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USE OF QUANTUM GIS TO ASSESS THE SPATIAL STRUCTURE OF RURAL AREAS ON THE EXAMPLE OF THE KELYANIVKA VILLAGE

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У статті здійснено оцінювання просторової структури села Келянівка (Польща) з використанням крос-платформи геоінформаційної системи Quantum GIS. Аналіз використання земель показав, що село Келянівка є типовим сільськогосподарським районом, так як 88,35% загальної площі є орні землі. На основі результатів дослідження отримано інформацію про населений пункт, яка після її інтерпретування виступає основою для оцінки просторової структури розвитку цієї території.

Ключові слова: геоінформаційна система, аналіз, просторова структура, сільські території.

One of the main drawbacks of the spatial structure of rural areas in Poland is excessive fragmentation of land holdings. The issue is particularly evident in the south and south-east of Poland, other areas of the country are also affected by this phenomenon, but to a lesser extent. Podkarpackie Voivodeship is characterized by farms with small areas. Fragmentation and dispersion of farms land plots leads to an increase in the value of crop production, resulting in income from agricultural production is very low, or even scanty. Often, costs are rising at a level that interferes with the maintenance of the production of cost-effective, even for families with a relatively large area of land [Harasimowicz S., Janus J. 2012]. The decisive factor in the fragmentation of the area of the economy is the excessive overcrowding of the village. The development of the industrial sector has not taken over the surplus labor from rural areas, and as a result contributed to the further refinement of farms [Noga K. 1985].

Household plots located in Subcarpathia are very often have an irregular shape, characterized by small size [Len P. 2010, Len P., Noga K. 2010] and a high degree of fragmentation. The layout and condition of the road network, often makes it impossible to access equipment and agricultural machinery serving farmlands. Such circumstances impede the development of farms and the production of the crop requires huge financial investments and labor costs. The dif-

ficulties caused by the excessive fragmentation and dispersion of farms, should be eliminated by performing the consolidation and land exchange. Such procedures and farm equipment, would greatly facilitate and improve the cultivation, further improvement of the spatial structure of the village, as well as to improve the quality and living conditions.

The purpose of this paper is to use GIS Quantum in the evaluation of the spatial structure of rural areas. The study was carried out on the example of Kelyanivka village, which is part of the municipality Boguchwala Pent County.

Characteristics of the Boguchwala municipality Kelyanivka village

Kelyanivka village is located in the Podkarpackie Voivodeship, in the northern part of the district of Rzeszow Boguchwala municipality (Figure 1). From the north, it adjoins to the village Przybyszowka, to the east of Staroniwa settlement, and from the north and west it is adjacent to the village Raclawowka. The area of settlement covers an area of 374.44 hectares.

Kelyanivka village is located on the hilly terrain, the hills reach 250 m above sea level. Lands of Kelyanivka belong to the III land class. This is good and average quality arable soils. Kelyanivka village in terms of climate is one of the sub-region of Sandomierz Basin, which is characterized by warm summers and plenty of sunshine. This is an area with a temperate cli-



Fig. 1. Spatial distribution of the analyzed settlement

Source: www.boguchwala.pl

mate, under the influence of continental climate. Average rainfall is about 680 mm per year. The growing season ranges between 210–220 days. The average annual temperature is 7,5°C. Months of vegetation in Kelyanivka and surrounding areas: May, June, July, August and September [Wiktor A., Wnęk S. 1998].

Analysis of the spatial structure of these rural areas

The structure of land ownership.

Analysis of the structure of land ownership in the Kelyanivka village is based on data from the register of land and buildings received from the district center of the county records of Geodesy and Cartography in Rzeszów. 7 groups of landowners, registered in the village Kelyanivka have been identified with the help of these data (Figure 2).

Use of Quantum GIS has made it possible to introduce land tenure by groups registration. Lands owned by the State Treasury occupy 1.8701 hectares, accounting for only 0.5% of the total area of settlement. 108 plots with a total area of 8.3980 ha (2.24%) belong to the municipal entities and associations. Analysis has shown that 1329 from 1488 land parcels are of ownership of physical persons. Land plots of this group covers an area of 345.3903 hectares, which is 92.27%

of the total investigated territory. The smallest square is occupied by land belonging to the church, they represent only 0.10% of the total area. Cooperatives lands occupy 4.8006 hectares, accounting for 1.28% of the area of the village Kelyanivka. 10.4985 hectares of land is owned by commercial companies (Figure 2, Table 1).

Land Use Structure

The structure of land use is a reflection of natural conditions of the area and the state of human intervention in the environment. The highest percentage in Kelyanivka village falls on arable land. They occupy 330.7254 hectares, which is 88.35% of the total area of the analyzed rural area. It consists of arable lands, which occupy 203.6143 ha (54.40%), pastures 62.1714 ha (16.61%), meadows 36.9026 ha (9.86%), agricultural buildings 0.8476 ha (0.23%), covered with forest vegetation and shrubs on agricultural lands 14.9813 hectares (4.00%), gardens 11.0594 ha (2.95%), ponds 0.6100 hectares (0.16%), channels 0.1155 hectares (0.03%) and uncultivated land, representing 0.11% of the total area of the Kelyanivka village (0.4233 hectares). Among the lands of built-up urban areas, in rural areas, there are only roads, which occupy 7.1012 ha (1.90%) and residential areas constituting 9.32% of the total area of the village Kelyanivka (34.8888 hectares).



Fig. 2. The three-dimensional image of the structure of land use
Source: own research.

Table 1

The structure of land ownership in the Kelyanivka village in 2014

Group Number	Registry Name	Number of sites	Area of group [ha]	Structure [%]
1	Land of State, except land transferred in perpetual usufruct.	17	1,9	0,50%
4	Land of municipalities and associations with the exception of land transferred in perpetual usufruct.	108	8,4	2,24%
7	Land of physical persons.	1329	345,4	92,27%
8	Land of cooperatives.	15	4,8	1,28%
9	Land of Churches and religious communities.	5	0,4	0,10%
11	County land, except land transferred in perpetual usufruct.	2	3,0	0,79%
15	Land subject to the right of ownership and possession of the persons referred to in paragraph. 1–14.	12	10,5	2,80%
Total:		1488	374,3	100,00%

Source: Own study based on data from PODGiK

Lands under water bodies represent 0.43% of the total area of the village, covering an area of 1.6021 ha. Analysis of land use patterns in rural areas is shown in Table 2.

The structure of land fragmentation
Fragmentation of lands is becoming more problematic for Polish villages. This is a very negative phenomenon causes difficulties and

Table 2

Land use structure in the village Kelyanivka 2014

Registry group	The total land area	Smallholding									
		Arable land		Gardens		Meadows		Pastures		agricultural buildings	
	[ha]	[ha]	[%]	[ha]	[%]	[ha]	[%]	[ha]	[%]	[ha]	[%]
1	1,9	0,27	14,4	0,3	16,0	0,27	14,4	0,08	4,28	–	–
4	8,4	0,22	2,62	–	–	1,03	12,3	0,75	8,9	–	–
7	345,4	193,5	56	10,8	3,12	34	9,85	58,8	17	0,85	0,25
8	4,8	1,13	23,6	–	–	0,15	3,12	1,98	41,4	–	–
9	0,4	0,07	18	–	–	–	–	0,11	28,2	–	–
11	3,0	–	–	–	–	–	–	–	–	–	–
15	10,5	8,46	80,6	–	–	1,42	13,5	0,4	3,84	–	–
Total:	374,3	203,61	54,40	11,06	2,95	36,90	9,86	62,17	16,61	0,85	0,23
	100,0	330,7									

Smallholding						Fallow Lands		Land for construction				Land under water bodies	
Land under ponds		Land under channels		Land under trees and shrubs				Residential areas		Roads			
[ha]	[%]	[ha]	[%]	[ha]	[%]	[ha]	[%]	[ha]	[%]	[ha]	[%]	[ha]	[%]
–	–	0	0,12	0,12	6,42	–	–	–	–	0,006	0,31	0,822	43,96
–	–	0,05	0,6	0,32	3,81	0	0,5	1,085	12,92	4,125	49,12	0,78	9,29
0,61	0,18	0,06	0,02	14,4	4,17	0,4	0,1	32,01	9,27	–	–	–	–
–	–	–	–	0,15	3,19	–	–	1,378	28,7	–	–	–	–
–	–	–	–	–	–	–	–	0,21	53,85	–	–	–	–
–	–	–	–	–	–	–	–	–	–	2,97	100	–	–
–	–	–	–	–	–	0	0,1	0,204	1,95	–	–	–	–
0,61	0,16	0,12	0,03	14,98	4,00	0,42	0,11	34,89	9,32	7,10	1,90	1,60	0,43
88,4								42,0		11,2		1,6	

Source: Own study based on data from PODGiK.

restrictions in agriculture. It is characterized by a continuous increase in the number of areas with a small area in the region [Harasimovich C., Janus J. 2012]. The analysis has shown the need for the implementation of measures to consolidate, as fragmentation of land plots for individual farms in the Kelyanivka village is very significant. The data required for analysis were provided by regional Documentation Centre of Geodesy and Cartography in Rzeszowie.

The village Kelyanivka counts 1488 plots with total area of 374.3175 hectares. Lands owned by individuals occupy a total area of 345.3903 hectares, which is 92.27% of the total land area. The average area of land in the register group 7 is 0.26 hectares. Analysis of the data toward

lands fragmentation in the village is shown in Figure 3.

On the basis of the data presented in Table 3 shows that the largest group are the areas less than 0.1 hectares, the average size of these plots is 0.0515 ha and covers 31.83% of all land in the analyzed group. The amount of land plots is 423 and occupies 6.31% of the total group area. Land plots in the range of 0.10 to 0.20 m were 360 sites that are at a level of 27.09% of all sites belonging to the register group 7. The next group of areas ranging from 0.20 to 0.30 m. They represent 15.92% of the total land area in the analyzed group and include 16.40% of the surveyed sites. The largest area (93.3497 hectares) occupy areas ranging from 0.30 to 0.60 hectares, they comprise

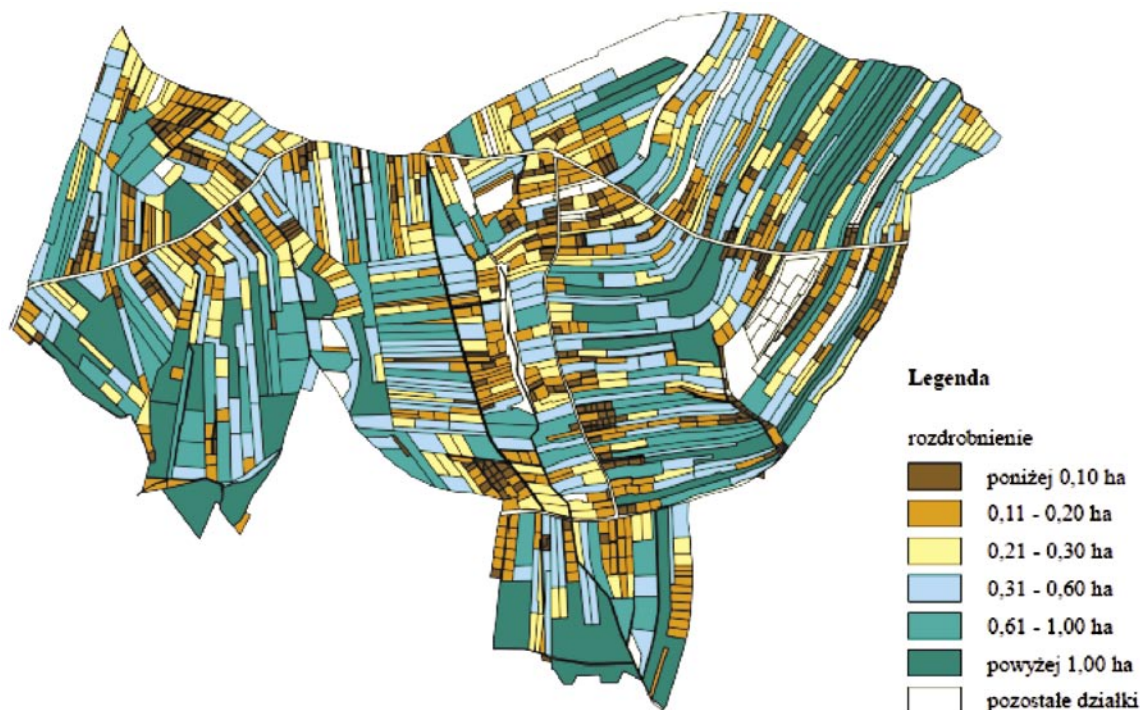


Fig. 3. The three-dimensional image of the lands fragmentation in the Kelyanivka village
 Source: Own study based on data from EGiB

Table 3

The structure of land fragmentation in Kelyanivka village within groups by size of land plots, 2014

The name of the village	Gradation of plot	Data on the number of land plots		The average size of land [ha]	Data on land plots structure	
		Number of sites	[%]		[ha]	[%]
Kelyanivka	less 0,10 ha	423	31,8	0,05	21,8	6,3
	0,10–0,20 ha	360	27,1	0,15	52,4	15,2
	0,20–0,30 ha	218	16,4	0,25	55,0	15,9
	0,30–0,60 ha	211	15,9	0,44	93,3	27,0
	0,60–1,00 ha	81	6,1	0,79	63,8	18,5
	over 1,00 ha	36	2,7	1,64	59,1	17,1
	Total	1329	100,0	0,26	345,4	100,0

Source: Own study based on data from PODGiK

27.03% of the total land area, located in the property of physical persons and constitute 15.88% of all sites. The second group on the land area, ie, 63.7521 hectares of land in the range of 0.60 to 1.00 hectares. They represent 18.46% of the total area of all regions in the analyzed group, their average size is equal to 0.7871 hectares. The smallest group is the group of land plots in excess of 1.00 hectares. They are formed at the level of 2.71% of all the sites and make up 17.10% of the total area belonging to individuals.

CONCLUSIONS

The article analyzes the spatial structure of the village Kelyanivka. Part of the images was created using Quantum GIS, which greatly improved the visualization of results. The necessary data were obtained from the regional center of Geodesy and Cartography documentation in Rzeszowie.

Analysis of land use showed that about 92.27% of the total area of land owned by private individuals, occupying an area equal to 345.3903 hec-

tares. Analysis of land use showed that Kelyanivka is a typical agricultural area, as 88.35% of the total area is arable land. The greatest number of land plots in the range up to 0.10 hectares, which is equivalent to an enormous fragmentation of the analyzed locality. The highest dispersion of lands is considered in the range of over 2.00 m.

Using Quantum GIS program, we can quickly and easily analyze the various areas. Based on the results and conclusions from them, we can take appropriate action. It is based on the results of the analysis, it is clear that the land in the village Kelyanivka resembles a chessboard. Thanks to comprehensive measures to consolidate and unite, of course, the spatial structure would be greatly improved, and it would be more useful for farmers and rural residents of Kelyanivka.

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УДОСКОНАЛЕННЯ СИСТЕМИ ПРИРОДНО-СІЛЬСЬКОГОСПОДАРСЬКОГО РАЙОНУВАННЯ В РОЗРІЗІ АДМІНІСТРАТИВНО-ТЕРИТОРІАЛЬНОГО ПОДІЛУ

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Проведено аналіз природних умов, структури земельного фонду, ґрунтового покриву та наявності ерозії ґрунтів правобережної лісостепової частини Київської області. Запропоновано коригування існуючих меж природно-сільськогосподарських районів із врахуванням ґрунтового покриву, ерозії ґрунтів та адміністративного поділу території.

Ключові слова: *природно-сільськогосподарське районування, деградація земель, водна ерозія, охорона сільськогосподарських земель, зонування території.*

Розвиток агропромислового комплексу залежить від багатьох чинників, у тому числі й від правильної організації використання земель: обґрунтованого екологічнобезпечного, ефективного використання та охорони кожного гектара сільськогосподарських угідь. Це потребує врахування територіальних, економічних, екологічних і соціальних чинників, які впливають на стан земель та їхню продуктивність.

Основою такого використання сільськогосподарських угідь є природно-сільськогосподарське районування. Це основа для оцінки земель, розроблення землевпорядної документації щодо використання та охорони земель, розміщення систем ведення сільського господарства і землеробства [6]. Основна мета районування полягає в тому, щоб виділити найдрібніші таксономічні одиниці, які організаційно