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Factors determining the formation of degraded areas in local government units and the effectiveness of revitalisation activities

Agata Girul[1]

Abstract

Modern local government units form important links in the socio-economic structure of the country and their development is closely related to the occurrence of degraded areas. This study focused on identifying the social, economic and environmental factors that determine the occurrence of degraded areas requiring revitalisation in Polish local government units. The article used unit data from a Statistics Poland survey based on the SG-01 report: Municipal Statistics – Revitalisation[2]. The PROFIT (PROperty FITting) multidimensional scaling program for local level territorial units was applied. The program takes into account the delimitation of rural areas based on the typology of Functional Urban Areas. The results were visualised through perception maps. Calculations and figures were made in Statistica 13. The focus on the problematic areas revealed the variety of challenges faced by local government units in their revitalisation activities. The survey was thus complemented by an analysis of the results of the undertaken revitalisation projects. The comprehensive analysis of the factors causing the degradation of areas in local government units and the effects of the revitalisation may prove important tools for rural and urban policy makers and planners in developing effective local development strategies and may have an impact on the quality of life of residents.

Key words: revitalisation, degraded areas, PROFIT, quality of life.

1. Introduction

Each territorial unit has degraded areas that require revitalisation and restoration activities. The diagnosis of degraded areas, including the identification of the factors influencing their occurrence, is one of the first mandatory activities included in the revitalisation processes, because an important element of the revitalisation process is

[1] Wroclaw University of Economics and Business, Poland. E-mail: agata.girul@ue.wroc.pl & Statistical Office in Wroclaw, Poland. E-mail: a.girul@stat.gov.pl. ORCID: https://orcid.org/0000-0003-0172-2315.

[2] The report implemented by the municipalities is available at the following link: https://form.stat.gov.pl/formularze/2023/passive/SG-01-5.pdf

the precise identification of the intervention areas that would require changes first, given the limited financial resources and organisational capacity of the territorial units.

Revitalisation intended to counteract the phenomenon of degradation is a comprehensive process aimed at infrastructural and socio-economic revitalisation of units (Kowalczyk, 2017), but also economic revitalisation combined with activities aimed at solving social, spatial-functional, technical and environmental problems (The Law of ..., 2015). It can also be said that revitalisation is a complex process of multiple transformations aimed at improving the quality of space in terms of historical, architectural and environmental values (Leshchenko and Gulei, 2024). Thus, as part of revitalisation activities, local governments are tasked with, among other things, restoring degraded areas, reconstructing old buildings, promoting employment and economic activity by attracting new investors or expanding existing businesses, creating new jobs in crisis areas, and improving environmental quality (Stepina and Pelše, 2022). By carrying out revitalisation activities in cooperation with the local community, it is possible to bring degraded areas out of crisis through projects that integrate undertakings for the well-being of the local community, the area and the economy (Sych, 2020).

Revitalisation activities are an important initiative due to the fact that the existence of degraded areas is a common problem and a barrier to the socio-economic development of local units and has a negative impact on the environment (Kowalczyk, 2017, Stepina and Pelše, 2022). Reliable and high-quality diagnosis of degraded areas, followed by corrective activities against them, remains an important element of local development policy (Raszkowski and Sobczak, 2018). In addition, methods and tools to obtain information on the degradation and rehabilitation of areas, including land and the environment, are needed to support policies for sustainable ecosystem management and environmental protection to restore biodiversity and maintain its sustainability (Mao et al., 2018, Mebrat, 2015, Lamb et al., 2005, Xie et al., 2019, Ferreira et al., 2018). Therefore, there is a strong need for systematic and spatial measurement of land and soil degradation (Wessels et al., 2004). This is because the degradation of land results in its lower productivity (Prince et al., 2009).

Research on diagnosing the drivers of land degradation is becoming increasingly important due to global population growth and the expansion of urban areas, which is affecting the faster degradation of land. Increasing numbers of urban residents are migrating to rural areas, which also creates opportunities and challenges for rural revitalisation (Zheng et al., 2024, Turek et al., 2018). Abandoned and dilapidated land or degraded areas also emerge during deindustrialisation, leaving potentially contaminated and underutilised land and buildings in the hands of local governments (Kalnina and Pelše, 2023). Therefore, it is necessary to combat land and soil degradation at different levels and scales around the world, not only for food security and ecological

health, but also to ensure global sustainable development (Jie, et al., 2002, Zambon et al., 2017) and to achieve a better quality of life for the inhabitants of territorial units (Kalnina and Pelše, 2023). It can be assumed that revitalisation should certainly be carried out in accordance with the principle of sustainable development (Makuch, 2020). Thus, it should meet the needs of society, respecting the requirements of environmental protection, without endangering the survival of future generations.

It is common for the revitalisation process in local government units to be carried out on the basis of a strategic document, such as a revitalisation programme, which sets out a framework for action and a schedule of activities. This programme has a significant impact on the development of policies to promote sustainable development, so it can be assumed that regeneration will become an important element of sustainable development.

The purpose of this article was an attempt to answer the research questions:

- Which factors (intervention areas) most significantly determine the occurrence of degraded areas in certain types of municipalities in Poland?
- What revitalisation activities are carried out by Polish local government units by area of intervention?

Without a clear diagnosis of the areas for intervention at the level of territorial units, it will not be possible to start the process of revitalising areas in crisis, nor will it be possible to achieve the strategic objectives of sustainable development. These considerations are a contribution to the discussion on the reasons for the formation of degraded areas in certain types of municipalities and to the analysis of the effects of revitalisation activities.

In order to answer the above research questions, individual data were applied from a survey conducted by Statistics Poland in 2023 on the basis of the SG-01 report: Municipal Statistics – Revitalisation[3]. The PROFIT (PROperty FITting) analysis was also used – one of the many multidimensional scaling programs that appeared on the market already in the first half of the 1980s (Gatnar, Walesiak, 2004), although in the Statistica 13 package, which was used for preparing statistical analyses and data visualisation, it was implemented in the Kit Plus add-on at the end of 2012. The application of the chosen method allowed the visualisation of the results by means of perception maps and the modelling of the properties of the objects (types of municipalities) in the context of intervention areas and negative phenomena that determine the occurrence of degraded areas due to a specific problem area.

[3] The report implemented by the municipalities is available at the following link: https://form.stat.gov.pl/formularze/2023/passive/SG-01-5.pdf.

2. Data and methods

In order to answer the research questions, the article used unit data from the survey conducted by Statistics Poland using the SG-01 report: Municipal Statistics – Revitalisation. The data collected in the survey made it possible not only to diagnose the causes of the formation of a degraded area, but also to assess the activity of the local government, the enterprises, the effects in the field of revitalisation and the planned financial resources for revitalisation initiatives. Information on degraded areas was provided by all municipalities, regardless of whether they were carrying out revitalisation activities in their area.

Using the report SG-01: Municipal Statistics – Revitalisation, the measurement of the causes of the formation of the degraded area, taking into account the five areas of intervention (social, economic, environmental, spatial-functional, technical) and the negative phenomena determining their occurrence, was determined by a 4-stage scale of intensity of problems:

- there were no problems of a certain type – value 0 was assigned,
- a low degree of difficulties was found to qualify the area as degraded – value 1,
- medium scale problems occurred to qualify the area as degraded – value 2,
- high degree of difficulties was found to qualify the area as degraded – value 3.

The definition of three thresholds of importance for the problems that occurred in the municipality made it possible to clearly identify which of these problems mostly contributed to the creation of a degraded area and which were of marginal importance.

The evaluation of negative factors leading to the occurrence of degraded areas is presented on the basis of data from 2022. The survey units were all municipalities in Poland (2477). Of these, 1488 provided information on the designation of a degraded area and 1440 municipalities carried out revitalisation activities to enhance a degraded area on the basis of a revitalisation document (municipal revitalisation programme, revitalisation programme, other strategic document).

Municipal units were analysed according to the type of municipality, but also according to the delimitation of rural areas, taking into account the typology of Functional Urban Areas (FUA). The following groups of areas were distinguished in the delimitation:

1. Agglomeration – rural areas within the FUAs of provincial cities or within the FUAs of other cities with at least 150,000 inhabitants:
   - high density agglomeration (Adg) – higher than the average population density in Poland,
   - low density agglomeration (Amg) – equal to or less than the average population density in Poland.

2. Non-agglomeration – rural areas outside the FUA boundaries of provincial cities or outside the FUA boundaries of other cities with a population of 150,000 or more:
   - high density non-agglomeration (pAdg) – with a population density greater than 1/3 of the population density in Poland,
   - low density non-agglomeration (pAmg) – population density equal to or less than 1/3 of the population density in Poland.

In the case of urban municipalities, a distinction was made between provincial cities and other cities with more than 150,000 inhabitants (M) and other cities with up to 150,000 inhabitants (pM). Twenty-five units were included in the group of provincial cities and other cities with more than 150,000 inhabitants. The average population density of Poland in 2022 was 120.8 inhabitants/km^2, and the threshold of 1/3 of the average population density was assumed to be 40.3 inhabitants/km^2.

The analysis, which took into account the delimitation of rural areas, did not consider urban-rural municipalities, as the SG-01 report did not provide data on urban and rural parts in urban-rural municipalities.

To answer the research questions, the PROFIT (PROperty FITting) analysis was applied, which uses two statistical techniques: multidimensional scaling to construct a classic perceptual map and multivariate regression. The main purpose of multidimensional scaling is to graphically represent the structure of similarity (or dissimilarity) between analysed objects with respect to a selected set of variables. Such a map, usually 2-dimensional or 3-dimensional (2-dimensional in this analysis), has a very simple interpretation. It is assumed that the smaller the distance between the objects studied, the more similar they are to each other. The result of multidimensional scaling is a plane (a space) on which the objects of interest are distributed. In the present analysis, these objects were the types of municipalities (Adg, Amg, pAdg, pAmg, M, pM) that characterize urban and rural municipalities.

In PROFIT analysis, multidimensional scaling aims to arrange objects in a way that simultaneously reduces the number of dimensions and reproduces the originally observed distances between objects as closely as possible.

The quality of the fit of the reconstructed data to the input data is measured by the STRESS function, which is most often defined as the square root of the standardised sum of squares of the residuals between the input distances and the distances reconstructed by multidimensional scaling. It takes the form:

$$\phi = \sqrt{\frac{\sum\sum(d_{ij} - f(\delta_{ij}))^2}{\sum\sum d_{ij}^2}} \tag{1}$$

where d_{ij} – denotes the reconstructed distance between points *i* and *j* on the perception map, δ_{ij} – denotes the distance between points *i* and *j* on the input data (observed distances), $f(\delta_{ij})$ – is a function defined on the input data where in the metric of multidimensional scaling it is assumed that $f(\delta_{ij}) = \delta_{ij}$.

The STRESS function is an indicator of the fit of the reconstructed data in the perception map to the input data. The smaller its value, the better the match between the reconstructed distance matrix and the observed distance matrix. It can be assumed that the perception map perfectly shows the observed distances when the STRESS function is close to 0.

In order to answer the question of how and in what direction the objects are arranged on a plane (in a space) due to the intensity of each of the input variables in the PROFIT analysis, multiple regression and estimation of model parameters were used, relating each variable to the position or the coordinates of objects on the perceptual map. These variables in the analysis presented in this paper were the intervention areas and the negative phenomena determining the occurrence of degraded areas due to a specific problem range (Appendix: Table A1).

The regression models were built on the basis of input data, which were averaged assessments of the causes of the degraded area, taking into account the assumed intervention areas and the negative phenomena that determine their occurrence. The coordinates assigned to the objects on the perception map were treated as independent variables in the regression model, and the averaged values of the individual variables for the given objects were treated as dependent variables. The number of regression equations constructed was therefore equal to the number of variables of the objects studied. After carrying out the regression analysis, the coordinates of the direction coefficients were superimposed on the previously constructed perceptual map. By projecting the points representing the individual objects (in this analysis, the types of municipalities) onto the vectors of the variables, it was possible to determine the position of the objects in relation to the intensity of these variables and thus to establish a preference series. The vector on the perception map pointed out the direction of increasing values of the variables analysed. Interestingly, the distance of a given object from the straight line on which the vector was located did not matter. What mattered was the ranking of the projections of the objects on these lines (Jabkowski, 2010).

When assessing the extent to which the ranking of objects in relation to the value of a given variable was explained by the position of these objects on the plane, the coefficients of determination of the regression equations were considered. The closer the value of the coefficient of determination is to 1, the better the fit.

The advantage of using the PROFIT scaling programme in this analysis was certainly the ability to present the results using perception maps. Although the PROFIT analysis is not the only method allowing to visualise the results on a diagram called a biplot, as such a diagram is also possible in the more popular Principal Component Analysis (PCA), it is worth noting that PROFIT is more oriented towards modelling specific variables and properties of objects in the context of data analysis, and not necessarily towards dimension reduction or identifying principal components as in PCA. On the other hand, both methods are useful for the hidden patterns' recognition.

All calculations and perception maps were made in Statistica 13 using the Kit Plus add-on and the PROFIT multidimensional scaling programme implemented in it.

3. Results

Using the PROFIT analysis, it was possible to diagnose the factors that have the greatest influence on the occurrence of degraded areas in certain types of local government units, based on the intervention areas included in the analysis. Perception maps were obtained with values of the STRESS function close to 0 and with acceptable levels of coefficient of determination for most of the variables greater than 0.7, due to the delimitation of rural areas taking into account the typology of Functional Urban Areas (Appendix: Table A2). The level of the coefficient of determination was considered acceptable to draw preliminary conclusions on the research topic in the cross-section of municipality types.

The results of the PROFIT analysis confirmed that the municipal units, due to the nature of the municipality, were not similar in their assessment of the impact of the analysed factors – the scatter of objects in the perception maps presented below for these objects was quite large.

The analysis also showed that in urban municipalities, social factors had the greatest impact on the classification of the area as a degraded area. This is particularly evident in provincial cities and other large cities with more than 150,000 inhabitants (the objects with symbols M and pM projected to the straight line Ob._S are ranked highest in the order hierarchy, Figure 1). The social sphere as a significant cause of the occurrence of degraded areas (rating 3 – high influence) was reported on average by 39% of all Polish local government units that identified a degraded area, and by 45% of urban local government units. In urban municipalities, environmental, technical and economic areas were important for the identification of degraded areas, in addition to the social area. These three areas were particularly problematic in cities with up to 150,000 inhabitants.

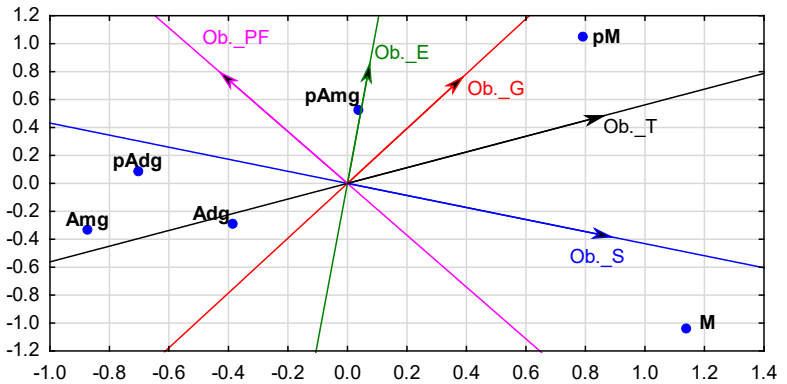

Figure 1. Perception map showing the results of the PROFIT analysis, including the areas of intervention and the delimitation of rural areas and the typology of functional urban areas

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

The environmental, technical and economic areas were identified as having a high impact on the occurrence of degraded areas by about 25% of the urban agglomerations. Interestingly, the spatial-functional area had a greater impact on the identification of degraded areas in rural (agglomeration and non-agglomeration) municipalities than in urban ones – especially for cities with up to 150,000 inhabitants. For large provincial cities and other cities with 150,000 inhabitants or more, the spatial-functional area had little influence on the identification of degraded areas. In rural non-agglomeration municipalities (with low population density), environmental and economic factors were also determinants of the existence of degraded areas.

Based on the PROFIT analysis, it was also possible to diagnose specific factors that more or less influenced the qualification of an area as a deprived area in the corresponding types of municipalities.

In the case of the social area in urban municipalities, aspects of problems related to unemployment, poverty, crime, but also poor demographics, were the determining factors for the occurrence of degraded areas. These factors were more pronounced in provincial cities and other large cities with more than 150,000 inhabitants than in smaller cities with up to 150,000 inhabitants (Figure 2). In rural municipalities, on the other hand, the factors that were linked to the existence of degraded areas were issues related to the level of participation in public and cultural life, as well as the level of social activity and education. The last factor, the level of education, also influenced the identification of degraded areas in urban municipalities, but to a lesser extent than in rural municipalities.

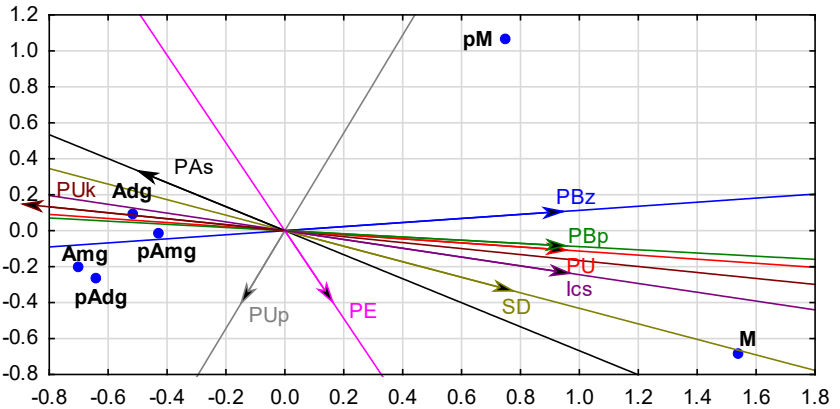

Figure 2. Perception map showing the results of the PROFIT analysis by social area of intervention and the delimitation of rural areas and the typology of functional urban areas

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

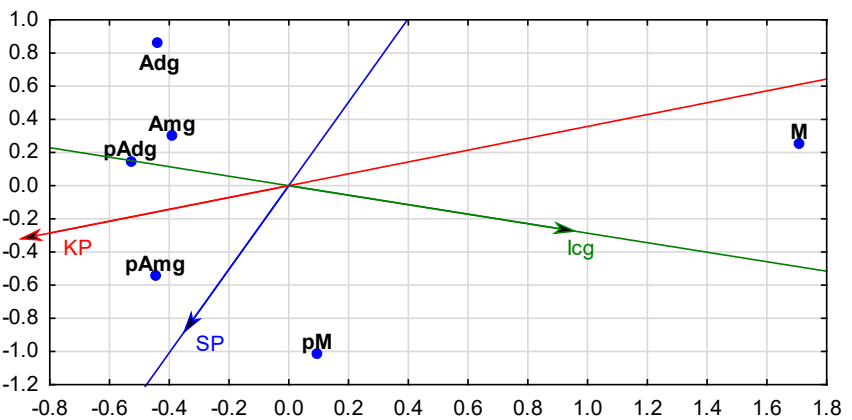

Figure 3. Perception map showing the results of the PROFIT analysis by economic area of intervention and the delimitation of rural areas and the typology of functional urban areas

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

In the economic area, as in the social area, it was possible to observe different factors determining the presence of degraded areas in urban and rural municipalities. In urban municipalities, the degree of entrepreneurship turned out to be the most problematic economic factor, while in rural municipalities – the condition of local businesses. The problem related to the level of entrepreneurship was particularly acute in smaller towns of up to 150,000 inhabitants and in non-agglomeration municipalities with low population density, while the problem related to the condition of businesses was more

pronounced in rural non-agglomeration municipalities than in agglomeration municipalities (Figure 3).

The environment was also an important area of intervention that could not be omitted from the analysis. In this area, it was found that in urban agglomerations, problems related to the exceedance of air quality and environmental quality standards, which affect smaller towns more than larger ones, were a factor in the occurrence of degraded areas in this area, while in rural agglomerations it was the presence of waste posing a threat to life, health or the environment (Figure 4).

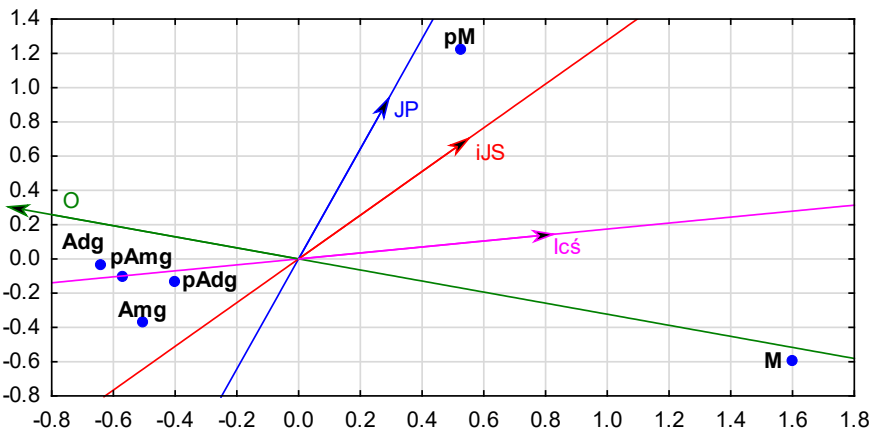

Figure 4. Perception map showing the results of the PROFIT analysis by environmental intervention area and the delimitation of rural areas and the typology of functional urban areas

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

The spatial functional area was characterised by the greatest intensity of influence on the designation of a degraded area in rural municipalities. On the basis of the analysis of individual factors, it also turned out that the spatial functional aspects determining the classification of an area as degraded in rural municipalities were, in particular, issues related to the degree of accessibility of technical and social infrastructure and the level of adaptation of urban solutions to the current functions of the area, the quality and availability of public areas but also the re-development of brownfield sites. The latter type of factor was particularly important for the qualification of degraded areas in rural non-agglomeration municipalities with low population density. In urban municipalities, on the other hand, among the spatial functional factors influencing the occurrence of degraded areas, other unspecified spatial-functional factors can be identified, both for large and smaller cities with up to 150,000 residents (Figure 5).

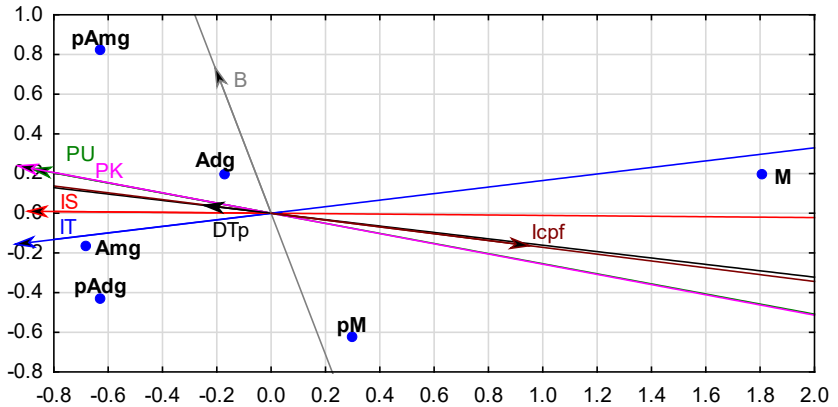

Figure 5. Perception map showing the results of the PROFIT analysis taking into account the spatial functional intervention area and the delimitation of rural areas and the typology of functional urban areas

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

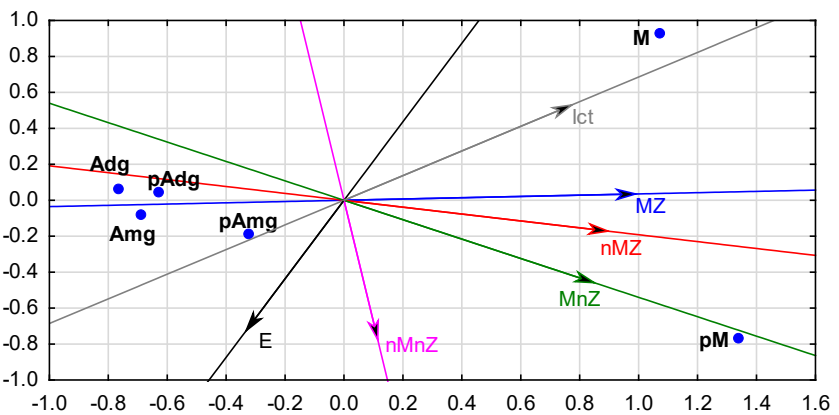

Figure 6. Perception map showing the results of the PROFIT analysis by technical area of intervention and the delimitation of rural areas and the typology of functional urban areas

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

The last area of research was the technical area, which was particularly important for the qualification of degraded areas in urban municipalities, due to the significant influence of factors related to the structural condition of both residential and non-residential buildings, with or without historic monument status. Interestingly, the

factor related to the functional technical solutions that enable the efficient use of buildings, e.g. in terms of energy efficiency and environmental protection, proved to have an impact on the diagnosis of degraded areas not only in urban municipalities, especially in relation to smaller cities with up to 150,000 inhabitants, but also in rural agglomeration and non-agglomeration municipalities (Figure 6).

Based on the analysis, it was possible to observe an ordering of factors for urban and rural municipalities on the two opposite sides of the coordinate axis, while the units characterizing urban-rural municipalities showed characteristics of both types of municipalities. This is due to the fact that urban-rural municipalities have one of the settlements in their area that has urban status and the rest of the area is rural. It can, therefore, be said that, in terms of the classification of degraded areas and the factors that determine the occurrence of intervention areas, urban-rural municipalities have similar characteristics to rural municipalities in social, economic, environmental and spatial functional areas, and to urban municipalities in the technical area.

4. Discussion and conclusion

Interest in the revitalisation of degraded areas has been growing steadily for several years. This is due to the desire of local governments to take advantage of the attractive locations of degraded areas, but also to the lack of a methodology for the revitalisation process that takes into account the specificity of degraded areas and the needs of the local community (Turek et al., 2018). Consequently, there is also a growing interest in spatial analysis or the use of satellite remote sensing to identify local causes of area degradation (Mao et al., 2018, Prince et al., 2009, Xie et al., 2019).

In the context of the process of enhancing degraded areas, it is also crucial for urban planners and policy makers, and especially for the socio-economic development of local government units, to have a thorough understanding of the factors influencing the occurrence of such areas on the territory of the municipalities concerned. The method applied in this study using the PROFIT multivariate analysis software proved to be a method that provides insight into the factors determining the qualification of areas as degraded for different types of municipalities. The identification of specific factors is a key step in developing solutions for individual units in terms of effective management of degraded areas and implementation of revitalisation processes on their territory. It is necessary to carry out research and analysis of the current situation in order to assess strengths and weaknesses, as well as to identify possible solutions for future actions in the process of infrastructural and socio-economic revitalisation of the units (Kalnina and Pelše, 2023).

On the basis of the survey carried out, it was possible to learn that urban and rural municipalities face a large number of identical problems in the context of the areas of

intervention, but they tend to target different problem factors. Although the social area is mainly a problem of urban municipalities, especially large cities where the accumulation of problems such as high unemployment, poverty, crime or unfavourable demographic trends is enormous, some deficits in this field can also be observed in rural municipalities. In rural areas, there is an unsatisfactory level of social activity and participation in the public and cultural life of the inhabitants, which, according to local authorities, has an impact on the occurrence of degraded areas in these areas. It seems that social inclusion through social innovation activities could help to effectively combat rural marginalisation as a panacea to counteract social inequalities between urban and rural areas (Bock, 2016).

Interestingly, the largest number of revitalisation activities is in the social sector. In 2022, Polish municipalities with a revitalisation programme or a municipal revitalisation programme planned more than 32,000 revitalisation projects worth about PLN 80 billion, of which about 12,000 projects concerned the social area of intervention, worth about PLN 12 billion. The revitalisation effects related to the social sphere of intervention in 2022 in local government units included, among other things: almost 134,000 inhabitants were provided with social assistance, e.g. in the area of nutrition; vocational activation courses were held, from which almost 11,000 people benefited; more than 60,000 courses were held, which were addressed to various groups of recipients (the elderly, children and young people). The second area in which most revitalisation activities were carried out is the spatial-functional area. In 2022, municipalities planned about 9 thousand revitalisation activities in this area for a sum more than twice as high as in the social sector – more than PLN 27 billion.

In terms of different factors, the spatial and functional area proved to be important in the classification of degraded areas, especially for the self-governments of rural municipalities. It turned out that in rural areas, the lack of infrastructure or its poor technical condition, the lack of land development according to its intended use, the low level of transport services and the lack of urban planning solutions or the underutilisation of brownfield sites were elements that required revitalisation activities. The underutilisation of brownfield land is an aspect that has proved to be particularly important for rural non-agglomeration municipalities with low population density. In the case of urban municipalities, where the spatial-functional area was not characterized by a significant intensity of factors influencing the occurrence of degraded areas, only other spatial functional factors, previously unspecified, determining the occurrence of degraded areas were detected in larger and smaller cities. Although public space and its accessibility are changing for the better, especially in terms of green spaces and parks (Liu et al., 2024), there are still evident gaps in the satisfaction of needs in this area, especially observed in rural areas. In this intervention area, the municipal results of revitalisation projects in 2022 included 536 km of repaired

and constructed roads, 138 km of constructed cycle paths, 209 ha of revitalised green spaces or 36 ha of revitalised brownfield sites, including 16 ha in rural municipalities.

Issues relating to the economic development of territorial units are a key element that should not be overlooked. Entrepreneurship is a driving force of the economy, but also an important factor in counteracting unfavourable socio-economic processes such as unemployment, exclusion or marginalisation. On the basis of the analysis it could be seen that in urban municipalities – in smaller towns – the factor influencing the diagnosis of degraded areas was too low a level of entrepreneurship, while in rural municipalities – mainly in units located outside towns – the poor condition of local businesses was the factor influencing the diagnosis of degraded areas. Business environment institutions, local governments should therefore stimulate and support entrepreneurs operating in rural areas. Cooperation between entrepreneurs and the implementation of development projects focusing on promoting regional diversity (e.g. tourism) and expanding the market for products and services should also play a key role (Yang et al., 2021). It is interesting to note that in 2022, municipalities planned 2,500 revitalisation projects from the economic intervention area with a total value of around PLN 6 billion. The effects of the revitalisation activities carried out in this area include, among others, the creation of almost 2,000 jobs or almost 2,000 business entities that have started operations in business premises in the revitalisation area.

Although there are studies confirming that local authorities in Poland do not perceive negative environmental phenomena as important factors in the assessment of problems in degraded areas, municipalities do include environmental issues in their local strategic programmes and perceive the need for revitalisation activities in this sphere (Jadach-Sepioło et al., 20–21). On the basis of this study, it was found that the environmental area is more relevant to urban municipalities than to rural ones, which does not mean that in rural areas it is not taken into account in the diagnosis of the establishment of intervention areas. In the case of urban municipalities, the factors determining the occurrence of degraded areas in relation to environmental problems were found to be aspects related to exceeding air quality standards or other environmental quality standards, and in relation to rural municipalities – the presence of waste that poses a threat to life, human health or the state of the environment. Rural municipalities should pay particular attention to activities that promote the implementation of proper waste management by raising the awareness of the local population of the need to protect the environment from waste.

In addition, local government units planned a total of more than 2,000 environmental revitalisation activities worth PLN 5.5 billion in 2022. Rural municipalities have planned more activities in this area (40% of the total) than urban municipalities (25%). The environmental effects of revitalisation include more than 3,000 buildings where asbestos was removed, including almost 2,000 in rural communes, and almost

5,000 flats where heat sources were replaced (e.g. by solar panels, gas heating), including almost 2,000 in rural units.

The last problem area included in the analysis was the technical area, where most factors had a greater influence on the delimitation of degraded areas in urban municipalities than in rural ones. Among the determinants influencing the occurrence of degraded areas in urban municipalities, especially those with up to 150,000 inhabitants, the poor technical condition of residential and non-residential buildings, including those with historical status, could be mentioned, as well as the non-functioning of technical solutions enabling the effective use of buildings, e.g. in terms of energy efficiency and environmental protection. The latter factor had a significant impact on the identification of degraded areas in rural municipalities. Once again, there is a need for municipalities in rural areas to take action to protect the environment. In 2022, more than 6,500 revitalisation projects were planned in the technical area, amounting to approximately PLN 16 billion, and among the revitalisation effects, the municipalities carried out works aimed at, among other things, improving the energy efficiency of 775 buildings or adapting about 300 buildings to the needs of people with disabilities.

The results of this study showed that local authorities are active in carrying out different types of regeneration in different areas of intervention. The study also pointed out the problematic factors influencing the qualification of degraded areas. Furthermore, it provided an insight into where financial resources and projects should be directed in order to mitigate the impact of the intensity of specific problem factors influencing the occurrence of degraded areas.

Finally, it should also be emphasised that the results of this study on the basis of unit data from the survey conducted by Statistics Poland using the SG-01 report: Municipal Statistics – Revitalisation, provided interesting conclusions, which encourage further research on this topic. The approach proposed in the article to identify problematic factors for the diagnosis of degraded areas, using the PROFIT analysis, may be of great importance for the implementation of effective revitalisation activities. It also seems reasonable to adapt the revitalisation process to the specificities of the territorial units. However, measures should be taken so that the units included in the SG-01 study for the urban-rural part are also presented with a breakdown between the rural part and the city. This would allow for more precise information, taking into account the delimitation of rural areas and the typology of Functional Urban Areas (FUAs). Research on the diagnosis of degraded areas in local government units should also be extended to include an analysis of the participatory activities of their inhabitants. The involvement of the public in the acceptance of changes in the intervention areas is an important element of revitalisation activities. The social reflections of the inhabitants of municipalities on the possibilities of renovating dilapidated or abandoned spaces can contribute to their quality of life and their civic attitude. Developing research in this area can influence local, national and European local development policies.

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Appendix

Table A1. Areas of intervention and factors identifying the degraded area

Full name	Abbreviation
SOCIAL AREA	**OB._S**
unemployment rate	PBz
poverty level	PU
the level of crime or other elements of public security	PBp
level of education	PE
level of social activity	PAs
level of participation in public life	PUp
the level of participation in cultural life	PUk
demographic situation	SD
other	Ics
ECONOMIC AREA	**Ob._G**
degree of entrepreneurship	SP
condition of local enterprises	KP
other	Icg
ENVIRONMENTAL AREA	**Ob._E**
exceeding of air quality standards	JP
exceeding of other environmental quality standards (e.g. noise)	iJS
presence of waste that poses a threat to life, human health or the state of the environment	O
other	Ics
SPATIAL FUNCTIONAL AREA	**Ob._PF**
degree of equipment in technical infrastructure and/or its technical condition	IT
the degree of equipment with social infrastructure and/or its technical condition	IS
the level of adaptation of urban planning solutions to the current functions of the area	PU
the level of communication services	PK
the quality of public areas and their accessibility	DTp
re-development of brownfield sites (post-industrial and other areas)	B
other	Icpf
TECHNICAL AREA	**Ob._T**
technical condition of residential buildings with monument status	MZ
technical condition of non-residential buildings with monument status	nMZ
technical condition of residential buildings without monument status	MnZ
technical condition of non-residential buildings without monument status	nMnZ
the functioning of technical solutions for the efficient use of buildings (in particular in terms of energy efficiency and environmental protection)	E
other	Ict

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.

Table A2. Results of the regression analysis and STRESS function

Variables	Results of the regression analysis				STRESS function
	constant term	coefficient of regression		coefficient of determination	
		β_1	β_2		
	by the delimitation of rural areas and the typology of FUA				
INTERVENTION AREA					
OB._S	1.88*	0.13*	-0.06*	0.93	
Ob._G	1.23*	0.03	0.07*	0.73	
Ob._E	0.94*	0.01	0.09*	0.73	0.0000041
Ob._PF	1.40*	-0.03*	0.07*	0.81	
Ob._T	1.15*	0.11*	0.07*	0.98	
SOCIAL AREA					
PBz	2.56*	0.16*	0.03	0.90	
PU	2.50*	0.28*	-0.05	0.93	
PBp	2.12*	0.45*	-0.06	0.92	
PE	1.84*	0.01	-0.02	0.28	
PAs	1.96*	-0.07	0.07	0.45	0.0000144
PUp	1.83*	-0.02	-0.07	0,28	
PUk	1.67*	-0.17*	0.04	0.81	
SD	2.12*	0.15*	-0.10	0.71	
Ics	0.27*	0.24*	-0.09*	0.99	
ECONOMIC AREA					
SP	2.07*	-0.04	-0.14*	0.90	
KP	1.44*	-0.16*	-0.07	0.90	0.0000014
Icg	0.17*	0.19*	-0.07*	0.99	
ENVIRONMENTAL AREA					
JP	1.32*	0.05	0.22*	0.97	
iJS	1.07*	0.03	0.05	0.80	0.000000
O	1.19*	-0.29*	0.13*	0.98	
Icś	0.20*	0.12	0.03	0.70	
SPATIAL FUNCTIONAL AREA					
IT	1.98*	-0.15*	-0.05	0.99	
IS	1.84*	-0.08*	0.00	0.80	
PU	1.44*	-0.11*	0.05	0.82	
PK	1.57*	-0.13*	0.06	0.92	0.0000046
DTp	1.71*	-0.02	0.01	0.26	
B	1.05*	-0.02	0.13	0.58	
Icpf	0.18*	0.13*	-0.04	0.93	
TECHNICAL AREA					
MZ	1.30*	0.24*	0.01	0.98	
nMZ	1.25*	0.12*	-0.04	0.83	
MnZ	1.40*	0.18*	-0.17	0.93	0.0000044
nMnZ	1.36*	0.01	-0.11	0.61	
E	1.42*	-0.04	-0.16	0.64	
Ict	0.20*	0.11*	0.13	0.88	

* Parameters statistically significant at the significance level $\alpha = 0.05$.

Source: own work based on the results of the SG-01 study: Municipal Statistics – Revitalisation of Statistics Poland.