http://dx.doi.org/10.15576/GLL/2017.1.35

GLL

Geomatics, Landmanagement and Landscape No. 1 • 2017, 35–49

THE ANALYSIS OF CHOSEN FACTORS OF SPATIAL STRUCTURE OF RURAL AREAS IN VILLAGES OF CENTRAL POLAND

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Summary

The article presents a spatial analysis of rural areas in 14 villages in the Białaczów commune. The study has focused on land tenure and use as well as land fragmentation in private farms. On the basis of a synthetic fragmentation index of registered parcels a detailed research of private land fragmentation in villages of the Białaczów commune was carried out. The index calculated for each area allowed to distinguishing four types of villages. The types differ according to parcels' fragmentation, a factor that may be one of the criteria in establishing which villages require land consolidation and land exchange works in the first place.

Keywords

spatial structure of rural areas • land fragmentation • land consolidation

1. Introduction

Spatial state of today's village is the result of centuries-old human activity strictly connected with socio-economic relations and natural conditions of each era. To ensure his livelihood, man has been changing his natural landscape, while disregarding negative consequences of his activity. Each change, especially the one related to transformation of a village's spatial structure, is dependent on various factors resulting mainly from natural and structural as well as economic conditions, and from the level of urbanization and investment. The spatial factors include: shape and area of parcels, land ownership and use, land fragmentation and dispersion structure of private farms. Natural site-specific conditions are also important, such as the lie of the land and climatic conditions.

Rural areas in Poland have different spatial parameters depending on the region. For this reason detailed analyses are necessary to determine adequate factors indicating where comprehensive land consolidation and land exchange works are particularly urgent. Such studies essential since rural areas in Poland require deep structural changes, related to both agricultural production as well as size of farms, fields layout, demo-

graphic, spatial and institutional structure [Sobolewska-Mikulska 2009, Sobolewska-Mikulska and Wójcik 2012, Wójcik 2012]. Villages in south-eastern Poland are known for their high parcels' fragmentation [Leń 2010, Noga and Leń 2010, Leń and Mika 2016a, Siejka et al. 2015]. The research showed that it is where land in private farms is highly dispersed too (external land patchwork). In villages of the Brzozów district every fourth plot owned by private individuals is located in the external land patchwork [Leń 2009, 2012]. In a village located in the Ropczyce-Sędziszów district every fifth plot is owned by an external non-resident owner [Leń et al 2015b]. The study conducted in the Lesko district showed that in Olszanica 32% of plots are owned by external non-resident owners, which is 36% of the total area of the village [Leń et al. 2015a]. The study carried out in the Strzyżów district proved that in the Konieczkowa village 15.8% of all parcels are located in the external land patchwork, which is 17.7% of the total area of the village. On the other hand in the Lutcza village 19.9 of parcels belongs to external non-residents, which is 18.8% of the total area of the village [Leń et al. 2016].

Like in south-eastern Poland, land belonging to private farms in eastern Poland is also highly fragmented. In the Brzeziny village, Puchaczów district, small parcels of 0.11 to 0.2 ha dominate [Król 2014]. As the study showed, the land of private farms is located in the external land patchwork. In the Cyców commune, Łęczna district, the plots within external land patchwork make 46.1% of all parcels belonging to private land owners in the village. The surface area of land belonging to those who live outside the analysed commune is 5370.6 ha, which is 43.6% of the total area of the studied commune. The total number of external non-residents possessing land in the Cyców commune is 2671 persons. More than 40% of private farms' plots is owned by external non-residents [Noga and Król 2016]. Whereas in Cyców alone, 211 owners (external non-residents) possess 317 register plots of total area 264.89 ha, that is 28.6% of the total area of the village. It turned out that 351 inhabitants in the Cyców village possess 675 register plots of 874.42 ha [Król and Leń 2016]. Both the dispersion and unfavourable elongation of too small plots impede field works, which increases the costs of farming, related to plots layout, negatively influencing the measurable benefits derived from agricultural production [Król 2014].

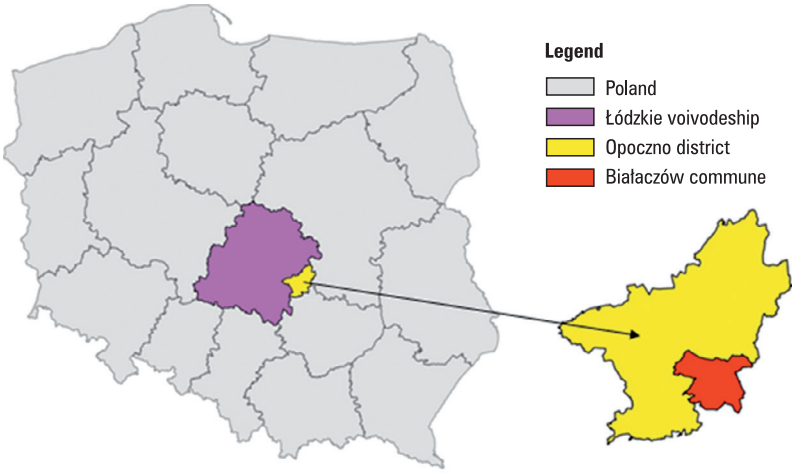
The studies conducted in villages of central Poland indicated that, like in eastern and south-eastern Poland, the land of private farms is located in the external land patchwork. In the Sławno commune within the external patchwork of land there are 40.9% of the total area of land in private farms, which make 43.1% of all plots in the private sector [Leń and Mika 2016b,c, 2017]. In the village of Brzustowiec, Drzewica commune, 26.9% of all parcels of private farms belong to external non-residents, which is 23.8% of all the area of private lands [Leń and Mika 2016d].

The goal of the article is to conduct a study of chosen spatial factors, such as the analysis of ownership, use and land fragmentation, with regard to land in private farms. The results will be used to determine the urgency of land consolidation works in the analysed area of central Poland, as it is an opportunity to properly organize the farms, while maintaining the natural environment. Land consolidation works ensure the proper conditions of sustainable and multifunctional development of rural areas by

limiting harmful influence of intensive agriculture on natural environment and also improves living and working standards of rural population [Wójcik and Leń 2015].

2. Characteristics of the research area

The commune Białaczów is located in the Opoczno district, in the south-eastern part of the Łódzkie voivodeship. The register surface area of the commune is 11483.6 ha, which is 11.0% of the total area of the district and 0.63% of the voivodeship. Spatial location of the studied commune is presented in Figure 1.



Source: authors' study

Fig. 1. Spatial location of the Białaczów commune

Białaczów is a rural commune, consisting of 14 subdivisions (sołectwo): Białaczów, Kuraszków, Miedzna Drewniana, Ossa, Parczów, Parczówek, Petrykozy, Radwan, Skronina, Sobień, Sędów, Wąglany, Zakrzów, Żelazowice. The commune has diverse natural and landscape values, because it is located in a transitional sphere between the uplands and lowlands. The region is suitable for development of tourism and recreation.

3. Detailed study

In villages of the Białaczów commune natural persons have the highest share in the ownership structure, the study shows. The surface area of private farms is 7690.1542, which is 67.0% of the whole area of the studied commune. Their percentage share across villages is diverse and ranges from 17.52% in Ossa to 94.3% in Żelazowice. The share of land in private farms that exceeds 90% was noted in Sędów (94.1%), Radwan

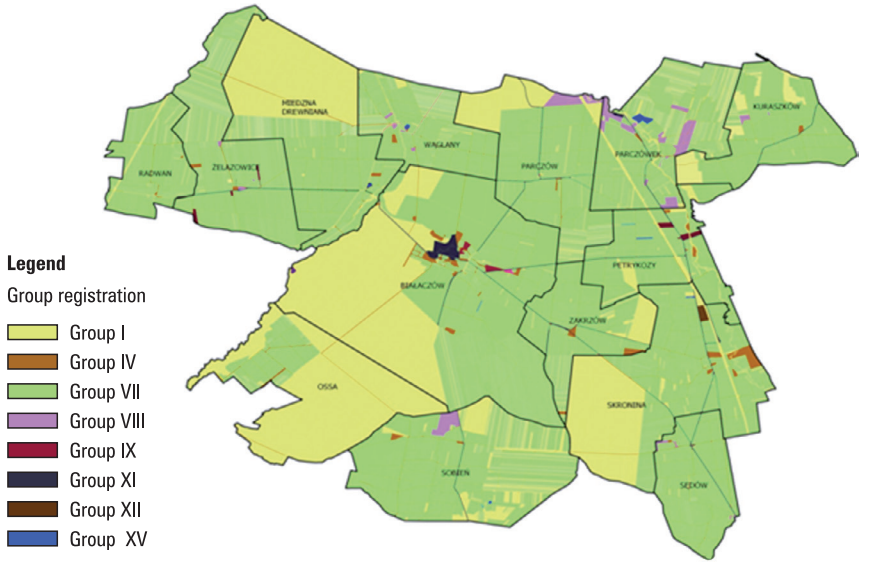
Table 1. Land ownership structure in villages of the Białaczów commune

No.	Village	Total area of land [ha]	Name of register group																			
			Land of State Treasury, excluding land given to perpetual usufruct		Land of companies wholly owned by the State Treasury, by state enterprises or other state legal entities.		Land of communes and intercommunal unions, excluding land given to perpetual usufruct		Land of communes and intercommunal unions given to perpetual usufruct		Land of natural persons		Land of cooperatives		Land of churches and religious associations		Land of land communities		Land of districts, excluding land given to perpetual usufruct		Land of voivodeship, excluding land given to perpetual usufruct		Land of other entities	
			Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
1	Białaczów	2214.9	926.3	41.8	–		44.5	2.0	–		1199.5	54.2	0.85	0.038	5.3	0.2	–		36.9	1.7	1.0	0.05	0.4	0.02
2	Kuraszków	570.5	82.8	14.5	–		14.7	2.6	–		465.8	81.6	–		–		3.1	0.5	3.9	0.7	–		–	0.00
3	Miedzna Drewniana	1057.5	521.9	49.4	–		20.6	1.9	–		511.9	48.4	0.03	0.003	–		–		2.2	0.2	–		0.8	0.07
4	Parczów	804.5	183.7	22.8	–		12.0	1.5	–		581.6	72.3	0.01	0.001	–		22.0	2.7	5.1	0.6	–		–	0.00
5	Parczówek	725.8	77.8	10.7	–		19.0	2.6	–		569.3	78.4	–		–		50.5	7.0	3.8	0.5	–		5.3	0.73
6	Petrykozy	518.7	53.2	10.3	–		13.5	2.6	–		435.3	83.9	0.02	0.003	8.0	1.5	–		7.3	1.4	–		1.3	0.24
7	Radwan	364.6	20.5	5.6	–		6.5	1.8	–		337.5	92.6	–		–		–		0.1	0.0	–		–	0.00
8	Skronina	1161.8	426.7	36.7	–		40.1	3.5	5.8	0.5	680.0	58.5	–		–		–		8.6	0.7	–		0.5	0.04
9	Sobień	1022.3	160.7	15.7	–		22.9	2.2	–		813.9	79.6	–		–		19.8	1.9	4.3	0.4	–		0.5	0.04

10	Sędów	437.3	3.3	0.8	–		14.2	3.2	–		411.7	94.1	–		–		3.3	0.8	4.7	1.1	–		–	0.00
11	Wąglany	480.6	22.8	4.7	–		15.8	3.3	–		435.0	90.5	–		–		3.1	0.6	–		2.9	0.60	1.0	0.20
12	Zakrzów	469.1	63.4	13.5	–		16.3	3.5	–		385.0	82.1	–		–		–		4.3	0.9	–		–	0.00
13	Żelazowice	746.7	20.8	2.8	–		12.0	1.6	–		704.0	94.3	–		4.6	0.6	2.1	0.3	2.9	0.4	–		0.1	0.01
14	Ossa	908.8	735.8	81.0	0.7	0.1	13.0	–	–		159.2	17.5	–		–		–		–		–		–	0.00
Total:		11483.1	3299.7	28.7	0.7	0.1	265.1	2.3	5.8	0.5	7689.7	67.0	0.91	0.008	17.9	0.2	103.9	0.9	84.1	0.7	3.9	0.03	9.7	0.08

Source: authors' study based on data from Land and Building Register (EGiB)

(92.5%), Wąglany (90.5%). The State Treasury land represents 28.7% (3299.7 ha), and it is mainly land belonging to Agricultural Property Agency of Treasury and The State Forests National Forest Holding. This hierarchy is maintained in every village, with the exception of Ossa, where the share of natural persons' land is only 17.5% (159.2%), whereas the State Treasury possess as much as 80.97% (735.8600 ha). In Białaczów and Miedzna Drewniana the share of these two register groups is relatively balanced. In every village of the studied commune the remaining register groups cover small areas. The spatial ownership structure in the villages of Białaczów commune is illustrated in Figure 2.

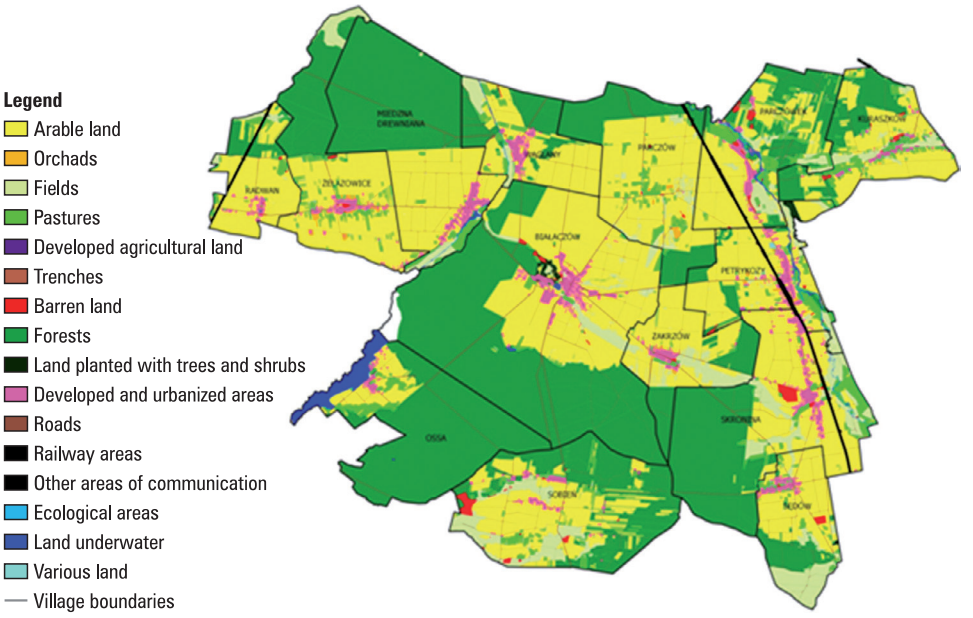


Source: authors' study made in QGIS software

Fig. 2. Spatial image of land ownership structure

The study of the ownership structure shows (Table 2) that the Białaczów commune is a typically agricultural area, with domination of cultivated land (54.16%), the largest part of which is arable land (40.23%), and the smallest share belongs to the land under ditches (0.19%). Another significant group are forest land and land planted with trees and shrubs, making 31.39%, out of which 41.11% is forest land, whereas land planted with trees and shrubs covers the remaining 0.28%. The overall share of developed and urbanized land is 3.07%, the largest part of which were roads (2.44%), and the smallest – industrial areas (0.01%). Land under water covers 1.35% of all the area, out which 0.31% are surface flowing waters, and 1.03% surface stagnant waters. The lowest percentage share in the structure of land use belongs to ecological land (0.02%) and various land (0.01%). The ways of using lands depend on climatic conditions, location

and lie of the land, and these are relatively favourable in the analysed commune. More than two thirds of private farms, occupying altogether 7689.7 ha, exercise only agricultural activity. In the commune recreational and rural tourism activity is also practised, a consequence of high afforestation rate and the use of water reservoirs for recreational purposes. Roads also play an important role in the structure of land use. Their route influences not only the location of buildings but also access to fields from farmsteads. The spatial image of land use in villages of the Białaczów commune is presented in Figure 3.



Source: authors' study in the QGIS software

Fig. 3. Structure of land use in studied villages

The analysis of land fragmentation was carried out with regard to land belonging to private farms (Table 3). The study covered 14573 register plots, or 79.3% of total number of plots in the studied commune. From the data presented in Table 3 it can be concluded that most plots, 34.6% of their total number, are the ones with an area from 0.11 to 0.30 ha. The percentage share in this range is very diverse and fluctuates from 21.7% in Kuraszków village, up to 45.8% in Parczówek village. The studies show that the share of plots in specific surface range in each village is very diverse.

Table 2. Structure of land use in the Białaczów commune

No.	Village	Total area of land [ha]	Agricultural land								Forest land, land planted with trees and shrubs			Developed and urbanized land									Ecological land	Land under water			Various land
			Arable land	Orchardsy	Permanent meadows	Permanent pastures	Developed agricultural land	Land under ditches	Wasteland	Total	Forests	Land planted with trees and shrubs	Total	Residential area	Industrial areas	Other developed area	Recreational areas	Communication areas			Total		Suface, flowing	Surface, stagnant	Total	
																		Roads	Railroad areas	Other communication areas						
1	Białaczów	2214.9	775.2	6.7	55.8	16.1	40.2	2.5	5.3	901.8	1195.5	14.9	1210.3	1.4	–	1.9	3.9	48.6	–	–	55.8	1.5	–	45.5	45.5	–
2	Kuraszków	570.5	264.1	6.5	37.6	55.0	11.2	1.3	5.0	830.7	172.6	–	172.6	0.1	–	–	–	17.1	–	–	17.2	–	–	–	–	–
3	Miedzna Drewniana	1057.5	329.9	1.6	21.1	26.1	27.5	–	0.3	406.5	617.3	1.9	619.2	0.2	–	0.7	–	24.5	–	–	25.4	0.1	6.3	–	6.3	–
4	Parczów	804.6	433.9	11.1	37.7	30.9	17.9	0.3	1.5	533.4	243.5	1.6	245.1	0.1	–	0.0	–	20.6	4.3	–	25.1	–	1.0	–	1.0	–
5	Parczówek	725.9	319.0	1.3	55.3	66.5	18.4	1.4	10.4	472.4	206.3	0.0	206.4	0.6	1.7	0.0	–	22.9	11.2	–	36.5	–	10.7	–	10.7	–
6	Petrykozy	518.7	305.5	19.4	36.5	32.0	23.8	0.4	2.4	419.8	53.6	4.0	57.7	0.3	–	0.9	–	16.9	12.1	–	30.3	–	9.6	–	9.6	1.3
7	Radwan	364.7	236.5	11.4	11.0	22.9	8.2	1.5	1.4	292.9	52.2	–	52.2	–	–	0.1	–	7.8	11.5	–	19.4	–	–	0.2	0.2	–
8	Skronina	1161.9	421.5	1.4	103.6	59.9	17.9	0.8	13.9	619.0	491.4	1.1	492.6	1.0	–	0.9	–	26.5	–	17.2	45.6	0.5	4.3	–	4.3	–
9	Sobień	1022.3	372.2	11.3	112.2	37.2	15.0	7.3	16.5	571.7	425.3	–	425.3	–	–	–	–	24.6	–	–	24.6	–	0.8	–	0.8	–
10	Sędów	437.4	213.6	3.0	86.5	20.1	10.5	2.1	3.7	339.5	79.3	0.7	79.9	–	–	0.2	–	17.7	–	–	17.9	–	–	–	–	–

11	Wąglany	480.7	227.3	3.3	33.0	22.8	23.8	1.6	3.7	315.6	144.9	2.7	147.6	0.1	–	–	–	17.3	–	–	17.4	–	3.1	–	3.1	–
12	Zakrzów	469.2	243.2	4.1	65.8	7.7	13.6	1.1	0.8	336.3	121.2	–	121.2	–	–	–	–	11.6	–	–	11.6	–	–	–	–	–
13	Żelazowice	746.7	385.5	17.9	34.0	39.3	20.5	1.5	2.6	501.2	228.7	2.3	231.0	0.3	–	0.4	0.2	13.2	–	–	14.1	–	0.4	–	0.4	–
14	Ossa	908.8	92.6	0.9	0.3	29.4	8.7	0.4	–	132.3	688.9	2.8	691.7	0.5	–	0.4	–	10.9	–	–	11.8	–	–	73.1	73.1	–
Total		11483.6	4620.0	99.9	690.5	465.8	257.1	22.2	64.6	6220.0	4720.7	32.0	4752.7	4.7	1.7	5.4	4.2	280.3	39.2	17.2	352.6	2.1	36.1	118.8	154.8	1.3
Percentage share of land use h			40.23	0.87	6.01	4.06	2.24	0.19	0.56	54.16	41.11	0.28	41.39	0.04	0.01	0.05	0.04	2.44	0.34	0.15	3.07	0.02	0.31	1.03	1.35	0.01

Source: authors' study based on data from Land and Building Register (EGiB)

Table 3. The number of plots in particular area range

No.	Village	No. of plots in private farms	Surface ranges of plots [ha]									
			to 0.10		0.11–0.30		0.31–0.60		0.61–1.00		above 1.01	
			No.	%	No.	%	No.	%	No.	%	No.	%
1	Białaczów	1712	555	32.4	390	22.8	406	23.7	315	18.4	167	9.8
2	Kuraszków	437	13	3.0	95	21.7	105	24.0	77	17.6	153	35.0
3	Miedzna Drewniana	1428	552	38.7	402	28.2	294	20.6	212	14.8	78	5.5
4	Parczów	816	57	7.0	270	33.1	230	28.2	199	24.4	157	19.2
5	Parczówek	1804	547	30.3	827	45.8	426	23.6	159	8.8	56	3.1
6	Petrykozy	600	69	11.5	185	30.8	152	25.3	135	22.5	96	16.0
7	Radwan	647	157	24.3	193	29.8	134	20.7	75	11.6	95	14.7
8	Skronina	1370	88	6.4	496	36.2	466	34.0	232	16.9	136	9.9
9	Sobień	1144	187	16.3	320	28.0	271	23.7	243	21.2	210	18.4
10	Sędów	746	47	6.3	236	31.6	269	36.1	185	24.8	66	8.8
11	Wąglany	1256	441	35.1	555	44.2	243	19.3	128	10.2	66	5.3
12	Zakrzów	588	52	8.8	234	39.8	141	24.0	120	20.4	108	18.4
13	Żelazowice	1472	291	19.8	601	40.8	380	25.8	195	13.2	167	11.3
14	Ossa	553	205	37.1	236	42.7	57	10.3	47	8.5	33	6.0
Total		14573	3261	22.4	5040	34.6	3574	24.5	2322	15.9	1588	10.9

Source: authors' study based on Land and Building Register (EGiB)

The area of plot is decisive of labour input. In the EU countries the surface area of plots ranges from 0.8 to 10.0 ha. The scope of this diversity depends mainly on the surface area of a farm and its specialization, degree of mechanization of field works, lie of the land and field invariants. With the increase of a plot's area the work becomes less time-consuming and deduction in plot's value is smaller [Noga 2005]. Detailed characteristics of plots' area in the villages of the Białaczów commune is presented in Table 4.

Table 4. The area of private farms

No.	Village name	Area of plots in private farms	Area range of plots [ha]									
			to 0.10		0.11–0.30		0.31–0.60		0.61–1.00		above 1.01	
			No.	%	No.	%	No.	%	No.	%	No.	%
1	Białaczów	1150.0	28.3	2.5	77.0	6.7	179.6	15.6	240.5	20.9	674.1	58.6
2	Kuraszków	462.9	1.1	0.2	20.3	4.4	46.1	10.0	61.3	13.2	337.1	72.8
3	Miedzna Drewniana	485.1	27.9	5.8	75.4	15.5	135.3	27.9	164.8	34.0	108.5	22.4
4	Parczów	536.7	3.9	0.7	54.0	10.1	102.1	19.0	161.9	30.2	259.8	48.4
5	Parczówek	517.4	28.5	5.5	157.5	30.4	181.0	35.0	120.0	23.2	82.3	15.9

6	Petrykozy	418.2	4.6	1.1	39.5	9.4	66.8	16.0	106.2	25.4	218.2	52.2
7	Radwan	334.1	8.1	2.4	36.9	11.0	59.0	17.7	57.5	17.2	176.0	52.7
8	Skronina	654.7	6.2	1.0	99.0	15.1	208.0	31.8	182.5	27.9	184.2	28.1
9	Sobień	770.5	10.1	1.3	65.1	8.4	120.4	15.6	187.6	24.3	430.8	55.9
10	Sędów	384.3	3.3	0.9	51.6	13.4	118.1	30.7	142.9	37.2	95.8	24.9
11	Wąglany	388.7	27.9	7.2	107.7	27.7	106.4	27.4	100.7	25.9	92.3	23.7
12	Zakrzów	360.3	3.3	0.9	46.6	12.9	61.1	17.0	93.8	26.0	180.2	50.0
13	Żelazowice	632.7	17.4	2.7	115.4	18.2	170.0	26.9	147.6	23.3	253.6	40.1
14	Ossa	151.6	13.9	9.1	41.5	27.4	24.2	15.9	36.7	24.2	43.0	28.4
Total		7247.4	184.5	**2.5**	987.7	**13.6**	1578.0	**21.8**	1804.1	**24.9**	3136.0	**43.3**

Source: Authors' study based on Land and Building Register (EgiB)

The study showed that the highest percentage (43.3%) are plots larger than 1.0 ha. Their area is 3136.0 ha. The percentage varies greatly according to a village and it ranges from 15.9% in Parczówek, up to 72.8% in Kuraszków. Plots up to 0.10 ha constitute only 2.5% of the total land area of private farms. In five villages the analysed area range is smaller than 1% of the overall area. The spatial image of land fragmentation in private farms, with respect to area of plots, is illustrated in Figure 4.

Source: authors' study made in QGIS software

Fig. 4. Land fragmentation in private farms

To acquire more specific and detailed results a synthetic index of land fragmentation in all villages of the Białaczów commune has been calculated according to a formula presented in Noga and Leń [2010]. On the basis of the calculated synthetic measure 4 types of villages were singled out. First with a value to 3.50; second in the range 3.51–4.00; third from 4.01 to 4.50, and fourth – above 4.51. The ranges assigned to each village, together with the value of land fragmentation index, is presented in Table 5.

Table 5. Land fragmentation index in the Białaczów commune

Village	Fragmentation index	Type
Parczówek	3.16	I
Wąglany	3.31	I
Ossa	3.34	I
Miedzna Drewniana	3.50	I
Skronina	3.63	II
Sędów	3.68	II
Żelazowice	3.71	II
Radwan	4.06	III
Zakrzów	4.09	III
Parczów	4.10	III
Petrykozy	4.15	III
Sobień	4.20	III
Białaczów	4.24	III
Kuraszków	4.54	IV

Source: authors' study

The above classification is aimed at singling out villages with similar spatial structure and determining the variation degree in the commune and consequently establishing the demand for comprehensive works of land consolidation and exchange. The set of features typical of particular villages and their percentage share allowed to make general characteristics of the studied area.

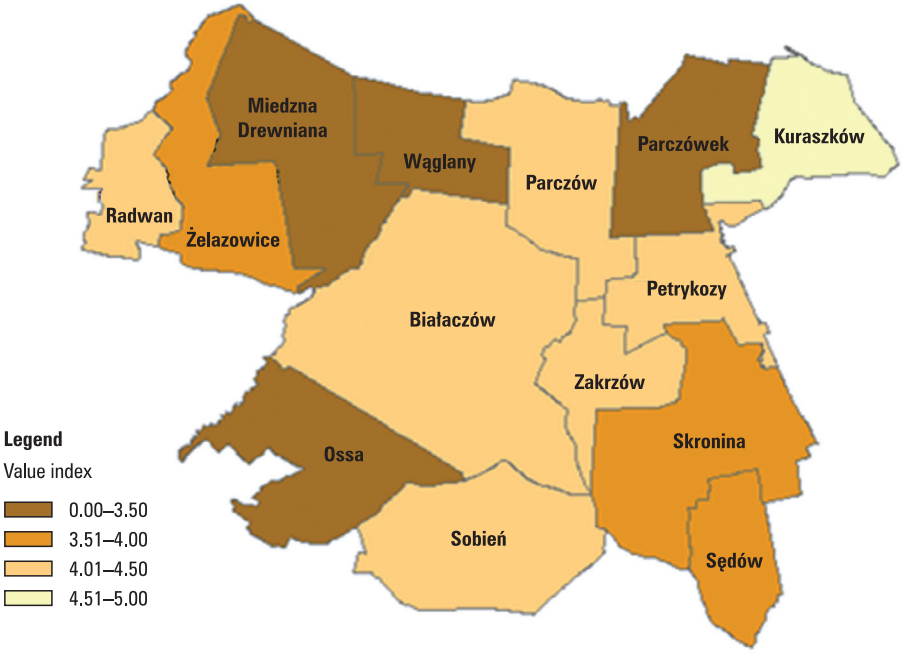
Table 6 and Figure 5 show that the first type of villages consist of 4 villages of total area 1542.85 ha and has the second highest share in total number of plots in the commune. The mean area of plots in this area range is the smallest with 0.31 ha. The second type consists of villages located close to borders of the commune, and takes more than 20% both of the total area and number of plots in the studied area. The most numerous group are villages belonging to the third area range. It consists of 6 villages

taking up almost 50% of the total area of the commune and nearly 40% of total number of its plots. These villages are mainly Białaczów and neighbouring ones: Zakrzów, Parczów and Petrykozy. The highest value of fragmentation index, belonging to the last type, was noted in Kuraszków, the village up to the north-east, with the lowest number of plots in private land.

Table 6. Characteristics of selected types of villages

Village type	Villages of one type		Area of villages of one type		Plots of one type		Mean area of plots [ha]
	No.	%	No. [ha]	%	No.	%	
I	4	28.57	1542.85	21.29	5041	34.59	0.31
II	3	21.43	1671.81	23.07	3588	24.62	0.47
III	6	42.86	3569.82	49.26	5507	37.79	0.65
IV	1	7.14	462.94	6.39	437	3.00	1.06
Razem	**14**	**100.00**	**7247.42**	**100.00**	**14573**	**100.00**	**0.50**

Source: authors' study



Source: authors' study

Fig. 5. Spatial variation of land fragmentation index in villages of the Białaczów commune

4. Conclusions

The conducted studies showed that not only southern or south-eastern Poland require spatial restructuring of rural areas. The analysis indicated that land of central Poland is characterized by very high percentage of land belonging to private farms. In 50% of studied villages private land constitutes 80% of their total area. In four cases the percentage reached over 90%. In the structure of land use the studied area is highly diverse. Arable land constitutes more than 40% of the total area of the commune, while forest land covers 41.1%. The study on land fragmentation in private farms showed that land fragmentation is considerably smaller in comparison with land of private farms located in the south and south-eastern Poland. The analysis revealed very high diversity in particular villages of the studied area. Therefore it was necessary to calculate the synthetic land fragmentation index, that was used to classify villages into types, and this allowed to notice relationships and similarities occurring in the studied area and to assess the state of plots' fragmentation in the private sector. The obtained value of the synthetic index of fragmentation will be one of many factors taken into consideration in determining the urgency of land consolidation works in villages in the Białaczów commune. It is noteworthy that plots in private farms of the Białaczów commune have a very flawed geometry, because of their excessive elongation.

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