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Analysis of the rate of socio-economic changes in rural areas between 2010 and 2020. Polish case

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Abstract. The article presents the results of research on the transformation process in the Polish country-side between 2010 and 2020, considering those rural communes (gminas) where the State-Owned Farms (PGR) were located. The study aimed to identify the spatial diversity of post-PGR communes on the grounds of socio-economic situation and to assess the rate of change in this situation in the surveyed communes over 11 years, as well as to answer the question how the socio-economic situation was influenced by the location of a given commune relative to voivodeship capitals. In the analyses, selected methods of descriptive statistics and multidimensional comparative analysis were applied. The results confirmed that in many post-PGR communes, also these days, we can observe financial problems, and that people experience significant difficulties with entering the labour market. The research also showed that in most cases communes located close to these cities were characterized by a better socio-economic situation than the communes located further away.

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1. Introduction

Publications on the socio-economic situation in rural areas indicate numerous factors affecting the issues that rural area residents have to face. Most often they are grouped in four areas: demography, distance and infrastructure and access to basic services such as: education, human capital and the labour market. By analysing the socio-economic situation in the Polish countryside, one cannot ignore the "burden" of post-PGR legacy, exacerbating the problems of rural communities. The article presents the results of research on the transformation process in the Polish countryside between 2010 and 2020, considering those rural communes where the State-Owned Farms (PGR) were located. The study aimed to identify the spatial diversity of post-PGR communes on the grounds of the socio-economic situation between 2010 and 2020 and to assess the rate of change in this situation in the surveyed communes over 11 years analysed. In addition, an important aspect of research included assessing the impact of commune location relative to urban centres (voivodeship capitals) on the rate of these changes.

The study used the information provided by the National Support Centre for Agriculture (KOWR) and indicators characterizing the socio-economic situation in rural areas between 2010 and 2020 from the Local Data Bank of the Central Statistical Office (GUS). On these grounds, thanks to the use of time series analysis methods, it was possible to distinguish communes where we could observe improvement, stagnation and deterioration of the socio-economic situation throughout the period analysed. For dynamic classification, the function of trend was applied, determined based on the value of synthetic measure obtained under the TOPIS method in particular years. The determined synthetic measure allowed for unambiguous assessment of the situation of communes in a static way, i.e., based on that it was possible to determine only the location of objects (communes) in each year, which helped to identify their spatial diversity. However, if we want to answer the question about the trend of changes in the socio-economic situation in particular communes throughout the period under analysis, the synthetic measures determined are insufficient. Therefore, it was decided to estimate trend models for each commune, where the values of synthetic measure in the analysed years were used as an explanatory variable. Based on the parameters of estimated trend models, it is possible to compare communes as per the level of dynamics and distinguish the typological groups of communes with similar trends of change regarding the phenomenon analysed. Thanks to this approach, it is possible to assess whether or not communes have improved their socio-economic situation throughout the period under analysis. It follows from the above that the methods applied in the study allow to detect a number of structural and dynamic regularities that cannot be captured under methods using multidimensional statistical analyses in the static viewpoint. This type of approach was used for the first time in this study, thus closing the existing gap in the field of research related to the dynamic analysis of the post-PGR commune similarities resulting from the socio-economic situation. The added value of this study also involves considering the geographical distance between the communes analysed and the urban centres. This will allow to verify whether the location of communes close to voivodeship capitals affects its socio-economic situation.

The structure of this article contains an introduction with the main goal of study presented as well as the most important justification on the part of the authors to conduct research on the rate of socio-economic changes in rural areas. This was followed by a review of literature on the socio-economic situation in rural areas, the origins and consequences of neglect and the trends in changes. In the subsequent part of the work – devoted to the situation in Poland – the statistical data applied in the study was presented as well as the research procedure applied in the study. The article ends with the presentation of research results as well as the discussion and conclusions resulting from the research conducted.

2. Socio-economic situation in rural areas – literature review

2.1. Transformations of the contemporary countryside

Until recently, the countryside was distinguished from the city by the community professional structure, the type of activities conducted by the community and the type of jobs. Nowadays, the village is subject to continuous transformations. In the face of huge civilizational and cultural changes, modernization, urbanization and suburbanization processes, changes in lifestyles, increase in spatial and social mobility, the concept of "countryside" is

no longer identical with the concept of "agricultural village", because in rural areas we can observe many forms of non-agricultural rural settlement (Szymańska, 2013).

The changes taking place in a modern village indicate that more and more of its residents make their living by performing non-agricultural jobs and it happens that they often perform, as Graeber, anthropologist, the author of the book published in 2018 entitled "Bullshit Jobs" – a meaningless job. The author also analysed the increasing phenomenon of a growing number of useless and sometimes, from the social perspective, harmful jobs. He even states that "the professional life of enormous number of people, especially in Europe and North America, involves performing tasks that they covertly consider unnecessary to perform. At the same time, he emphasizes that the moral and spiritual damage caused by such situation is profound (Graeber 2019). This results from many reasons. In rural areas, it results, on the one hand, from the transition of agricultural population to other non-agricultural jobs, sometimes intentionally formed by the authorities at various levels (government, governor, mayor, etc.); on the other hand, from the influx of urban population to the countryside, well-educated and wealthy, looking for a quiet and not too distant place to live and cheap labour.

In Poland, as in many other post-socialist countries, the attempts to reconstruct the Polish countryside, taken since 1990s, failed to bring the expected results. The previously applied programs and tools proved to be far from effective. This is especially true in villages where large state-owned farms were located. Many former PGR employees (Liwiński et al., 2008)(*Note 1*) (often subsequent generations) failed to adjust to the market economy reality. Meanwhile, the long-term regression of the post-PGR villages led to the alienation and exclusion of many village residents and almost entire local communities. This exclusion, apart from the social aspect, is also manifested in the economic aspect (financial barrier to access goods and services), as well as in the spatial aspect, which translates directly into education (physical distance from large urban centres and the lack or very limited communication by public transport). As a result, among rural population we can observe not only civilization backwardness but also the feeling of inferiority and as John (2018) defined, something like “hidden epidemic of loneliness” and exclusion (*Note 2*).

2.2. Origin and effects of socio-economic negligence in rural areas

Rural areas, both globally, continentally, regionally and nationally, are significantly diverse due to environmental, socio-economic and cultural conditions. The German settlement researcher Muller-Wille distinguished five types of settlement as per their duration and type of people's occupation:

1. Ephemeral settlement (briefly established);
2. Temporary settlement: a – seasonal, b – periodic, c – episodic;
3. Semi-permanent settlement;
4. Permanent settlement (Muller-Wille 1954).

In most European countries, permanent settlement is dominant. In Poland and in other countries, especially post-socialist ones (e.g., Romania, Bulgaria, Hungary, the Czech Republic), after World War II and until the 1990s, this continuity (inheritance from generation to generation) was broken. Nevertheless, Poland, within the so-called Eastern bloc, was the only country with the dominance of private sector in agriculture, although there were also forms of socialist land ownership. It means that in general it was retained throughout the entire period of central planning (or real socialism) as an essential element of traditional agricultural structures - family farms. For these reasons, we can observe a fundamental difference in the nature and difficulties in the reconstruction of economic structures and functions in Poland and in other countries of the former Eastern bloc, e.g., such as those above mentioned: Romania, Bulgaria, Hungary, and the Czech Republic (Rosner, 2003).

The community of PGR employees was developed close to, and even as some indicate, in opposition to the traditional village. The common attributes of PGR villages included: lack of traditional customs and rituals, lack of work ethos, social rigorism, as well as consent to drunkenness, petty theft and careless work (Bereza & Kasprzak, 2004). Most state-owned farms were located in the post-German lands (Dziubińska-Michalewicz, 2004). Large-scale state-owned farms were supported by budget subsidies, protective policy of authorities and had easier access to rare goods, e.g., fertilizers, machinery. Despite state support, their productivity was low, and wastage was widespread. Low work efficiency combined with mediocre quality management resulted in low farm productivity. Tin state-owned farms the consumption of feed, fertilizers, equipment and other materials was two or even three times higher than in individual farms, and the production per

hectare was much lower. The deficit in state-owned farms was covered by state subsidies, which until 1988 constituted more than 50% of funds allocated to investments in agriculture. Some state-owned farms were profitable, but most of them generated losses or operated on the verge of profitability, including the state subsidies (Dziechciarz, 2013).

Social benefits for employees were also disproportionately extensive. In addition to salaries and additional financial pay (e.g., 13. salary, various allowances and bonuses for production growth and overtime) PGR employees were granted social housing, a plot of 25 acres (for those interested), coal before the heating season, for children: camps, Christmas gifts, extra food; second breakfast at school. In addition, depending e.g., on the farm specialization, the employees also received several types of allowances, e.g.: 1 litre of milk per day per person, 25 quintals (2.5 tons) of potatoes per year, etc. The political changes and economic transformation that took place after 1989 put an end to state-owned farms. After the withdrawal of state subsidies, as a result of economic reforms in 1989, state-owned farms mostly went bankrupt, were taken over by the Agricultural Market Agency or employee companies (Dziechciarz, 2013).

Rules for shock therapy of the Polish economy, adopted as part of economic reforms in the early 1990s, placed state farms in a difficult situation. The introduction of market economy provided grounds for ownership and organizational changes, as well as changes in the management system in the former state-owned farms. It was considered that the privatization of state-owned farms (Woś, 1994) was the priority. The collapse of state-owned farms generated many problems in regions where they constituted the only employers. These actions resulted in severe outcomes, e.g., rapid loss of jobs and mass redundancies, which in turn generated increasing unemployment among the residents of post-PGR villages. Unemployment came along with huge impoverishment of the communities. The work loss and the lack of success in searching for a new occupation failed to encourage increased efforts, because former PGR employees were paid monthly allowances – the unemployment benefits. When the benefits were cut, people dependent on them, taught not to work, became considerably apathetic, and often descended into alcoholism. In the families of former PGR employees' pathological phenomena would intensify. Some people went into early retirement and the amount of their pension was relatively low. The former PGR employees were captured by feelings of disappointment and harm, often passed down from generation to generation (Urbanik, 2008). The main feature of post-PGR communities included inaction and social helplessness. The situation and attitude of the former PGR employees began to be perceived a flagship example of "inability to pull oneself together in the new system". After a few years, it was believed that some counterculture of poverty is developed in the former state-owned farms, and the residents of former PGR settlements are the potential members of underclass formed in Poland (Bereza & Kasprzak, 2004). At present, most of the post-PGR areas are considered problematic ones. The changes that occurred in these areas over the last two decades, and the resulting increase in disparities in the socio-economic development, significantly separate them from other parts of the region and the country (Jasiulewicz, 2011).

These factors have largely determined the rural-urban correlation. In some European countries, these relations are shaped in a complementary way and are based on partnership, while in other countries, especially post-socialist ones, the harmful effects of previous negligence are noticeable. On the one hand, the society understands and respects the rural specificity and expresses interest in the countryside and rural communities because of their values, on the other, both society and particular governments in Poland after 1989 have shown a lack of understanding and respect for the specificity of rural areas. Different governments also lacked determination to evaluate the proposed postulates, as suggested by the Norwegian researcher Aven, in terms of not only their rationality, but also their credibility and knowledge (strength of knowledge) (Aven, 2009).

2.3. Trends in socio-economic changes in the modern countryside

Currently, villages are subject to continuous transformations and undergo profound socio-demographic as well as functional and spatial transformations. These transformations constitute a manifestation of the modernization, urbanization, internationalization and globalization processes. It is difficult to clearly indicate which process has the strongest impact on the changes in rural areas. However, certainly it is difficult to discuss modernization without urbanization and urbanization without modernization (Węgleński, 1992; Szymańska & Matczak, 2002). These issues are becoming very important, because around the world the scientific revolution, civilizational progress, technical and technological progress, and

recently robotization and socio-economic changes modernize and urbanize countryside to a greater or lesser extent. The modernization and urbanization processes lead to closing the gap between the people's living conditions in the countryside and in the city, to modernizing the agriculture, gradually transforming the socio-professional structures of rural residents and reducing the employment in the agricultural sector. However, as Williamson (2000) wrote, in order for these processes to operate smoothly, institutional changes at all levels of government must follow the technological progress.

Transformations in the countryside can also be observed in the economic context. They are manifested through the introduction of, e.g., new cultivation techniques, new plant varieties, mechanization, and new breeding methods. As Szymańska (2013) points out, this is inseparably linked to the countryside modernization in the context of social and economic infrastructure (modernization, transport and communication, sewage system, gas supply system, water supply, Internet media, etc.). Transformation in the countryside can also be observed in the social context through greater professionalism of the farmer's job and the selected specialization, as well as an increase in employment in non-agricultural professions and the change in socio-cultural approach. Naturally, this depends on the external and internal conditions and, most importantly, on the initiatives of local community of a given village. Consequently, in rural areas, depending on the region, we can observe changes in various areas in the following contexts:

- social – level of income, income inequality, unemployment, population aging;
- environmental – increased pollution generated by agriculture, non-agricultural entities, various resident groups, global climate change;
- economic – intensification of production, level of income of residents and communes, creating new jobs, sectoral structure of economy, development of entrepreneurship.

Finally, it is worth noting that in Poland, especially for the last two decades, as in many other countries, modernization and urbanization leads to developing many settlements that do not fit into the traditional category of agricultural village or a city. Golachowski (1971) defines them as "semi-villages" or "semi-cities". The development of such forms is called semi-urbanization (*Note 3*). Semi-urbanization reflects well the indirect character of these forms of settlements. They have one more feature; they do not develop pointwise but in groups (Kiełczewska-Zalewska, 2013). These transformations were also presented, as a model, by Mittelhäusser (1960). The model was based on quantitative (purely statistical) relations between farmers' houses, residential houses and industry and production related buildings. On these grounds, it was possible to present the tendencies to transform rural settlements into transitional settlements. The model proposed by Mittelhäusser (1960) applies only to those countries where spontaneous, intensive industrialization processes have been observed, and in villages we could, or we can observe the surplus of agricultural population.

To sum up, the contemporary problems in the countryside, both in the world and in Poland, occur with varying intensity. It is assumed that to overcome these problems it is necessary to guarantee the conditions for stable development based on the sustainable development, founded on three main pillars: economic, social and environmental one. Certainly, it should be remembered that understanding the need for changes, on the part of rural residents, towards the sustainable development requires, above all, empowering the local communities and instilling in them the idea of social participation, involvement of local community in the village daily life and readiness to speak about socio-economic issues disturbing for the residents.

3. Material and methods

3.1. Material – surveyed community and diagnostic features applied in the study

The study began by identifying the communes where state-owned farms (PGR) were located, while indicating the degree of their "burden" with the post-PGR legacy. Given the fact that for over 30 years since the political transformation, which contributed to the liquidation of state-owned farms, the number and boundaries of administrative units have changed, it was necessary to find a solid and reliable source of data as regards this phenomenon at the lowest level of aggregation, i.e., at the level of communes. The data was obtained from the National Support Centre for Agriculture (KOWR) and referred to the number of flats sold previously owned by state-owned farms – as of 26 June 2020. After calculating the number of these flats per 10,000 people, an indicator (W) was obtained; its value made it possible to identify communes with

varying degrees of "burden" with post-PGR legacy in 2020. In order to check whether the results obtained based on the KOWR data are correct, the results were compared with the results of spatial differentiation of communes as per the share of agricultural area owned by the socialized farms in 1989. Based on the data received from KOWR, it was found that the results are very similar, and that Poland was and is clearly divided into two parts:

- western and northern part covering the areas of the so-called reclaimed territories (Zachodniopomorskie Voivodeship, Lubuskie Voivodeship, Dolnośląskie Voivodeship) and Warmińsko-Mazurskie Voivodeship, where the number of state-owned farms and their housing resources were the largest,
- central, eastern and southern with a much lower number of state-owned farms (Bąk et al. 2021).

In view of considerable similarity of the spatial distribution of post-PGR communes in 1989 and June 2020, the value of index *W* was used to unambiguously determine the analysed community. Based on this index, the group comprised 1 502 communes where the index was higher than 0. Information on the total number of communes and the number of surveyed communes by voivodeships in Poland in 2020 is presented in Table 1.

Table 1 shows that the surveyed community accounts for 60.6% of all communes in the country. The largest share of the communes surveyed in the total number of communes (over 90%) can be found in the following voivodeships: Warmińsko-Mazurskie, Zachodniopomorskie and Lubuskie, whereas the smallest (less than 40%) can be found in the following voivodeships: Świętokrzyskie and Małopolskie.

To assess the socio-economic situation of the communes surveyed between 2010 and 2020 the following indicators (diagnostic features) were selected:

- X_{1D} – beneficiaries of environmental social services per 10,000 people,
- X_{2D} – share of the number of the unemployed in the working-age population (%),
- X_{3S} – own income per 1 inhabitant in PLN (communes including cities with county rights),
- X_{4S} – total income per 1 inhabitant in PLN (communes including cities with county rights),
- X_{5D} – percentage of the post-working age population (%),

Table 1. Number of communes surveyed compared to all communes by voivodeships in Poland in 2020

Description	Total number of communes	Number of surveyed communes	Share of the surveyed municipalities in the total number of municipalities (%)
Poland	2477	1502	60.6
Warmińsko-Mazurskie	116	114	98.3
Zachodniopomorskie	113	106	93.8
Lubuskie	82	75	91.5
Opolskie	71	59	83.1
Pomorskie	123	101	82.1
Dolnośląskie	169	137	81.1
Wielkopolskie	226	181	80.1
Kujawsko-Pomorskie	144	109	75.7
Podkarpackie	160	83	51.9
Podlaskie	118	61	51.7
Lubelskie	213	100	46.9
Śląskie	167	75	44.9
Mazowieckie	314	136	43.3
Łódzkie	177	76	42.9
Świętokrzyskie	102	38	37.3
Małopolskie	182	51	28.0

Source: own elaboration

- X_{6S} – percentage of working-age population (%),
- X_{7S} – percentage of the pre-working age population (%),
- X_{8S} – net migration rate per 1000 people,
- X_{9D} – extent of benefits from the environmental social service (%).

Among them, 5 stimulants were distinguished (X_{3S}, X_{4S}, X_{6S}, X_{7S}, X_{8S}), i.e., indicators that exert a positive impact on the socio-economic situation of the surveyed communes and 4 destimulants (X_{1D}, X_{2D}, X_{5D}, X_{9D}), i.e., indicators that show low values. These features characterize the financial, and demographic situation and labour market situation in the surveyed communes.

The last feature included in the study involves the geographical distance of particular commune from voivodeship capitals, the impact of which on the socio-economic situation of communes was assessed in the final stage of the study.

3.2. Methods

The research procedure applied in the study comprises three stages, closely related to the research objectives.

The first stage involved the ranking of post-PGR communes as per the socio-economic situation between 2010 and 2020, obtained under the TOPSIS method included in the methods of multidimensional statistical analysis.

The TOPSIS method, or Technique for Order Preference by Similarity to an Ideal Solution, proposed and described by Hwang and Yoon in 1981, is one of the multi-criteria methods of decision-making (Hwang & Yoon, 1981; Ishizaka & Nemery, 2013; Parida & Sahoo, 2013; Yoon & Kim, 2017, El Alaoui, 2021). The linear ordering of multidimensional objects under the TOPSIS method reads as follows:

1. Defining the output matrix:

$$\mathbf{X} = [x_{ij}] \tag{1}$$

where:
x_{ij} – value of j-th diagnostic feature for i-th object,
i – number of object (i = 1,2,…,n),
j – number of diagnostic feature (j = 1,2,…,m),
n – number of objects (communes),
m – number of diagnostic features (indicators).

2. Normalization of diagnostic features to ensure their comparability as per the formula:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \tag{2}$$

where: z_{ij} – value of j-th normalized diagnostic feature for i-th object.

3. Defining two reference points for each normalized diagnostic feature, defining the coordinates of Positive Ideal Solution and Negative Ideal Solution:

$$z_j^+ = \begin{cases} \max\limits_i z_{ij} & \text{for stimulant} \\ \min\limits_i z_{ij} & \text{for destimulant} \end{cases} \tag{3}$$

$$z_j^- = \begin{cases} \min\limits_i z_{ij} & \text{for stimulant} \\ \max\limits_i z_{ij} & \text{for destimulant} \end{cases} \tag{4}$$

where:
z_j^+ – j-th coordinate of Positive Ideal Solution,
z_j^- – j-th coordinate of Negative Ideal Solution.

4. Calculating the Euclidean distance for each object from Positive Ideal Solution and Negative Ideal Solution:

$$d_i^+ = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - z_j^+\right)^2} \tag{5}$$

$$d_i^- = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - z_j^-\right)^2} \tag{6}$$

where:
d_i^+ – Euclidean distance of i-th object from Positive Ideal Solution,
d_i^- – Euclidean distance of i-th object from Negative Ideal Solution.

5. Defining the value of synthetic measure defining the relative proximity of i-th object to Positive Ideal Solution and Negative Ideal Solution

$$R_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{7}$$

where: 0≤R_i≤1.

The preferred object shows the smallest distance from the Positive Ideal Solution and at the same time the largest distance from the Negative Ideal Solution, i.e., it takes the largest value of coefficient Ri. Based on the value of the synthetic measure, it is possible to classify objects into four typological groups according to formulas (Galik et al., 2022):

$$\text{group 1: } R_i \geq \bar{R} + S(R) \quad (8)$$

$$\text{group 2: } \bar{R} \leq R_i < \bar{R} + S(R) \quad (9)$$

$$\text{group 3: } \bar{R} - S(R) \leq R_i < \bar{R} \quad (10)$$

$$\text{group 4: } R_i < \bar{R} - S(R) \quad (11)$$

where: $\bar{R}$ – arithmetic mean of synthetic measure; $S(R)$ – standard deviation of synthetic measure.

The first typological group (the best one) includes objects (communes) with the highest values of synthetic measure, whereas the fourth group (the worst one) – with the lowest values.

The second stage includes dynamic classification based on the trend functions of synthetic variables (Bąk & Cheba, 2018a; 2018b). Dynamic multivariate comparative analysis deals with the statistical analysis of data included in the form of a three-dimensional matrix (Grabiński, 1985):

$$\mathbf{X} = [x_{ijt}], \qquad (i = 1, \ldots, n;\ j = 1, \ldots, m;\ t = 1, \ldots, k) \quad (12)$$

where:
i=1 ,…,n; n – number of objects,
j=1,…,m; m– number of diagnostic features,
t=1,…,k; k – number of moments (periods) of time included in the studies.

Synthetic measures allow to reduce the output matrix of observation **X** of dimensions $n \times m \times k$ to two-dimensional matrix $n \times k$ containing realizations of synthetic measures for each object in the form of k-element time series. These series can be used to estimate the parameters of models of the linear and exponential development trends of the first, second and third degree:

$$\hat{Y}_t = \hat{\alpha}_1 t + \hat{\alpha}_o \quad (13)$$

$$ln\hat{Y}_t = \hat{\alpha}_1 t + \hat{\alpha}_o \quad (14)$$

$$\hat{Y}_t = \hat{\alpha}_1 t + \alpha_2 t^2 + \hat{\alpha}_o \quad (15)$$

$$ln\hat{Y}_t = \hat{\alpha}_1 t + \alpha_2 t^2 + \hat{\alpha}_o \quad (16)$$

$$\hat{Y}_t = \hat{\alpha}_1 t + \alpha_2 t^2 + \alpha_3 t^3 + \hat{\alpha}_o \quad (17)$$

$$ln\hat{Y}_t = \hat{\alpha}_1 t + \alpha_2 t^2 + \alpha_3 t^3 + \hat{\alpha}_o \quad (18)$$

Separating the typological groups of objects with a similar level of dynamics of the analysed phenomenon is based on a sequence containing the values of relevant trend parameters ordered as per non-increasing values. For this sequence of values, the mean and the standard deviation are determined and based on these, the four typological groups are determined as per the principle described in formulas 8 to 11.

The third stage involves the study of the relationship between the socio-economic situation of communes and the distance from urban centres using geometric models (Chen, 2001; Degórska, 2017) of:

$$Y = \alpha_1 x^{\frac{\alpha_2}{x}} \quad (19)$$

where:
α_1, α_2 – coefficients of model,
x – geographical distance from urban centre,
Y – dependent variable, represented in the study by the synthetic measure.

Due to the non-linear nature of the model, the quasi-Newton method was applied to estimate coefficients of models (Schoenberg, 2001).

4. Results

4.1. Identification of spatial diversity of post-PGR communes as per socio-economic situation

By applying nine diagnostic features presented in subsection 3.1, the TOPSIS method was used to determine the synthetic measures characterizing the socio-economic situation of the analysed communes between 2010 and 2020 and based on their values, four typological groups were distinguished. The highest values of measure in 2010 and 2020 were observed for the Śląskie voivodeship (0.346 and 0.419 – an increase of about 21.1%), while the lowest for Warmińsko–Mazurskie voivodeship (0.288 and 0.323 – an increase of about 12.1%).

Figs.1 and 2 present the spatial distribution of communes as per the level of synthetic measure in 2010 and 2020.

Based on these, one can observe the predominance of communes included in the third and fourth typological groups (pink and red colour on the maps), where the level of synthetic measures was below the average (Table 2). This applies specially to communes from the following voivodeships

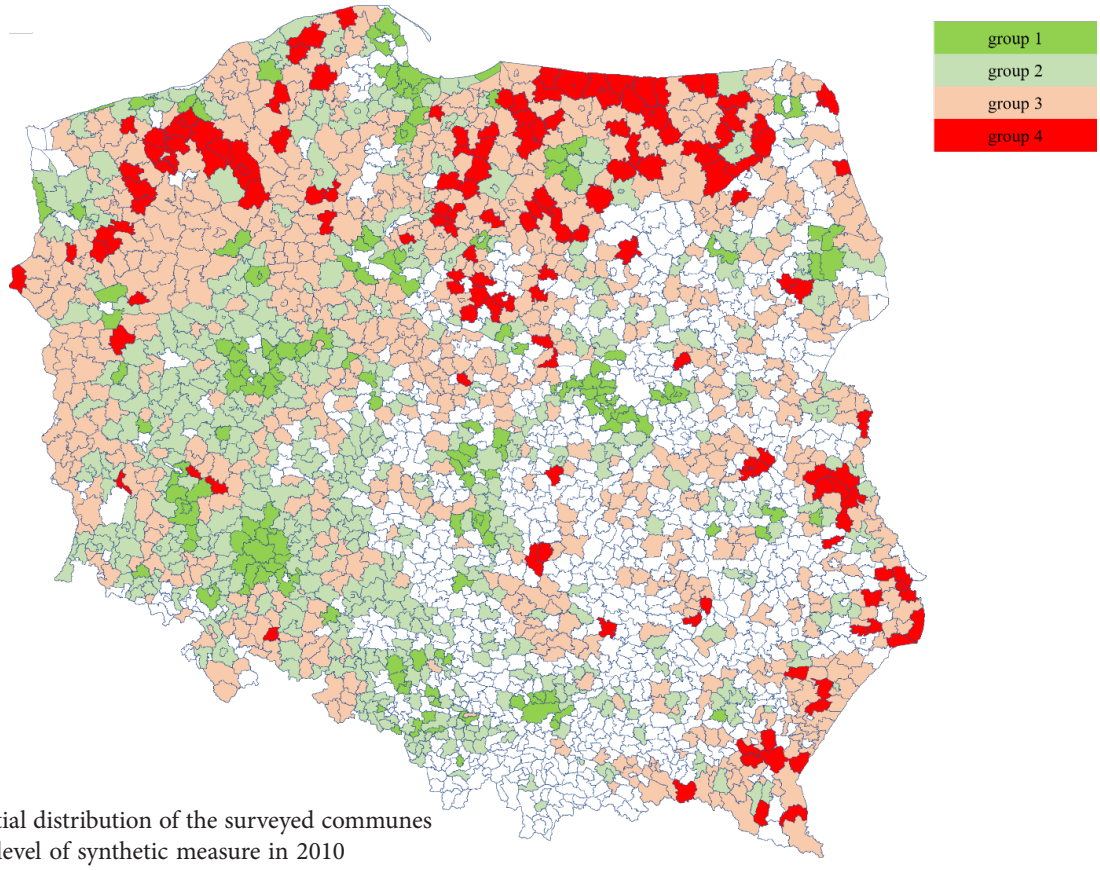


Fig. 1. Spatial distribution of the surveyed communes as per the level of synthetic measure in 2010
Source: own elaboration

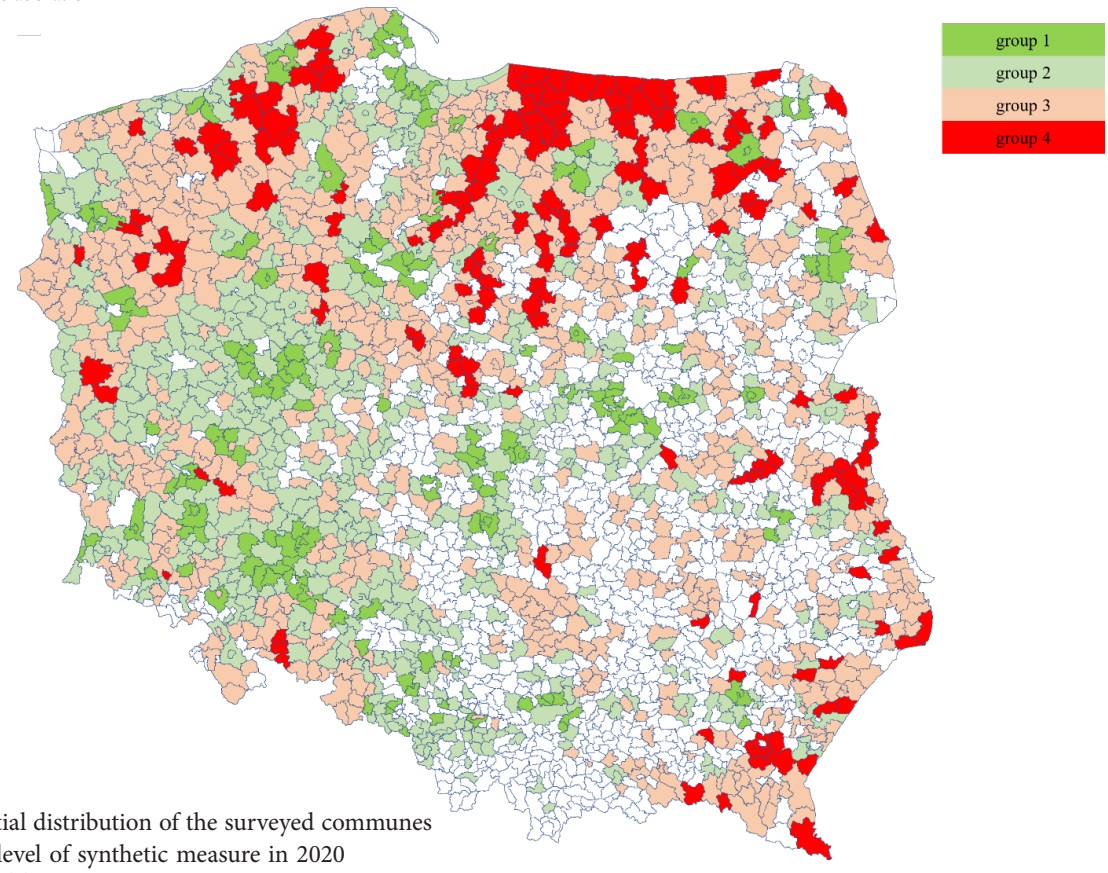


Fig. 2. Spatial distribution of the surveyed communes as per the level of synthetic measure in 2020
Source: own elaboration

Table 2. Structure of surveyed communes by typological groups in 2010 and 2020

Group	2010		2020	
	Number of communes	%	Number of communes	%
1	149	9.9	154	10.3
2	510	34.0	506	33.7
3	702	46.7	682	45.4
4	141	9.4	160	10.7

Source: own elaboration

Lubuskie, Zachodniopomorskie, Warmińsko-Mazurskie, Lubelskie, Podkarpackie and Kujawsko-Pomorskie. For both years compared, the share of communes from groups 3 and 4 of the total number of surveyed communes was the same and amounted to 56.1% (Table 2). However, the number of communes in these groups has slightly changed – the share of communes in the third group decreased by 1.3 percentage points and the share of communes in the fourth group increased by the same value.

Communes with the above average values of synthetic measures (typological groups 1 and 2) were mainly found in the areas of central and southern Poland, i.e., in the following voivodeships: Wielkopolskie, Dolnośląskie, Opolskie, Śląskie, Małopolskie, as well as Łódzkie and Mazowieckie. The number of communes in these groups changed slightly in 2020 compared to 2010 – the share of communes in the second group decreased by 0.3 percentage points, and the share of communes in the first group increased by 0.4 percentage points.

In order to assess the consistency of the values of synthetic measures characterizing the socio-economic situation in the surveyed communes in particular years, matrix of Pearson linear correlation coefficients was determined (Table 3).

High values of correlation coefficients (above 0.850) mean that the values of synthetic measures for most of the surveyed communes in particular years were at a similar level. This indicates that within 11 years, the socio-economic situation in most communes has not significantly changed. However, it can be noted that the values of correlation coefficients decreased over the years, so the largest differences in the socio-economic situation of the surveyed communes were observed in 2020 compared to the previous years. This observation is confirmed by information presented in Table 4, providing the numerical shifts of communes between the typological groups in particular voivodeships in 2020 compared to 2010.

A thorough analysis of information from Table 4 indicates that we could observe shifts between particular typological groups – out of 1502 communes surveyed, 1050 municipalities (70%) did not change their position, 232 communes (15.4%) were referred to worse groups, while 220 communes (14.6%) to better groups. In this context, distinctive

Table 3. Matrix of Pearson linear correlation coefficients between the synthetic measures between 2010 and 2020

Years	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2010	1.000	0.914	0.884	0.917	0.906	0.910	0.894	0.882	0.881	0.883	0.852
2011	0.914	1.000	0.925	0.928	0.918	0.900	0.898	0.882	0.867	0.881	0.844
2012	0.884	0.925	1.000	0.916	0.908	0.864	0.872	0.836	0.835	0.860	0.809
2013	0.917	0.928	0.916	1.000	0.940	0.931	0.921	0.905	0.896	0.904	0.868
2014	0.906	0.918	0.908	0.940	1.000	0.966	0.929	0.909	0.897	0.909	0.870
2015	0.910	0.900	0.864	0.931	0.966	1.000	0.973	0.931	0.931	0.933	0.909
2016	0.894	0.898	0.872	0.921	0.929	0.973	1.000	0.933	0.918	0.927	0.894
2017	0.882	0.882	0.836	0.905	0.909	0.931	0.933	1.000	0.917	0.926	0.888
2018	0.881	0.867	0.835	0.896	0.897	0.931	0.918	0.917	1.000	0.949	0.928
2019	0.883	0.881	0.860	0.904	0.909	0.933	0.927	0.926	0.949	1.000	0.940
2020	0.852	0.844	0.809	0.868	0.870	0.909	0.894	0.888	0.928	0.940	1.000

Source: own elaboration

Table 4. Shifts of communes between typological groups in provinces in 2020 compared to 2010

Voivodeship	Group	Decrease	No change	Improvement	Voivodeship	Group	Decrease	No change	Improvement
Dolnośląskie	1	7	15		Podkarpackie	1	1		
	2	14	43	8		2	5	11	3
	3		36	12		3	6	40	6
	4		2			4		8	3
Kujawsko-Pomorskie	1		8		Podlaskie	1	1	5	
	2	8	9	2		2	5	5	1
	3	12	48	8		3	7	27	5
	4		10	4		4		2	3
Lubelskie	1	2	2		Pomorskie	1	4	11	
	2	7	13			2	8	15	4
	3	10	40	7		3	5	33	10
	4		12	7		4		4	7
Lubuskie	1	1	3		Śląskie	1	6	9	
	2	9	15	1		2	5	50	2
	3	3	28	12		3		3	
	4			3		4		0	
Łódzkie	1	5	7		Świętokrzyskie	1		0	
	2	2	22	6		2	4	3	
	3	2	17	12		3		27	
	4		2	1		4		1	3
Małopolskie	1	1	7		Warmińsko-Mazurskie	1	2	3	
	2	5	23			2	3	10	1
	3		13	2		3	15	37	2
	4		0			4		31	10
Mazowieckie	1	4	17		Wielkopolskie	1	5	15	
	2	13	20	4		2	18	72	6
	3	8	51	11		3		40	24
	4		2	6		4		1	
Opolskie	1		1		Zachodniopomorskie	1	1	6	
	2	6	23	4		2	5	16	1
	3	1	22	1		3	6	46	7
	4		1			4		7	11

Source: own elaboration

is Łódzkie voivodeship, where 9 communes fell into worse groups (and only 2 to groups 3 and 4), and 19 communes improved their positions with 12 of them shifted to groups 1 and 2. This indicates clear improvement in the socio-economic situation of the surveyed communes in this voivodeship. A similar regularity (more communes improved their socio-economic situation than worsened the situation) can also be observed in the following voivodeships: Wielkopolskie, Pomorskie, Zachodniopomorskie, and Podkarpackie. A different situation (more communes worsened their socio-economic situation than improved the situation) can be observed in the following voivodeships: Opolskie, Śląskie, Świętokrzyskie, Małopolskie, Dolnośląskie, Mazowieckie and Warmińsko-Mazurskie, where more communes fell into groups with a synthetic

measure value below the mean (typological groups 3 and 4).

The observed shifts of communes between 2010 and 2020 result from the deterioration or improvement of the socio-economic situation, which is the result of changes in the value of diagnostic features providing grounds for the development of synthetic measures. These changes in particular typological groups are presented in Fig. 3. Changes in the value of feature X_1 (beneficiaries of environmental social service per 10,000 people) and feature X_9 (scope of environmental social service benefits in %), which indicate an improvement in the financial situation of people in the surveyed communes (poverty reduction), should be viewed in a positive light. The share of the unemployed in the working-age population has markedly decreased (X_2), suggesting an improvement on the labour market. Within the years compared, an increase in the commune total income (X_3) and own income per 1 inhabitant (X_4) was observed. In the case of total income, there are noticeable differences between particular typological groups. The largest relative increase was observed among communes in group 4 (by 155.5%), and the lowest among communes in group 1 (by 95.7%). It results e.g., from the increased transfers from the central budget (especially after 2015) towards tasks allocated to local governments, including those resulting from the implementation of additional social programs (e.g., 500+). In the case of the commune own income, the relation between the values of gain for particular typological groups is opposite to the total income, but the differences are not so significant. The highest relative increase in income was recorded for communes in group 1 (113.8%), the lowest for group 4 (100.7%). This clearly indicates an improvement in the economic situation of the surveyed group of communes. However, the demographic changes should be evaluated as negative. The negative values of the increase in feature X_6 (percentage of the working-age population) and X_7 (percentage of the pre-working age population) and the positive values of the increase in feature X_5 (percentage of the post-working age population) are a sign of impending problems with the availability of workers on the labour market.

4.2. Assessment of the rate of change in the socio-economic situation in the surveyed communes between 2010 and 2020

The results discussed so far referred to comparing the socio-economic situation of post-PGR communes only in two extreme periods, i.e., in 2010 and 2020. To fulfil the second research objective, i.e., to assess the value the rate of change in the socio-economic situation in communes throughout the period under study, trend models for each commune were estimated, based on the value of synthetic measures. The best adjustment for most of the communes was observed for the exponential model of the first-degree trend (formula 14), and the directional parameter of this trend (α_1) was used to assess the rate of changes in particular communes. Based on the values of this parameter four typological groups of communes were identified; they differ from one another in the rate of change in the socio-economic situation in the analysed period. Fig.4 presents the spatial distribution of analysed communes as per the value of directional parameter of the first-degree

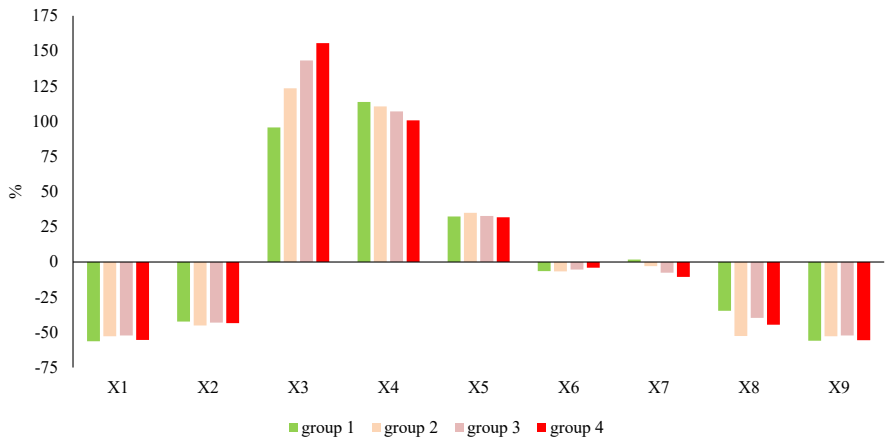


Fig. 3. Relative increases in the diagnostic features in typological groups in 2020 compared to 2010
Source: own elaboration

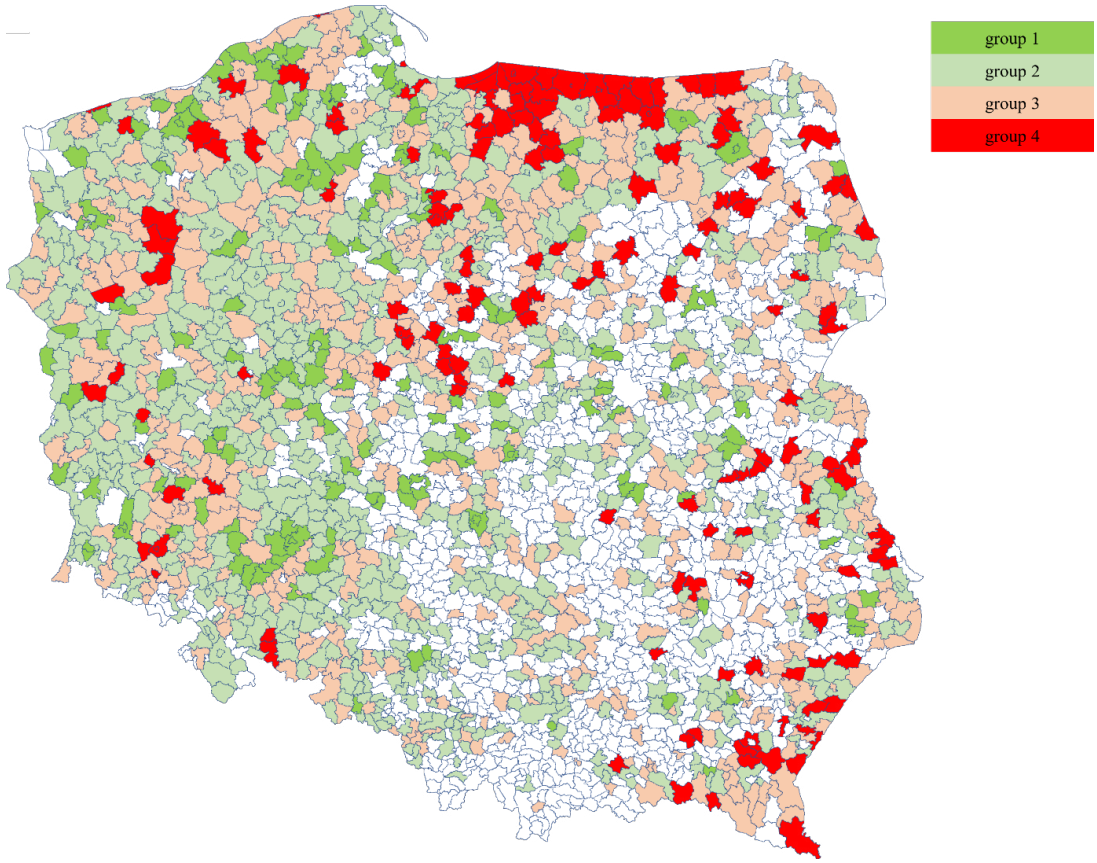


Fig. 4. Spatial distribution of analysed communes as per the value of directional parameter of the first-degree exponential model for the period between 2010 and 2020
Source: own elaboration

Table 5. Structure of the communes analysed as per typological groups obtained under the directional parameter of first-degree exponential

Group	Number of communes	%
1	151	10.1
2	655	43.6
3	537	35.7
4	159	10.6

Source: own elaboration

exponential model for the period between 2010 and 2020, and Table 5 the structure of analysed communes as per the defined typological groups.

Table 5 shows that most communes (53.7%) are classified as typological groups 1 and 2 (shades of green in Fig. 4). This means that for these communes the rate of changes in the value of trend directional parameter was higher than the average for the entire community analysed by 0.0268, i.e., 2.7%. In the case of other two groups (3 and 4), where the rate of change was below average (pink and red), the largest concentration of communes was observed in Zachodniopomorskie, Lubuskie, Warmińsko-Mazurskie, Kujawsko-Pomorskie, Lubelskie and Podkarpackie voivodeships.

Within the 10 communes with the highest positive assessment of the trend model directional parameter (Table 6), urban-rural communes prevail, located in Wielkopolskie (3 communes) and Dolnośląskie (2 communes) voivodeships. The voivodeships where there are communes featuring a deterioration of the socio-economic situation (negative value of the directional parameter) include: Podkarpackie (3 communes), Warmińsko-Mazurskie (2 communes) and Lubelskie (2 communes). In this case, the urban-rural communes also prevail.

4.3 Assessment of the impact of the location of communes relative to urban centres on their socio-economic situation

The final research objective involved assessing the impact of the location of communes relative to urban centres on their socio-economic situation. By using

Table 6. Structure of the communes analysed as per typological groups obtained under the directional parameter of first-degree exponential

Name	Voivodeship	Type of commune	$\hat{\alpha}_1$	Name	Voivodeship	Type of commune	$\hat{\alpha}_1$
The highest assessments of the directional parameter				The highest assessments of the directional parameter			
Stary Brus	Lubelskie	urban-rural	0.069	Lutowiska	Podkarpackie	urban-rural	-0.012
Wieliszew	Mazowieckie	urban-rural	0.066	Bircza	Podkarpackie	urban-rural	-0.012
Stargard	Zachodniopomorskie	urban-rural	0.062	Kock	Lubelskie	rural	-0.013
Miękinia	Dolnośląskie	urban-rural	0.060	Lelkowo	Warmińsko-Mazurskie	urban-rural	-0.015
Kobylnica	Pomorskie	urban-rural	0.058	Krempna	Podkarpackie	urban-rural	-0.015
Czernica	Dolnośląskie	urban-rural	0.055	Otmuchów	Opolskie	rural	-0.015
Parzęczew	Łódzkie	urban-rural	0.054	Wilczęta	Warmińsko-Mazurskie	urban-rural	-0.015
Kórnik	Wielkopolskie	rural	0.054	Kikół	Kujawsko-Pomorskie	urban-rural	-0.015
Rydzyna	Wielkopolskie	rural	0.054	Wyryki	Lubelskie	urban-rural	-0.022
Dominowo	Wielkopolskie	urban-rural	0.053	Krynica Morska	Pomorskie	urban	-0.045

Source: Own elaboration

the information on the value of synthetic measure for 2010 and 2020, the relationship between the levels of these measures and the geographical distance of particular communes from their voivodeship capitals cities was modelled. Because of the nature of this relationship, the geometric models (formula 19) were used, expressing a non-linear inversely proportional direction of the relationship between the dependent variable (synthetic measure) and the independent variable (geographical distance). The modelling results for selected voivodeships are summarised in Table 7.

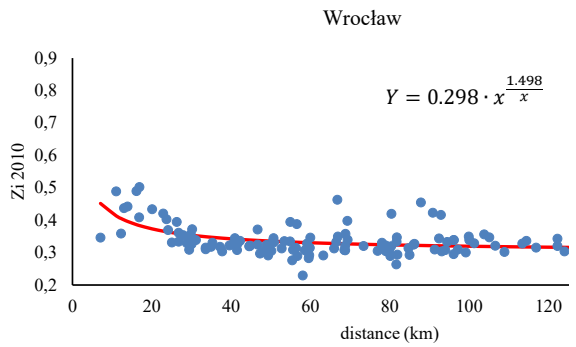
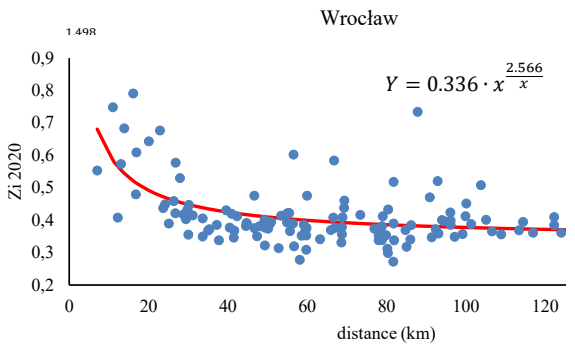
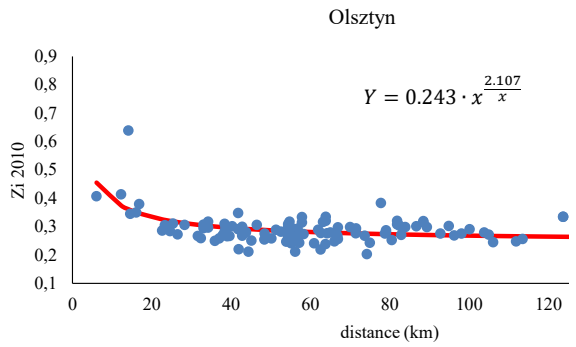
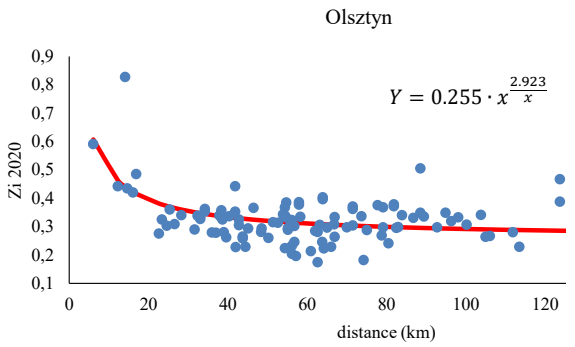
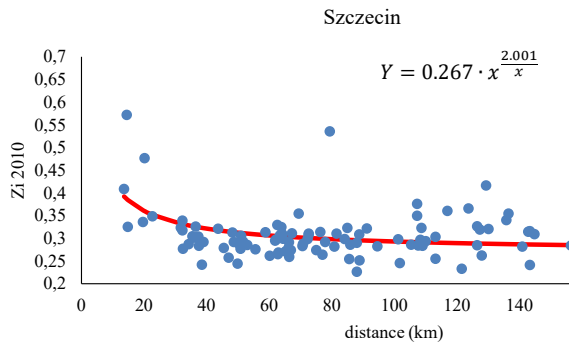
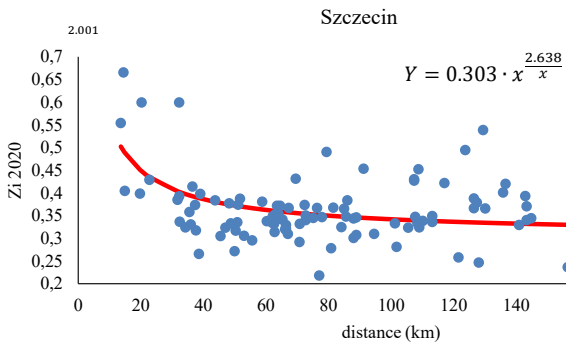
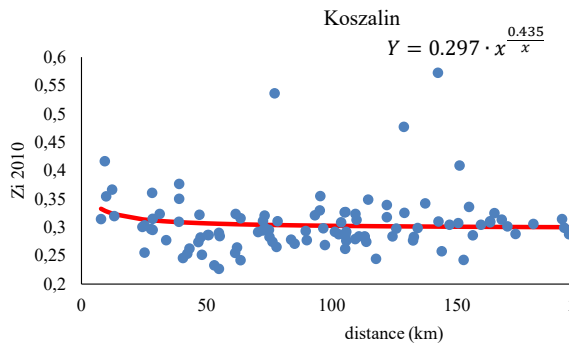
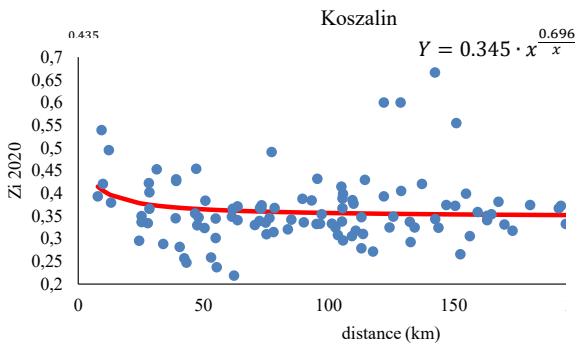
Based on the analysis of drawings, the following conclusions can be drawn:

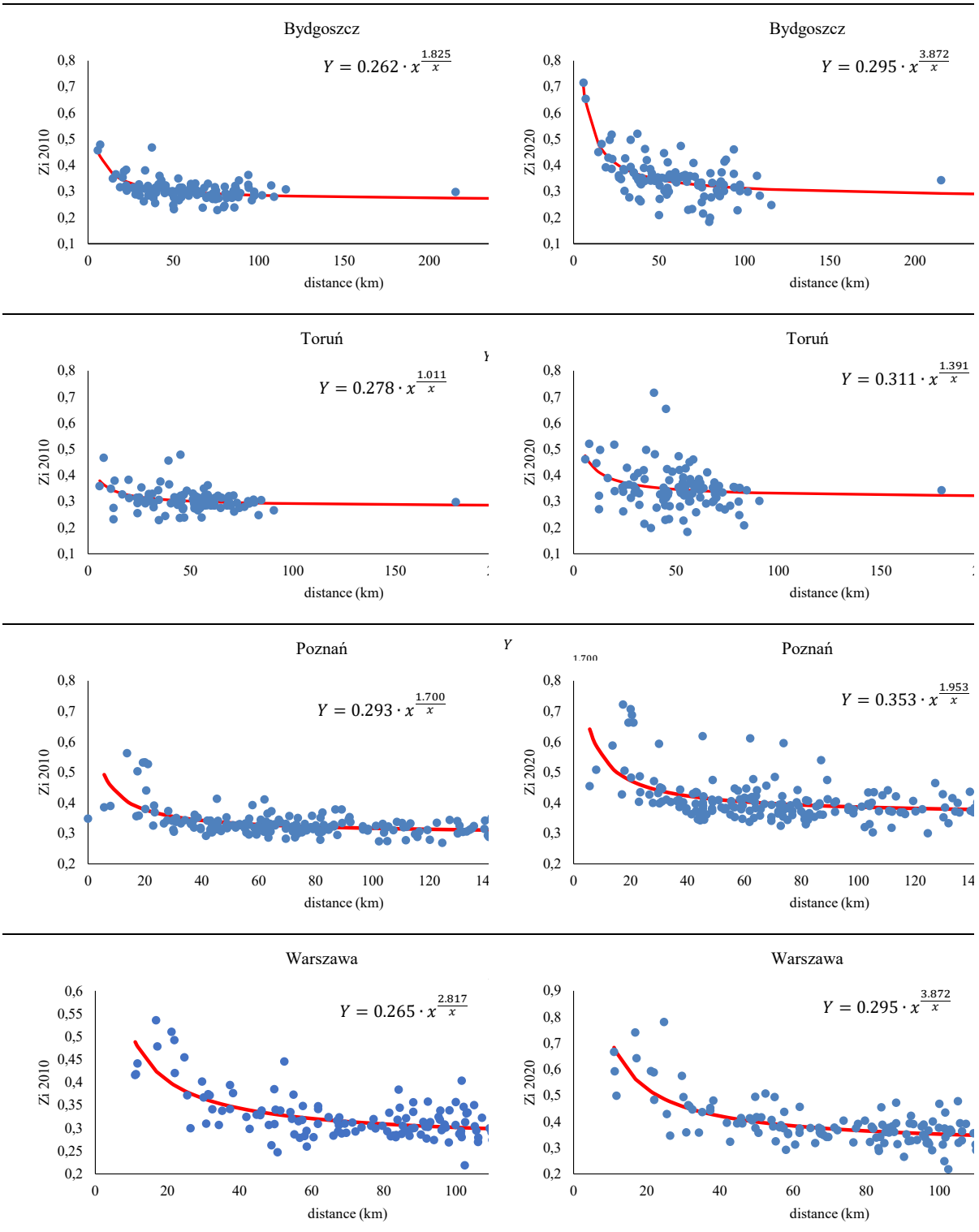
1. The regression line for 2020 is higher than for 2010. It results directly from the increase in the level of synthetic measure.
2. Communes located closer to the urban centre were characterized by a better socio-economic situation in both years compared to communes located further away.
3. It is noticeable that there is a greater dispersion of points for 2020 than for 2010. This suggests that in 2020, the impact of distance on the socio-economic development was lower. This may result, among other things, from the following factors: intensive development of communication infrastructure, development of services based on Internet connections, etc.
4. The identified relationship between the level of synthetic measure and the geographical distance is noticeable not only for voivodeship capitals, but also for other large urban centres. This can be clearly seen in Kujawsko-Pomorskie voivodeship (Bydgoszcz and Toruń) and Zachodniopomorskie voivodeship (Szczecin and Koszalin).

5. Discussion and conclusions

The socio-economic situation in rural areas is the subject of interest to scientists from all over the world, who raise various issues related to this topic. For example, Tsymbalista (2016) - based on research conducted in the Chernivtsi Oblast in Ukraine - indicates the main problems of rural areas, such as: depopulation, outflow of qualified labor, underdeveloped or neglected transport infrastructure, insufficient level or lack of IT infrastructure and communication. In relation to Russia, also Vorobyov & Bugai (2019) emphasize the importance of the level of infrastructure, especially medical, educational and social, in the development of rural areas. On the other hand, in work (Blumenthal & Kagen, 2002), a clearly higher mortality rate and worse health status of the US population living in rural areas was recorded than among the population living in cities. The above-mentioned problems occurring in rural areas were also noticed in the work (Wrzochalska & Chmielewska, 2017) and, according to the authors, they clearly translate into a lower level of the quality of life of the rural population. In turn, Bartkowiak-Bakun (2017) states that the level of development of municipalities significantly depends on their distance from large centers and the proximity of large centers stimulates economic development. This problem is also discussed in the work by Stanny et

Table 7. Results of modelling the relationship between the value of synthetic measure and the geographical distance from the voivodeship capital for 2010 and 2020

2010	2020
	
	
	
	



Source: Own elaboration

al. 2021. The authors indicate that even communes distant from urban centres are able to achieve an average level of development, provided that this development is multifunctional.

Although the rural environment is constantly changing and many of the above-mentioned problems are being eliminated, it can still be observed that rural areas are much less developed than the urban ones. In the case of many rural areas, the historic conditions related to land ownership are also important (Bąk et al., 2021). This applies especially to the countries of Central and Eastern Europe, which after the end of World War II became part of the Eastern bloc camp and on the territory the state-owned farms were established – large production units which were to benefit from common labour resources and then divide the outputs and revenues equally (van Dijk 2004).The fall of these farms in the early 1990s generated a complete range of problems, such as: local redundancies, rising unemployment, community impoverishment, increasing pathological phenomena.

The results of research presented in this article confirmed that there are still financial problems and people's difficulties with entering the labour market in the post-PGR regions. The rate of socio-economic changes in these areas are very diverse and there are communes for which even the proximity of urban centres does not translate into the improvement of the socio-economic situation. In both 2010 and 2020, there was a slight predominance of communes for which the level of synthetic measure was lower than the average level (typological groups 3 and 4). Worse socio-economic situation was observed primarily for communes located in eastern voivodeships: (Warmińsko-Mazurskie, Lubelskie and Podkarpackie) and western voivodeships (Lubuskie, Zachodniopomorskie) as well as Kujawsko-Pomorskie voivodeship. A clearly better situation (prevalence of communes from the 1st and 2nd typological groups) was observed in the south (Dolnośląskie, Opolskie, Małopolskie voivodeships) and central Poland (Wielkopolskie, Mazowieckie voivodeships). The analysis of shifts among the groups of particular voivodeships, especially between groups 2 and 3, indicates an improvement in the socio-economic situation in voivodeships: Łódzkie, Wielkopolskie, Pomorskie, Zachodniopomorskie and Podkarpackie. At the same time, a slight deterioration in the socio-economic situation was observed in the following voivodeships: Opolskie, Śląskie, Świętokrzyskie, Małopolskie, Dolnośląskie, Mazowieckie and Warmińsko-Mazurskie. The analysis of directional parameter of the models of the first-degree exponential trends, developed based on the synthetic values, indicates that most communes were characterized by the rate of change higher than the average (typological groups 1 and 2). A slower rate of change was observed primarily for communes classified as voivodeships: Lubuskie, Zachodniopomorskie, Pomorskie, Warmińsko-Mazurskie, Lubelskie, Podkarpackie and Kujawsko-Pomorskie. As a result of the use of geometric models, the relationship between the level of synthetic measure and the distance of communes from voivodeship capitals was identified. In most cases, the communes located close to voivodeship capitals were characterized by a better socio-economic situation than the communes located further away. However, the increase in the degree of dispersion of points along the regression line between 2010 and 2020 indicates that this relation has weakened.

The authors believe that the development of post-PGR regions must occur at both local and supra-local level. They should, above all, initiate active participation of local communities. Local social service and individual work aimed to activate local labour market are not sufficient to improve the socio-economic situation in the communes lagging behind in this respect. It is necessary to conduct multifaceted, complementary activities, properly coordinated in terms of time and territory, which provides further opportunities for research in the post-PGR regions.

Notes

1. State-Owned Farm (PGR). PGR farms were established on 1 January 1949 from the State Agrarian Real Estates, State Horse Breeding and State Plant Breeding Centres.
2. Moreover, T. John indicates in his study that in Europe loneliness becomes the condition affecting many people not only in rural areas and that it has been no coincidence that the former prime minister of Great Britain, Teresa May, nominated the first in the world Minister for Loneliness in 2018 – announcing the "hidden epidemic" affecting 9 million Britons as "one of the major challenges for public health in our times".
3. Most frequently such situation results from the development of non-agricultural functions of the economy. The changes are exemplified by e.g., forcing out the agricultural functions by the housing functions and by developing the industrial and housing settlements close to the production plants.

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