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THE HIERARCHY OF LAND CONSOLIDATION PROCESSES IN VILLAGES OF EASTERN POLAND, AS EXEMPLIFIED BY THE ABRAMÓW COMMUNE

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Summary

The making of strategic decisions concerning directions for the reconstruction of the spatial structure of rural localities necessitates action based upon current and reliable cadastral data, encompassing the present state and requirements of the commune, poviat, or voivodeship under examination. The prerequisite for effective generation of advancement in the agricultural sector, carried out within the framework of sustainable growth, is responsible planning of the executed alterations and precise execution of the established objectives. The documented need for modernising Polish agriculture, primarily involving changes aimed at the comprehensive development of rural regions, implies an increasing need for undertaking several activities regarding the development of a hierarchy for these works. Land consolidation represents one of the principal measures undertaken to optimise agrarian structures and facilitate an environment conducive to sustainable development. The study's objective was to establish a ranking of the demand for land consolidation works within the villages of the Abramów commune, Lubartów poviat, Lublin voivodeship, by employing established statistical methodologies utilised in this type of investigation. The study encompassed 11 sołectwos within the Abramów commune. According to available records, the commune under analysis covers an area of 8448.58 ha, constituting 6.55% of the Lubartów poviat and 0.34% of the Lublin voivodeship. To better illustrate the need for land consolidation work, an analysis of the selected area in the village of Ciotcza was conducted, focusing on transformations in the spatial structure over a period exceeding 100 years. The studies developed were based on data relating to land and building records obtained from the Poviat Office in Lubartów and demographic data procured from the Abramów Commune Office.

Keywords

land consolidation • rural areas • cadastre data

1. Introduction

The concern regarding the organisation of production space in agriculture in relation to its profitability in Poland was initially acknowledged upon the country's regaining of independence in 1918. As early as 1920, a regulation regarding the consolidation of land within the former Russian partition was enacted and subsequently utilised by land

commissions. The initial legislation specifically addressing land consolidation, known as the Land Consolidation Act, was introduced on July 31, 192 [Przegon and Rybicki 2020]. The approximate area of land required to be consolidated in 1921 was roughly 57% [Radwan 1938]. As per the Act of 26 March 1982, which pertains to the consolidation and exchange of land, the objective of land consolidation is to establish more favourable conditions for managing agriculture and forestry by enhancing the area structure of farms, forests, and forest lands; rationally shaping the land offsets; and adapting the property boundaries to the system of water drainage, roads and terrain. Additionally, according to Radwan [1938], a notable outcome of consolidation is that instead of numerous plots dispersed across a vast area, one or more consolidated plots are created in close proximity to one another, thereby enabling more efficient cultivation practices.

Initially, when consolidations were introduced, it was noted that a checkerboard pattern of land in rural areas amounted to several hundred plots per registration unit. This pattern of land and an excessive elongation of plots generate problems with proper management and cultivation, uniform fertilisation and rational crop rotation. The utilisation of mechanical cultivation methods within narrow plots creates furrows and ridges as a result of ploughing. This, in turn, leads to a loss of plot surface area. Furthermore, the expenses associated with fertilising arable fields are exacerbated by the substantial distance to the fields. These distances generate costs that are often unable to be offset by the profits derived from the crop yield. Another consequence of this distance issue is that landowners frequently leave land situated far from economic hubs fallow or idle [Radwan 1938]. The process of land consolidation and exchange is a primary technical procedure that facilitates the enhancement of the spatial structure of farms [Mika et al. 2019].

The primary objective of this research was to formulate a ranking of the demand for land consolidation works in the sołectwos of the Abramów commune, situated within the Lubartów poviat, Lublin voivodeship. The study encompassed eleven villages of the Abramów commune. In terms of land registry, the area covered by the commune is 8,448.58 hectares, which constitutes 6.55% of the Lubartów poviat and 0.34% of the Lublin voivodeship. To provide a more comprehensive understanding of the issue concerning the demand for land consolidation works, an analysis of the selected complex in the village of Ciotcza was conducted, focusing on changes in the spatial structure over a period exceeding 100 years. The studies were developed utilising data sourced from the land and building register acquired from the Poviat Office in Lubartów, coupled with demographic data obtained from the Abramów Commune Office.

2. Research area

The commune of Abramów is situated in the Lublin voivodeship, in the south-western part of the Lubartów poviat, in the central part of the Lubartów upland, at the intersection of roads connecting Lubartów with Puławy and Kurów with Łuków. The spatial view of the commune and how it is situated in relation to the poviat, voivodeship and the country is illustrated in Figure 1.

Source: Authors' own study in QGiS programme using data from administrative units in the PRG database from the website of the Head Office of Geodesy and Cartography

Fig. 1. Spatial position of the Abramów municipality in relation to the whole country

Table 1 shows the areas and percentage shares of cadastral districts in the total area of the entire cadastral unit of the Abramów commune.

Table 1. List of cadastral districts and their percentage share in the total area of the cadastral unit

Ord.	District	Total district area [ha]	Area share	Ord.	District	Total district area [ha]	Area share
1	Abramów	1519.1	17.98%	7	Michałówka	368.4	4.36%
2	Ciotcza	702.4	8.31%	8	Sosnówka	504.9	5.98%
3	Dębiny	882.2	10.44%	9	Wielkie	801.6	9.49%
4	Glinnik	1042.9	12.34%	10	Wielkolas	1027.0	12.16%
5	Izabelmont	383.1	4.53%	11	Wolica	831.1	9.84%
6	Marcinów	386.0	4.57%	Total		8448.6	100.00%

Source: Authors' own study

The largest share in the area of the commune is made up of soils of the IVa quality class – 22.41%, while the smallest percentage share is made up of soils of the class quality II, which is only 0.002%. It is worth noting that class I and VI do not appear in the

study area. In the ownership structure, the largest percentage is the land of individuals, i.e. 8208.02 ha, which is 97.15%. In each cadastral district, the share of group 7 exceeds the threshold of 90%. In comparison with other localities, the Wielkolas district has the smallest percentage of land owned by individuals, while the largest is the locality of Michałówka. The difference between these locations is 3.61%. In second place in terms of the size of shares in the structure are the lands of group 4 – communes, inter-communal or metropolitan unions, if they do not occur in conjunction with perpetual users – they occupy 112.30 ha – which gives 1.33% share percentage. This group occupies 2.31% in the town of Wielkie – the largest share with an area of 18.51 ha. In the town of Michałówka, the lands of group 4 have the smallest percentage share – 0.52%. The percentage threshold of 1% is not exceeded by 5 villages – Ciotcza, Glinnik, Marcinów, Michałówka, Wolica. The land in the remaining registration groups does not exceed 0.60% in the area of the commune. As the research shows, there are 19 types of land use in the Abramów commune. In the area of 13 villages there is no: Bz – recreational and recreational areas, K – mineral resources, Tk – railway areas, Ti – other communication areas. Of the distinguished land uses, the largest share is characterised by the use of R – arable land. In the area of the entire cadastral unit, it occupies 5482.94 ha, in percentage terms it is 64.90%. The largest share of arable land can be seen in the village of Ciotcza, where the area of arable land reaches 618.68 ha – 88.09%, while the smallest share is in the Abramów sołectwo – 46.62%. Abramów and Glinnik are the only villages that do not exceed the 50% threshold for the percentage of arable land. The second largest in terms of shares is the agricultural land – Ł – permanent meadows – it covers an area of 1110.74 ha – 13.15%. The largest share of permanent meadows is in the village of Glinnik – 299.37 ha – 28.70%. Out of 11 sołectwos, three – Abramów, Glinnik and Wielkie – exceed the 20% threshold for the share of such use. While the 1% threshold is not exceeded by Michałówka and Sosnówka – it is 0.93% and 0.89% respectively.

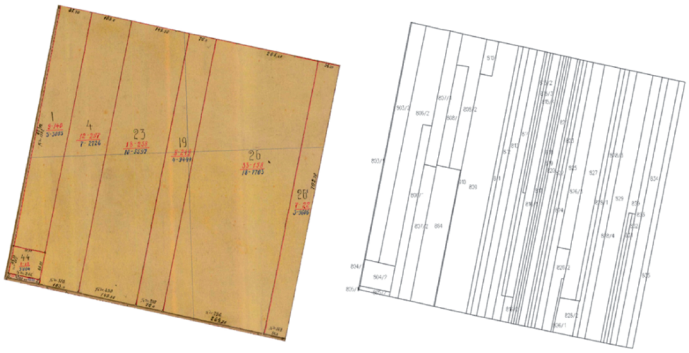
3. Analysis of changes in the spatial structure of the selected complex in the village of Ciotcza over the years

This report presents an analysis of changes in the spatial structure of a selected complex in the village of Ciotcza, located in the Lubartów poviat, a commune situated within the broader commune of Wielkie. The analysis is based on a review of the plan for the measurement of peasant lands in the village, as documented in historical records. Figure 2 illustrates the selected complex that forms the focus of this analysis.

As can be observed in Figure 2, during the study period, numerous divisions of cadastral parcels occurred. Detailed data on land divisions of the analysed complex are presented in Table 2.

From 1919 to 2022, an eight-fold increase was observed in the number of plots located within the chosen complex situated in the village of Ciotcza. In order to elucidate the demand for land consolidation within the selected complex, a simplified analysis of the ownership and usage structures was conducted. The initial analysis examined the ownership structure, specifically focusing on whether the given complex encompassed

land owned by the same proprietors who were subject to consolidation. This analysis was subsequently combined with an examination of the usage structure in terms of use B or Br, which holds significant importance in the land consolidation process, as buildings are excluded from consolidation procedures. The outcomes of these analyses are depicted in Table 3 and Figure 3.



Source: Plan of measurement of peasant lands of the village of Ciotcza in the district of Lubartów, commune located in the commune of Wielkie, data from EGiB

Fig. 2. The complex in the village of Ciotcza – condition in 1919 and 2022

Table 2. Comparison of the number of plots in the complex

As of 1919		As of 2022		As of 1919		As of 2022	
Ord.	**Plot number**	**Ord.**	**Plot number**	**Ord.**	**Plot number**	**Ord.**	**Plot number**
1	1	1	803/1	5	26	25	817
		2	803/2			26	818
		3	804/1			27	819
		4	804/2			28	820
		5	805/1			29	821
		6	805/2			30	822
2	4	7	806/1	6	26	31	823
		8	806/2			32	824
		9	807/1			33	825
		10	807/2			34	826/2
		11	808/1			35	826/3
		12	808/2			36	827

Table 2. cont.

As of 1919		As of 2022		As of 1919		As of 2022	
Ord.	**Plot number**	**Ord.**	**Plot number**	**Ord.**	**Plot number**	**Ord.**	**Plot number**
3	19	13	809	7	44	37	828/1
		14	810			38	828/2
		15	810			39	828/3
		16	811			40	828/4
		17	812			41	829
		18	813			42	830
4	23	19	814	8	45	43	831
		20	815/2			44	832
		21	815/3			45	833
		22	815/4			46	834
		23	816/1			47	835
		24	816/2			48	864

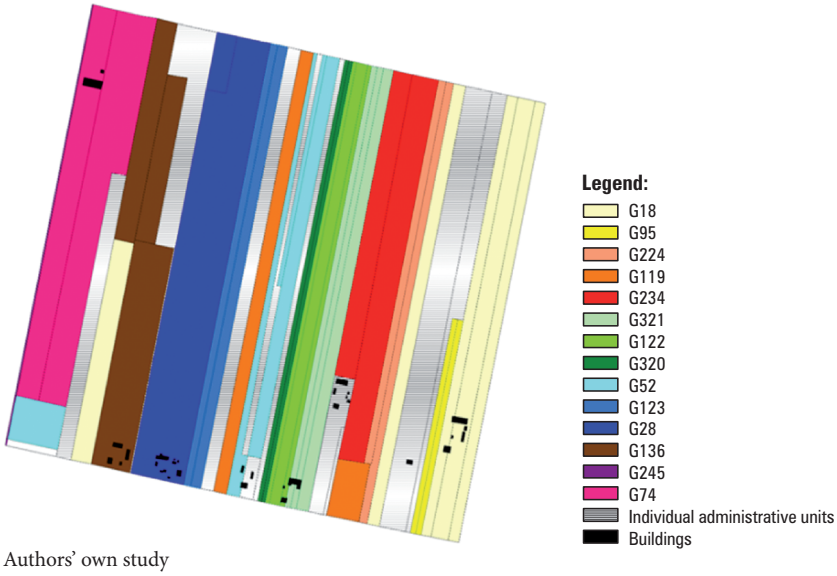
Source: Authors' own study

Table 3. Analysis of ownership structure and presence of buildings in selected complex

Ord.	Plot number	Register unit	Buildings	Ord.	Plot number	Register unit	Buildings
1	835	G18		26	816/2	G275	Yes
2	834		Yes	27	815/4	G322	
3	833		Yes	28	816/1	G52	
4	828/4			29	815/3		
5	807/2			30	815/2		Yes
6	830	G225		31	804/2		
7	829	G261	Yes	32	813	G188	
8	832	G95		33	812	G123	
9	831			34	811		

10	828/2	G119		35	810	G86	
11	814			36	809	G28	Yes
12	828/3	G224		37	810		
13	828/1			38	864	G136	Yes
14	827	G234		39	808/1		
15	826/3			40	807/1		
16	826/2	G283	Yes	41	808/2	G134	
17	825	G321		42	806/2	G74	
18	824		Yes	43	803/2		Yes
19	823		Yes	44	805/1	G245 Commune	
20	822	G122	Yes	45	804/1		
21	821		Yes	46	803/1		
22	820			47	806/1	G317	
23	819	G320		48	805/2	G108	
24	818			49	910	G64	
25	817	G21					

Source: Authors' own study



Source: Authors' own study

Fig. 3. Analysis of changes in the ownership structure of the studied complex

In analysing the changes in the spatial structure of rural areas in the selected complex, which is characterized by significant imperfections, a detailed analysis should be conducted of the Abramów commune selected for the research, prioritizing the demand for land consolidation works.

4. Materials and methods

The application of statistical methods with a multidimensional background enables the determination of synthetic measures, which are beneficial in the analysis of the comparison of the applied features of the objects included in the scope of the study. These methods are useful in determining the urgency rankings in the implementation of the consolidation procedure. Synthetic methods allow for the segregation of analysed objects in terms of the applied features [Król and Leń 2016].

The fundamental operation of multivariate statistics is to construct a ranking for objects in terms of their features across multiple dimensions. In the process of establishing the positions of objects, it is essential to standardize the features in terms of magnitude and eliminate the units that define the features [Kukuła 2012].

Regarding the evaluation of land consolidation demand rankings, quantitative traits are at hand. For qualitative traits, the suggested method is the zeroing unitarisation process, in which traits are bound within the scope <0;1> [Kukuła 2012].

The literature review [Hellwig 1968, Bartosiewicz 1976] has revealed that employing multivariate statistical methods is beneficial in analyses of land consolidation urgency and exchange initiatives, particularly in spatial comparative analyses, as it facilitates the development of a synthetic measure. These measures replace a sizable set of traits from the analysed subject with a single aggregated variable, facilitating the ranking of the analysed subjects (villages) based on the studied phenomenon; urgency of executing land consolidation and exchange initiatives.

By utilizing multivariate statistical analyses, local governments can pinpoint disparities and identify areas that necessitate interventions to remedy deficiencies, thereby accelerating development and bolstering competitiveness [Adamowicz and Janulewicz 2012].

To create a ranking of land consolidation work demand in the villages of the Abram\ u00f3w commune, factors that facilitated appropriate analysis were chosen: stimulants and dis-stimulants. The adopted factors are presented in Table 4.

Drawing upon two methodologies – the zeroing unitarization method and Hellwig method – a demand ranking for land consolidation work was generated for 11 villages within the commune of Abramów. The conventional categorization of normalization procedures comprises the following methods: standardization, unitarization, quotient transformations, and ranking methods. Unitary methods are distinguished by the adoption of a range of variables, which are categorized as stimulants, destimulants, and nominants [Kukuła 1999].

Table 4. Characteristics of the selected factors

Stimulants	General information	x_1	total area of the precinct in hectares,
		x_2	total number of plots
		x_3	number of inhabitants in the village
		x_4	number of inhabitants per 1 km^2
		x_5	percentage of land area of individual farms
		x_6	percentage of land plots of individual farms
		x_7	average plot area in group 7
	Information regarding land on individual farms	x_8	number of registration units in the subgroup 7.1
		x_9	percentage of registration units in subgroup 7.1
		x_{10}	number of plots of registered units of the subgroup 7.1
		x_{11}	area of plots of registered units of the subgroup 7.1
		x_{12}	percentage of the number of plots in subgroup 7.1 in relation to group 7
		x_{13}	percentage of the area of plots in subgroup 7.1 in relation to group 7
		x_{14}	average number of plots in the registration unit of the subgroup 7.1
		x_{15}	average area of the subgroup's registration unit 7.1
	Productivity index	x_{16}	arable land productivity index
		x_{17}	grassland productivity index
	Ownership	x_{18}	percentage share of group 1 lands in the ownership structure
		x_{19}	percentage share of group 4 lands in the ownership structure
	Plots without road access	x_{20}	percentage of the number of plots without road access
		x_{21}	percentage of the plot area without road access
Destimulants		x_{22}	fragmentation rate in villages
		x_{23}	percentage of orchards
		x_{24}	percentage of forests
		x_{25}	percentage of ditches

Source: Authors' own study

Boosters are variables that cause an increase in ranking for a given object. They are calculated by the formula:

$$Z = \frac{(x - x_{\min})}{(x_{\max} - x_{\min})}$$

Destimulants are the opposite of stimulants - they cause a decrease in the position of a given object and are calculated according to the following formula:

$$Z = \frac{(x_{\max} - x)}{(x_{\max} - x_{\min})}$$

where:

Z – normalized variable,
x – variable before normalization,
$x_{\max}$ – maximum value of the variable,
$x_{\min}$ – minimum value of the variable.

Using the stimulant and destimulant values for given objects, we can create a synthetic measure, which we calculate from the formula [Leń and Mika 2016]:

$$Z_i = 1p_i = 1p_{xiji} = 1, \ldots m$$

The derived synthetic measurement meter results for the specified objects fall within the range (0,1). These results can be regarded as ideal values in relation to the analysis of objects. Correspondingly, the highest synthetic measurement meter value corresponds to the highest position in the ranking, while the lowest value corresponds to the lowest position [Leń and Mika 2016].

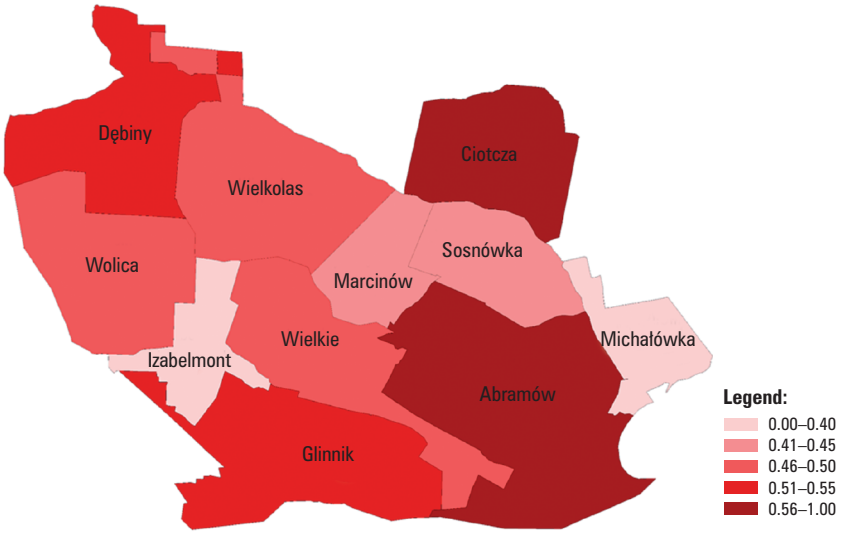
The analysis results of variables of the zero unitarization method are presented in Table 5 and Figure 4.

Table 5. Ranking of villages using the zero unitarization method

Ord.	Village name	Synthetic meter	Ranking position	Ord.	Village name	Synthetic meter	Ranking position
1	Abramów	0.59	1	7	Wolica	0.47	7
2	Ciotcza	0.56	2	8	Sosnówka	0.45	8
3	Dębiny	0.53	3	9	Marcinów	0.41	9
4	Glinnik	0.51	4	10	Izabelmont	0.38	10
5	Wielkie	0.48	5	11	Michałówka	0.36	11
6	Wielkolas	0.46	6				

Source: Authors' own study based on EGiB data

The subsequent technique for formulating a ranking of the demand for land consolidation is the Hellwig method. This method involves a synthetic measure of development, which enables the segregation of examined objects in terms of phenomena that cannot be measured with a single metric. It allows for the examined phenomena to be measured on an equal scale. Within the Hellwig method, both stimulant and destimulant features are considered, as outlined by Krakowiak-Bal [2005].



Source: Authors' own study

Fig. 4. Spatial image of research results (MUZ)

The initial phase of the Hellwig measure of development method entails determining the value of standards for subsequent calculations for stimulants and destimulants, respectively, using the following form:

$z_{oj} = z_{ij}$ if the feature is a stimulant,
$z_{oj} = z_{ij}$ if the feature is a destimulant,

The next step involves determining the taxonomic distance from the standard features for the intervals of spatial units. The following formula presents the equation for taxonomic distance [Krakowiak-Bal 2005]:

$$c_{io} = \left[\sum_{j=1}^{n} (z_{ij} - z_{oj}) \right]^{\frac{1}{2}}$$

Taxonomic distances for individual villages were used to calculate Hellwig's development measure:

$$d_i = 1 - \frac{c_{io}}{c_o}$$

where:

d_i – measure of Hellwig's development,
c_{io} – taxonomic distance,
c_o – critical distance of the unit from the standard, determined by the formula:

$$c_o = \underline{c_o} + 2s_d$$

where:

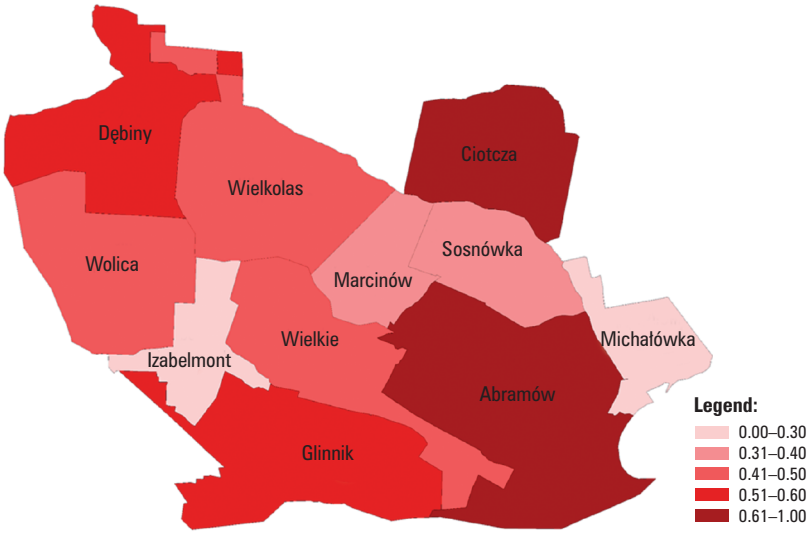
$$\underline{c_o} = \frac{1}{n}\sum_{j-1}^{n} c_{io} \qquad s_d = \left[\frac{1}{n}\sum_{j-1}^{n}(c_{io} - \underline{c_o})^2\right]^{\frac{1}{2}}$$

The values are in the range [0;1] The conclusion is that if the value is closer to this unity then the analysed object is close to the specified pattern. The obtained ranking according to the method of development measure according to Hellwig is presented in Table 6. The spatial image of the Hellwig method- development measure is presented in Figure 5.

Table 6. Ranking of demand for land consolidation work – Hellwig method

Ord.	Village name	Measure of development	Ranking position	Ord.	Village name	Measure of development	Ranking position
1	Abramów	1	1	7	Ciotcza	0.36	7
2	Glinnik	0.65	2	8	Wielkie	0.35	8
3	Sosnówka	0.57	3	9	Marcinów	0.25	9
4	Wolica	0.42	4	10	Izabelmont	0.22	10
5	Dębiny	0.41	5	11	Michałówka	0.21	11
6	Wielkolas	0.39	6				

Source: Authors' own study



Source: Authors' own study

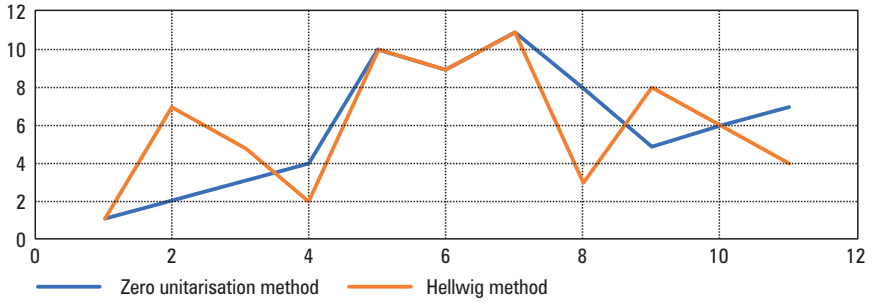
Fig. 5. Spatial image of research results (MUZ)

5. Results and discussion

As results from the data in Table 7 and Figure 6, in the following villages: Abramów, Izabelmont, Marcinów, Michałówka and Wielkolas, despite the use of another method for creating the ranking, the position of these locations has not changed. The greatest changes in the ranking positions can be seen in Ciotcza and Sosnówka. The sołectwo in Ciotcza has dropped by 5 positions, while Sosnówka has gained 5. For the rest of the locations, the positions have fluctuated by +/- 2 or +/- 3 positions. The differences between the rankings of demand using the example of the change in the position of the village are presented in Table 7.

Table 7. Comparison of the zero unitarization method and the Hellwig method ranking

Village	Abramów	Ciotcza	Dębiny	Glinnik	Izabelmont	Marcinów	Michałówka	Sosnówka	Wielkie	Wielkolas	Wolica
Zero unitarization method	1	2	3	4	10	9	11	8	5	6	7
Hellwig method	1	7	5	2	10	9	11	3	8	6	4
Position difference	none	–5	–2	+2	none	none	none	+5	–3	none	+3



Source: Authors' own study

Fig. 1. Comparison of the zero unitarisation method and the Hellwig method

An examination of the data presented in Table 8 reveals that the land fragmentation index for Glinnik, which is ranked second in the Hellwig method, is 3.59, whereas it is 4.19 for Ciotcza when the zero unitarization method is employed.

In the Hellwig method, the fragmentation index value for the village of Ciotcza is 4.19, resulting in a mere seventh place for the sołectwo in this methodology.

It is noteworthy that the trend observed in the Hellwig method, based on the fragmentation index plane, is one of decrease, with lower values corresponding to higher rankings. Conversely, the zero unitarization method exhibits the opposite trend.

Table 8. Detailed analysis of the results obtained from the study

Method		Hellwig						Zero unitarisation					
Rank	2	3	4	5	7	8	2	3	4	5	7	8	
Name	Glinnik	Sosnówka	Wolica	Dębiny	Ciotcza	Wielkie	Ciotcza	Dębiny	Glinnik	Wielkie	Wolica	Sosnówka	
x_1	1042.9	504.9	831.0	882.1	702.4	801.6	702.4	882.1	1042.9	801.6	831.0	504.9	
x_2	2676.0	2321.0	1437.0	1325.0	1127.0	1090.0	1127.0	1325.0	2676.0	1090.0	1437.0	2321.0	
x_3	421.0	289.0	463.0	276.0	365.0	463.0	365.0	276.0	421.0	463.0	463.0	289.0	
x_4	40.4	57.2	55.7	31.3	52.0	57.8	52.0	31.3	40.4	57.8	55.7	57.2	
x_5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
x_6	1.0	1.0	1.0	1.0	0.9	1.0	0.9	1.0	1.0	1.0	1.0	1.0	
x_7	0.4	0.2	0.6	0.7	0.6	0.7	0.6	0.7	0.4	0.7	0.6	0.2	
x_8	213.0	141.0	237.0	242.0	181.0	225.0	181.0	242.0	213.0	225.0	237.0	141.0	
x_9	0.3	0.4	0.5	0.7	0.6	0.5	0.6	0.7	0.3	0.5	0.5	0.4	
x_{10}	1930.0	1608.0	1049.0	1112.0	908.0	769.0	908.0	1112.0	1930.0	769.0	1049.0	1608.0	
x_{11}	852.0	424.2	662.4	802.9	633.3	675.5	633.3	802.9	852.0	675.5	662.4	424.2	
x_{12}	0.7	0.9	0.7	0.9	0.8	0.7	0.8	0.9	0.7	0.7	0.7	0.9	
x_{13}	0.8	0.7	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.8	0.7	
x_{14}	9.1	11.4	4.4	4.6	5.0	3.4	5.0	4.6	9.1	3.4	4.4	11.4	
x_{15}	4.0	3.0	2.8	3.3	3.5	3.0	3.5	3.3	4.0	3.0	2.8	3.0	
x_{16}	41.0	64.5	60.9	60.5	57.5	55.3	57.5	60.5	41.0	55.3	60.9	64.5	

x_{17}	48.9	57.6	56.7	55.2	51.9	48.3	51.9	55.2	48.9	48.3	56.7	57.6
x_{18}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x_{19}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x_{20}	0.1	0.0	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.0
x_{21}	0.1	0.0	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.0
x_{22}	3.6	3.5	4.5	4.2	4.2	4.2	4.2	4.2	3.6	4.2	4.5	3.5
x_{23}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x_{24}	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2
x_{25}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Authors' own study

Another factor where significant discrepancies can be observed is the proportion of registration units of subgroup 7.1 ($x9$). For instance, in the village of Ciotcza, the Hellwig method assigns a value of 0.6115, which corresponds to the 7th position, while the zero unitarization method assigns the same value to the 2nd position. Similar trends are observed for other factors, such as the productivity index of arable land and grasslands ($x18$, $x19$), the average area of the registered unit ($x8$), and the average number of plots in the registered unit ($x16$).

Upon examination of the calculated statistics, it can be inferred that the Hellwig method does not simultaneously consider the minimum and maximum values of the set, but only the minimum or maximum value according to the stimulant and destimulant terms. Conversely, the zero unitarization method incorporates both the minimum and maximum values from the set when calculating the components for the final calculations.

6. Conclusion

The principal objective of the research endeavour was to formulate a ranking system for gauging the demand for land consolidation initiatives within the villages that comprise the Abramów commune. The research findings revealed that, in terms of ownership structure, the largest share falls within Group 7, encompassing individuals' lands that collectively span an area of 8208.02 hectares, representing 97.15 percent. Within the context of land use, arable terrain emerged as the predominant category among the 19 distinct uses, covering an expanse of 5482.94 hectares, which translates to 64.90 percent of the entire cadastral unit.

The productivity index indicated the presence of high-quality soils across the Abramów commune, with respective indices of 53.30 for arable land and 51.30 for green areas. Notably, the village of Sosnówka exhibited the highest productivity index for arable land at 64.54, while Michałówka sołectwo registered the lowest at 31.70. Regarding green areas, Wielkolas claimed the highest productivity index of 61.64, while Michałówka, mirroring its standing in arable land productivity, registered the lowest value.

An examination of land fragmentation within registration group number 7 revealed an indicator of 3.99 for the communal area. However, when comparing individual villages, the overall area indicator was observed to be lower, with Wolica and Wielkolas sharing the highest indicator at an identical value of 4.45. Conversely, the lowest fragmentation was noted in Abramów, with an indicator of 3.00.

Furthermore, an analysis of land parcel accessibility to roads unveiled a significant concern within the region. The area encompassing parcels devoid of road access amounted to 900.77 hectares, representing 10.66 percent of the total land area. In terms of the number of parcels lacking road access, the figure stood at 2692, translating to 13.25 percent. Notably, the villages of Abramów and Wolica exhibited a road access issue exceeding the 20 percent threshold in terms of area, with Wolica also facing a substantial challenge in terms of the number of affected parcels, registering a value of 22.27 percent.

Further research endeavours have substantiated the necessity of implementing a land consolidation process. This conclusion was drawn based on a multitude of factors employed in formulating a ranking system to assess the demand for land consolidation initiatives within the villages of the Abramów commune. The research findings unequivocally indicated that Abramów exhibited the most pressing need for land consolidation interventions, a conclusion corroborated by two separate ranking methodologies. In both approaches, this village consistently secured the top position. The second position varied, with Ciotcza occupying it under the zero-rated unitary method, while Glinnik claimed it under the Hellwig method. According to the synthetic measure, the sołectwo of Dębiny secured the third position, while Sosnówka attained that ranking based on the development measure.

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