
| 3 | Georgiyevsky, Kirovsky, Mineralovodsky, Predgorny, Shpakovsky | 107.2 | 21.5 | −9.5 | 12.0 | 122.2 | 4.0 | 62.9 | 1.5 | 113.7 | 19.8 | 0.14 | high | low | average |
| 4 | Andropovsky, Apanasenkovsky, Arzgirsky, Kursky, Levokumsky, Stepnovsky, Turkmensky | 105.4 | 22.4 | −2.0 | 7.3 | 51.2 | 2.0 | 33.1 | 3.4 | 58.9 | 14.4 | 0.12 | high | low | average |
| 5 | Budyonnovsky, Neftekumsky | 106.7 | 21.8 | −14.4 | 36.4 | 550.7 | 2.5 | 29.7 | 2.1 | 83.7 | 4.9 | 0.14 | low | low | average |

*Note:* Green cell—average cluster value of the indicator is higher than the regional average; red cell—average cluster value of the indicator is lower than the regional average.
*Source:* Authors' calculations.

The intra-cluster differentiation of districts was assessed by analyzing the variation coefficients of indicators characterizing economic, social, and natural subsystems. The level of variation was determined as follows: low — coefficient of variation of indicators is less than 30%, average — from 30 to 50%, high — above 50%. The greatest homogeneity is observed for social indicators, while the largest differences are characteristic of economic subsystems. This situation can be attributed to the high dynamism of economic processes and the relative inertness of social ones.

### *5.2. Multidimensional scaling of rural areas in Stavropol Krai using rural survey data*

According to the survey results, a matrix was formed to conduct multidimensional scaling, which represents the values of nine indicators for three spheres — economic, social, and natural (Table 4). Due to the systemic nature of the subject matter of this study, the rural area, this division, in a sense, is conditional.

The results of selecting indicators that represent the scale and its interpretation are presented in Table 5. The following conclusions can be drawn.

(a) In Dimension 1, the best correlated indicators were related to employment opportunities (indicator 3) and conditions for starting a business (indicator 1); Those related to moving from rural areas (indicator 4) and social infrastructure (indicator 6) had a lower correlation.

(b) Dimension 2 primarily represents issues related to climatic and environmental living conditions in rural areas due to indicators 7 and 9 strongly predominate over the rest in terms of correlation and regression coefficients (see Table 5). They are supplemented by indicators related to economic and social problems, although their impact on the position of the district on the scale is much lower.

(c) In Dimension 3, correlation between the indicators and the corresponding values is, in general, slightly lower than in the previous two dimensions, which corresponds to the scree test (see Fig. 2). However, three indicators stand out among the nine criteria: problems associated with rising prices (indicator 2), low salaries, and the possibility of leaving the rural area. That is, the third scale focuses on their role in determining the position of the district according to rural opinion.

The analysis of the correlation between variations in the indicators of the districts and the values of Dimension 1, Dimension 2, and Dimension 3 using correlation and regression analysis approaches (see Table 5) with mandatory expert analysis, including visualized data, yielded the following interpretations of the scales:

- Dimension 1 — employment opportunities;
- Dimension 2 — living conditions;
- Dimension 3 — economic well-being.

In conclusion to the interpretive characterization of the dimensions, it may be noted:

1. Indicator 4, reflecting the intentions of rural residents to leave rural areas, is represented in all three scales; however, it is not prevalent in any of them. Therefore, it can be considered, to some extent, as a result of existing employ-

**Table 4**
Survey results (percentage of respondents).

| | Municipal and urban districts of Stavropol Krai (the number of surveys) | Economic | | | Social | | | Natural | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | who indicated "no initial capital and insufficient state support" as a significant reason for not starting their own business | who chose "rise in prices of goods and services" as one of the main problems of their area | who reported losing their job that year | who reported that they plan to leave the settlement in the near future | who chose "low salary" as one of the main problems of their area | who reported social infrastructure problems as the main reason for moving from a rural area | who indicated "ecological situation and state of the environment" as one of the main problems in their area | who do not consider agricultural development a priority area for the region | who reported "climate" as one of the main reasons for moving from a rural area |
| 1 | Alexandrovsky (128) | 31.3 | 80.5 | 3.9 | 4.7 | 60.2 | 113.4 | 3.1 | 5.5 | 0 |
| 2 | Andropovsky (296) | 24.0 | 74.3 | 1.7 | 11.1 | 52.4 | 62.2 | 3.0 | 9.8 | 9.4 |
| 3 | Apanasenkovsky (112) | 26.0 | 83.1 | 2.6 | 6.5 | 77.9 | 107.7 | 9.1 | 10.4 | 7.7 |
| 4 | Arzgirsky (262) | 36.2 | 79.1 | 4.0 | 8.5 | 70.7 | 87.5 | 7.0 | 8.0 | 53.1 |
| 5 | Blagodarnensky (167) | 33.5 | 74.3 | 2.4 | 8.4 | 73.7 | 113.7 | 5.4 | 18.0 | 17.2 |
| 6 | Budyonnovsky (118) | 23.5 | 55.1 | 10.2 | 4.1 | 83.7 | 85.8 | 1.0 | 14.3 | 0 |
| 7 | Georgiyevsky (120) | 32.5 | 73.3 | 5.8 | 5.8 | 63.3 | 115.8 | 0.0 | 11.7 | 0 |
| 8 | Grachyovsky (125) | 42.4 | 80.0 | 4.8 | 4.0 | 70.4 | 35.7 | 4.0 | 13.6 | 7.1 |
| 9 | Izobilnensky (121) | 43.6 | 70.3 | 4.0 | 4.0 | 70.3 | 109.2 | 4.0 | 38.6 | 0 |
| 10 | Ipatovsky (124) | 21.4 | 66.3 | 2.0 | 5.1 | 78.6 | 83.4 | 3.1 | 19.4 | 33.3 |
| 11 | Kirovsky (129) | 41.1 | 81.4 | 6.2 | 10.1 | 67.4 | 76.2 | 0.8 | 7.0 | 0 |
| 12 | Kochubeyevsky (139) | 35.3 | 62.6 | 5.8 | 2.9 | 41.7 | 125.0 | 0.0 | 26.6 | 0 |
| 13 | Krasnogvardeysky (206) | 35.4 | 82.5 | 1.0 | 4.4 | 60.7 | 95.6 | 4.9 | 12.6 | 8.7 |
| 14 | Kursky (117) | 42.2 | 78.1 | 4.7 | 9.4 | 70.3 | 138.9 | 6.3 | 7.8 | 38.9 |
| 15 | Levokumsky (131) | 53.2 | 84.7 | 4.5 | 12.6 | 59.5 | 132.2 | 10.8 | 6.3 | 29.4 |
| 16 | Mineralovodsky (135) | 15.6 | 73.3 | 3.3 | 6.7 | 75.6 | 100.1 | 1.1 | 15.6 | 0 |
| 17 | Neftekumsky (157) | 42.0 | 56.1 | 7.0 | 7.6 | 40.8 | 93.3 | 0.6 | 16.6 | 16.7 |
| 18 | Novoalexandrovsky (135) | 26.7 | 76.3 | 11.9 | 9.6 | 65.2 | 141.1 | 3.7 | 2.2 | 0 |
| 19 | Novoselitsky (119) | 32.5 | 79.2 | 2.6 | 10.4 | 68.8 | 75.1 | 1.3 | 13.0 | 12.5 |
| 20 | Petrovsky (116) | 45.3 | 28.3 | 9.4 | 11.3 | 27.4 | 100.1 | 3.8 | 6.6 | 0 |
| 21 | Predgorny (115) | 33.7 | 82.2 | 1.0 | 7.9 | 51.5 | 23.6 | 3.0 | 23.8 | 0 |
| 22 | Sovetsky (125) | 32.3 | 76.3 | 5.4 | 5.4 | 73.1 | 38.5 | 0.0 | 18.3 | 7.7 |
| 23 | Stepnovsky (108) | 49.5 | 68.9 | 10.7 | 19.4 | 67.0 | 50.1 | 3.9 | 1.0 | 0 |
| 24 | Trunovsky (108) | 46.8 | 66.0 | 4.3 | 17.0 | 51.1 | 53.1 | 8.5 | 9.6 | 3.1 |
| 25 | Turkmensky (100) | 60.0 | 86.0 | 12.0 | 9.0 | 70.0 | 77.7 | 1.0 | 2.0 | 11.1 |
| 26 | Shpakovsky (147) | 41.2 | 57.7 | 10.3 | 8.2 | 28.9 | 160.8 | 3.1 | 24.7 | 4.3 |

*Source:* Authors' calculations.

**Table 5**
Correlation of dimensions and variables in multiscaling analysis with survey data.

| Indicator | Dimension 1 | Dimension 2 | Dimension 3 |
|---|---|---|---|
| 1. Percentage of respondents who indicated "no initial capital and insufficient state support" as a significant reason for not starting their own business | 0.598 | 0.206 | 0.178 |
| 2. Percentage of respondents who chose "rise in prices of goods and services" as one of the main problems of their area | −0.540 | 0.443 | 0.437 |
| 3. Percentage of respondents who reported losing their job that year | 0.773 | −0.398 | 0.196 |
| 4. Percentage of respondents who reported that they plan to leave the settlement in the near future | 0.544 | 0.377 | 0.393 |
| 5. Percentage of respondents who chose "low salary" as one of the main problems of their area | −0.504 | 0.251 | 0.243 |
| 6. Percentage of respondents who reported social infrastructure problems as the main reason for moving from a rural area | 0.208 | 0.030 | −0.594 |
| 7. Percentage of respondents who indicated "ecological situation and state of the environment" as one of the main problems in their area | 0.163 | 0.846 | −0.150 |
| 8. Percentage of respondents who do not consider agricultural development a priority area for the region | −0.299 | −0.233 | −0.386 |
| 9. Percentage of respondents who reported "climate" as one of the main reasons for moving from a rural area | −0.094 | 0.719 | −0.282 |

*Source:* Authors' calculations.

ment opportunities as well as conditions for life and economic development in the rural areas of the region.

2. Indicator 8, representing the priority of agricultural development in the district, was not included in the descriptions of any of the scales. This fact, according to the authors, is attributed to the agricultural profile of the region and the sufficiently developed agriculture throughout its territory. In all the districts, from 70 to 100% of respondents noted this sphere as a priority for local development; in this connection, the indicator variation did not have a significant impact on the differentiation of districts in the course of multidimensional scaling.

The groups are presented in Fig. 5, with the values of Dimension 1 and Dimension 2 positioned on the corresponding coordinate axes; Dimension 3 — by means of the corresponding color range. The distribution and characterization of the groups are based on the primary role of Dimension 1 and Dimension 2, and the complementary role of Dimension 3.

Despite the fact that the rocky scree criterion (see Fig. 2) indicates the sufficiency of using Dimension 1 and Dimension 2 indicators for grouping municipal rural districts at the regional level, when working out development programs for each of them, its position within the group should be taken into account. It is demonstrated by the heterogeneity of the groups according to the color indicator Dimension 3 (see Fig. 5). The position on the Dimension 3 scale reflects the opinion of rural residents in terms of the prospects for leaving their home area. In this context, such positioning is very informative for decision making regarding rural development management at the municipal level.

According to the local population, the first group of districts, which is the largest in the number of districts, leads in living conditions and employment

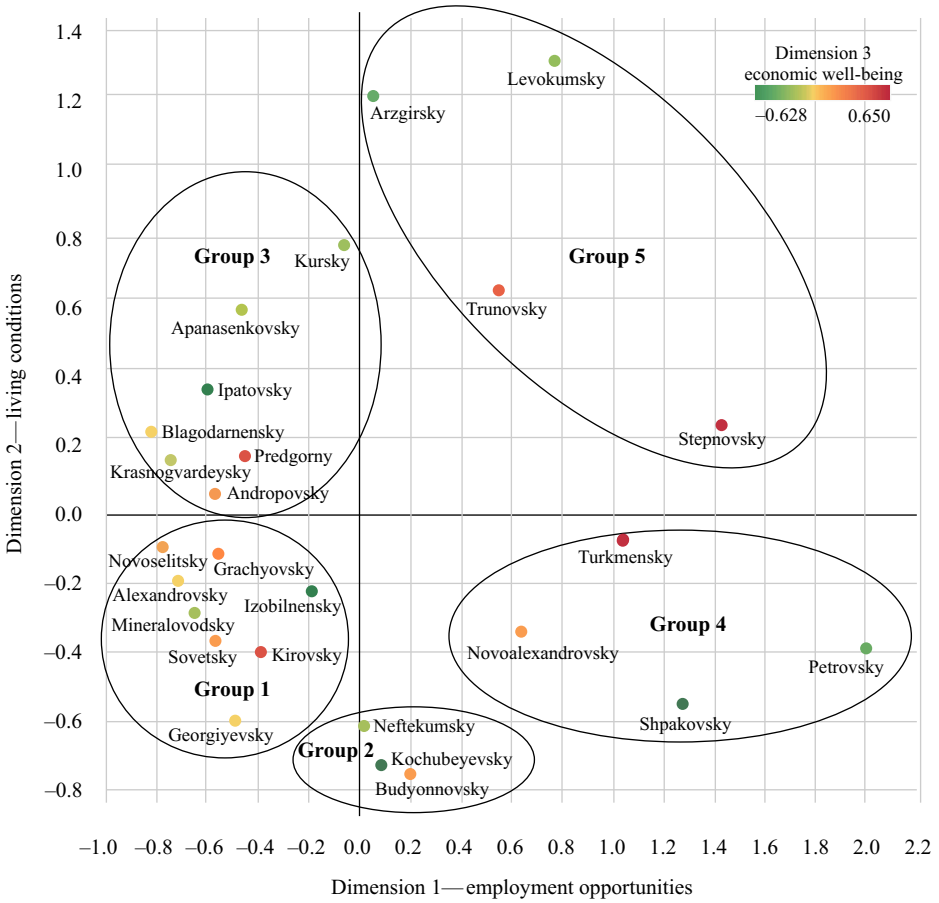


**Fig. 5.** Grouping of districts in Stavropol Krai according to the results of multidimensional scaling.
*Source:* Authors' calculations.

opportunities in rural areas. However, half of the districts are negatively assessed by the population as to the level of well-being.

The second group comprises three districts of the region (Neftekumsky, Kochubeyevsky, and Budyonnovsky). A special feature of the group is the concentration of industrial production; as a result, the population positively assesses the living conditions and the growth of well-being. Employment conditions are assessed by the population at an average level.

The third group consists of districts that, according to rural residents, have good employment opportunities and conditions for economic development. However, the residents note difficult living conditions due to climate changes and environmental problems.

The fourth group includes districts where conditions for starting a business are unsatisfactory and the risk of job loss is high. In this group, living conditions remain at a high level. The economic conditions, as assessed by the population, range from very poor (Turkmensky Municipal District located in the eastern zone of Stavropol Krai) to excellent (Shpakovsky Municipal District, within whose boundaries the administrative center of Stavropol Krai is located, which guarantees higher salaries and options for commuting).

The fifth group comprises districts offering the least favorable living conditions and employment opportunities for the rural population. In common with the fourth group, the rural economy here is strongly diversified.

### *5.3. Comparison of results obtained in cluster analysis and multidimensional scaling*

A comprehensive perception of the situation in the rural areas of the region implies taking into account both objective data, which are based on statistical information, and subjective data reflecting rural perceptions. At this stage, the study compares the clusters and groups of districts determined during the previous stages. The comparative analysis reveals discrepancies in the objective and subjective assessment of rural development (Fig. 6):

(a) 16 districts did not present or presented only minor discrepancies (0; +1; –1) between the position in the ranking generated by both methods, i.e., the subjective assessment of the social and economic development of rural areas is similar to, or coincides with, the objective assessment.

(b) 5 districts (Budyonnovsky, Georgiyevsky, Kirovsky, Mineralovodsky, and Neftekumsky) showed significant positive deviations (+2; +3)—the level of rural development in the district assessed by rural residents is higher than that reported by statistical data.

(c) 5 districts (Ipatovsky, Krasnogvardeysky, Novoalexandrovsky, Petrovsky, and Trunovsky) showed significant negative deviations (−2; −3; −4)—a higher level of rural development is indicated by objective statistical data than perceived by the local population.

Drawing on the obtained results, we can conclude the presence of various differences between the objective and subjective assessment of rural development. Such differences suggest the diverse contrariety of the social and economic

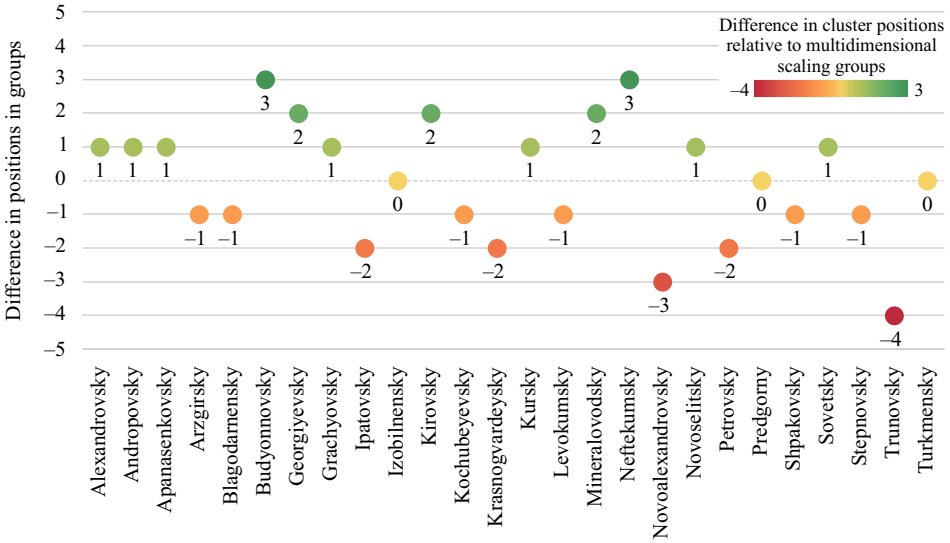


**Fig. 6.** Comparison of the groupings of districts of Stavropol Krai using the results of cluster analysis and multidimensional scaling.

*Source:* Authors' calculations.

situation in the districts, indicating the need to use a differentiated approach in the design of rural development patterns in the region.

### *5.4. Rural development patterns*

Our study has revealed the need to establish a set of patterns representing the social and economic development of districts in the region. The results of comparing data on the objective and subjective assessments of rural development in Stavropol Krai allow us to identify three types of patterns (Fig. 7), which are based on the systemic focus of development. Even in cases where it seems that the district prioritizes the development of one of its three subsystems, its systemic relations inevitably involve the transformation of the other subsystems as well.

1. A structural pattern is developed for an area characterized by a consistent subjective-objective assessment of its condition. Proactive development programs aimed at higher goals are to be worked out.

2. Type A behavior pattern is developed for areas whose level of rural development perceived by residents is higher than that of objective assessment. This situation most likely indicates the existence of untapped reserves for area development, as perceived by local residents. A detailed analysis of reasons for the discrepancies in assessment data is required, as well as creating individual development paths for the districts, taking into account the activation of reserves in the three main rural subsystems.

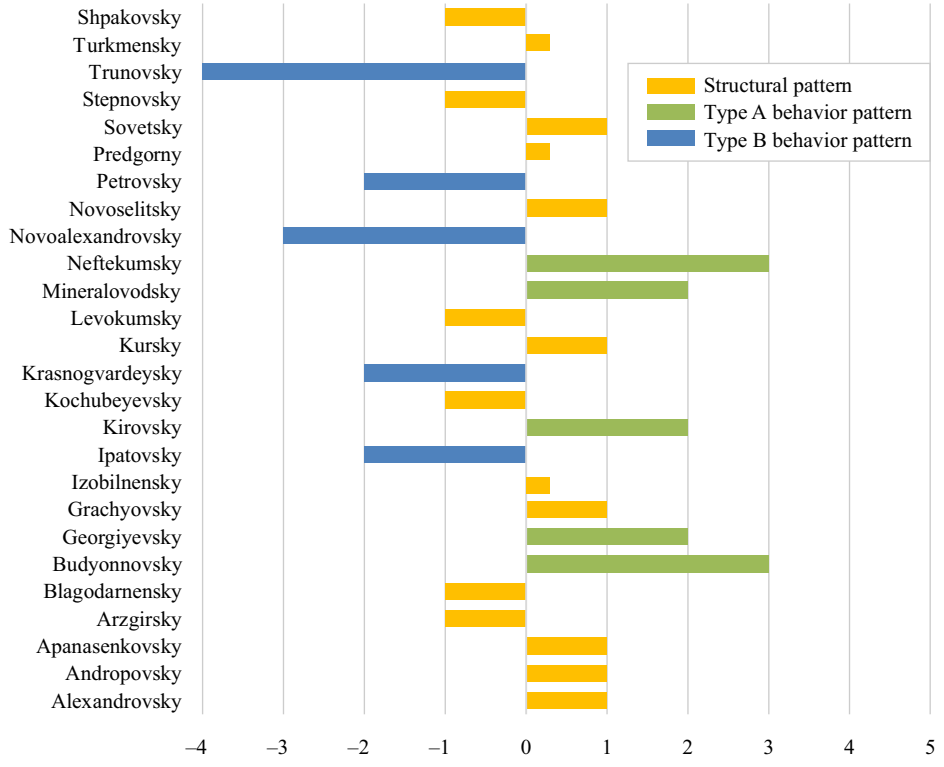


**Fig. 7.** Pattern distribution of districts of Stavropol Krai (conventional units; c.u.).

*Source:* Authors' calculations.

3. Type B behavior pattern is developed for areas whose level of rural development perceived by residents is lower than that of objective assessment. Such discrepancies may result from the ineffective use of territorial capacity: presence of objectively favorable development conditions, on the one hand, and dissatisfaction with the quality of rural life, on the other hand. In this case, special development paths for the district could be created through the assessment of areas for improving the rational use of territorial capacity.

The realization of individual paths within the behavior patterns of rural development implies regular monitoring and estimation of target indicators for a timely update of pattern characteristics or transition to development within another pattern. It seems possible to use an extended grouping of patterns, taking into account the characteristics of economic, social, and natural rural subsystems.

## 6. Discussion

The procedure for conducting an objective and subjective assessment of rural development at the municipal level presented in the article can establish conditions for the creation of higher-quality and targeted development programs. The obtained results can be used to justify choosing certain areas of territorial development and update some of them.

We hope that our study has achieved the stated aim. The combined use of multivariate statistical analysis methods yielded assessment data combining the objective and subjective perspectives on the subject matter of the study, which served as a basis for the multi-aspect grouping of districts in Stavropol Krai. The establishment of the matrix of indicators was based on the systems approach to the study of rural areas, enabling their multidimensional assessment from the combined perspectives of the economic, social, and natural subsystems of rural areas. The proposed procedure complements existing approaches to the assessment of rural development processes, expanding the used information and analytical support as well as providing a means to obtain multidimensional assessment data under the systems approach. It is applicable not only for Stavropol Krai and the rest of Russia, but also for rural areas of other countries, while allowing for the expansion or narrowing of the information base used, both from the standpoint of accessibility of its formation and taking into account local specifics.

The study compares the results of objective and subjective assessment of the social and economic situation in rural areas, which was not presented in earlier works. As compared to the index assessment method, the procedure of multi-aspect assessment expands the capabilities to use the obtained results in practice while maintaining the universality and adaptability in the selection of indicators. In common with ranking or typologization, the approach proposed in this article enables a comparison of rural areas, significantly improving the quality of assessment results due to the multi-aspect grouping and the use of information support. In addition, the procedure provides a means to create a future image of rural areas and use relevant patterns to achieve it.

While cluster analysis is a more conventional and proven method, the application of multidimensional scaling to this problem is understudied. Despite the subjective-objective approach used in the article to determine the essence of

scales, we realize the possibility of improving the application of this toolkit using correlation and regression analysis, in particular, a closer examination of the applicability scope of the multiple regression toolkit.

Another aspect that requires further study is the procedure for selecting and validating the patterns of rural development as well as their adaptation to specific conditions, including within individual subsystems of the territory. Working with patterns, in turn, implies conducting a dynamic assessment and building forecast scenarios for the rural development pattern adaptation or change. This area of research involves constructing the cluster trajectories of rural areas for a certain time period as well as vectors of changes in perceiving the social and economic situation by their population. The identification of rural development trends and a multi-aspect prognostic study intended to create a future image (Baydakov, 2022) of rural areas will help improve the validity in identifying areas of focus and timely update development programs.

The creation of a set of patterns and the choice of one of them for a particular rural area should be agreed upon with governing bodies, which are multi-actor in nature. These issues require a separate study due to the problems related to actors' conflicting efforts in the management of rural areas.

## 7. Conclusion

The obtained results of the multi-aspect rural development assessment provide a means to study rural territorial entities in greater depth. The study results help improve the quality of information and analytical support to rural development management. They can be used in the preparation of programs and projects for the development of territories. Further analysis of the dynamics and management features of rural development will make the reasoning behind rural development decisions more grounded.

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