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THE IMPACT OF SPATIAL STRUCTURE OF AGRICULTURAL PLOTS ON DEVELOPMENT OPPORTUNITIES IN RURAL AREAS, CASE STUDY

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Abstract

Over the recent years, rural space has been a subject to continuous changes, both at the structural and qualitative level. The way Polish rural areas look today results from long-lasting changes determined not only by historical, but also social or economic factors. The areas currently face a number of problems, including unfavourable ownership structure.

The purpose of the study was the analysis of the spatial structure of agricultural parcels, and the assessment of its effect on the possibilities of development of selected study areas. Spatial analyses were performed, providing the basis for the determination of the urgency of conducting arrangement-agricultural works with the most considerable impact on the development of the areas. Two rural areas were selected for the study: Jabłonów in Brzeźnica commune, Żagański County, Lubuskie Voivodship, and Gardzienice Pierwsze in Piaski commune, Świdnicki County, Lubelskie Voivodship. The areas, like the voivodships in which they are located, are distinguished by a completely different agrarian structure. According to data of the Central Statistical Office, in Lubelskie Voivodship farms reach an average size of 7.57 ha, and in Lubuskie Voivodship – 20.75 ha. Study areas selected this way permitted the presentation of various problems resulting from the ownership structure of land, and a proposal of the rearrangement of the space for the purpose of sustainable development.

Key words: equipment-agricultural work, land consolidation

INTRODUCTION

In comparison with other European Union member states the Polish countryside areas play a noticeable role. Rural terrains in Poland are inhabited by 15 million people (Central Statistical Office of Poland, 2014), which represents approximately 39% of the total Polish population. Average population density in countryside amounts to 52 inhabitants/km^2. However, population density is characterised by significant diversity in different areas of Poland and ranges from 25 inhabitants/km^2 in Zachodniopomorskie, Warmińsko-Mazurskie and Podlaskie voivodships and 28 inhabitants/km^2 in Lubuskie Voivodship up to 121 in Śląskie Voivodship and 126 in Małopolska.

Over the recent years, rural space has been subjected to continuous changes, both at the structural and qualitative level. The way Polish rural areas look today results from long-lasting changes determined not only by historical, but also social or economic factors (Knapik, Kowalska, 2014). Polish villages face many problems and the most important one is the agrarian structure. It is defined as the status of agricultural production units; the number of farms that fulfil certain criteria: land ownership, total area of farms, dispersion of plots, in the total number of farms in a country (or e.g. in a region, a voivodship or a commune) (Tyszkiewicz, 1978; Pietrzak, Walczak, 2014).

Rural areas in Poland are characterised by unfavourable, for the effective agricultural or non-agricultural business activity, spatial and area structure (Rural Development Programme for 2014-2020). This follows from long-lasting ownership transformations caused by inheritance provisions, transfers of farms to successors and trade in real property. It has resulted in significant fragmentation of plots and unfavourable shape of boundaries. Moreover, many plots have lost formal access to public roads (Janus, 2011). The characteristics of spatial structure of rural areas significantly influence management thereof. Improvement of the fragmented agrarian structure increases the income generated by farms, which become more competitive and operate more efficiently (Hałasiewicz, 2011). However, in Poland this process is slow and at present it has little impact on improvement of agricultural efficiency. A precondition to improve agrarian structure is the decrease in the number of farms (Sobolewska-Mikulska, Pułecka, 2007). It is estimated that by 2020 the total number of farms will be decreased by at least 20%, while the average agricultural area of a farm will increase up to approximately 12 ha. The number of farms with an area of up to 10 ha will gradually decrease. The most significant increase in the number of farms is observed with respect to farms with an area of at least 50 ha. The number thereof has increased twice over the last 10 years. However, they still represent only 1.2% of the total number of farms. It has to be emphasized that farms with an area smaller than 5 ha constitute 70% of the total number of farms (Central

Statistical Office of Poland, 2012). Spatial structure of farms varies significantly in different parts of Poland. The least favourable can be observed in the southern and south-eastern part of Poland, where the average farm area does not exceed 5 ha. The best situation is in the following voivodships: Warmińsko-Mazurskie, Pomorskie and Zachodniopomorskie.

Correct shaping of space is effected by systematic spatial planning. However, rural space has recently been shaped also by arrangement-agricultural works in agricultural areas. They are defined as a set of planned efforts (technical and organizational) that take into account environmental, economic, legal and social conditions. They are aimed at adjusting the spatial structure of a given area to the needs of rational arrangement of agricultural production space. It should also be noted that arrangement-agricultural works pertain solely to those rural areas, which are connected with agricultural production (Bielska, Kupidura, 2013).

THE PURPOSE OF THE RESEARCH AND THE RESEARCH AREA

The purpose of the research was the analysis of plot ownership structure and assessment of its impact on development opportunities of selected research areas. Spatial analyses were performed, providing the basis for the determination of the urgency of conducting arrangement-agricultural works with the most considerable impact on the development of the areas. Two rural areas were selected for the study (Fig. 1): Jabłonów in Brzeźnica commune, Żagański County, Lubuskie Voivodship, and Gardzienice Pierwsze in Piaski commune, Świdnicki County, Lubelskie Voivodship. The areas, like the voivodships in which they are located, are distinguished by a completely different agrarian structure. According to data of the Central Statistical Office, in Lubelskie Voivodship farms reach an average size of 7.57 ha, and in Lubuskie Voivodship – 20.75 ha. Study areas selected this way permitted the presentation of various problems resulting from the ownership structure of land, and a proposal of the rearrangement of the space for the purpose of sustainable development.

Gardzienice Pierwsze

Geodetic unit located in the southern part of Piaski commune, central part of Lubelskie Voivodship, approximately 32 km from Lublin (i.e. the capital of the voivodship) and approximately 5 km from the town of Piaski. The commune is located along an important route that links Lublin with Zamość, as well as with Chełm and the eastern border of the country. The total area of the unit amounts to 601 ha. The village has approximately 350 inhabitants and approximately 100 households. Population density is mediocre and amounts to approximately 59 inhabitants/km^2. Houses are located along the main road at a distance of approximately 3.5 km. Gardzienice Pierwsze is located on the border of Giełczewska

Elevation and in its northern part it passes into (without a distinct border) Świdnicki Plateau. Brown soils formed from shallow loesses are most frequent in this geodetic unit. Groundwater remains deep in cracked cretaceous layers. A hill with the height of approximately 40 m is characteristic for this area. There is also a part of Rudka Gorge and Giełczew River Valley runs through the unit.

Jabłonów

Geodetic unit located in the southern part of Brzeźnica commune, in the southern part of Lubuskie Voivodship, approximately 45 km from Zielona Góra (i.e. the capital of the voivodship) and approximately 6 km from Brzeźnica. The commune is close to the border with the Federal Republic of Germany (not further than 50 km). The total area of the unit amounts to 1,929 ha. The village has approximately 624 inhabitants and approximately 480 households. Population density is low and amounts to approximately 32 inhabitants/km^2. This results from the fact, that there is a large forest complex (340 ha) in the unit. Houses are located along the main road at a distance of approximately 3.5 km. The relief of Jabłonów geodetic unit is hilly. The village itself is located between hills of 112.5-155.0 m above sea level. Relative height difference amounts to 42.5 m. The terrain constitutes the most western part of Dalkowskie Hills. There are many streams, which use erosional dissections. The area is highest in the western part and slopes down in the north and in the east.

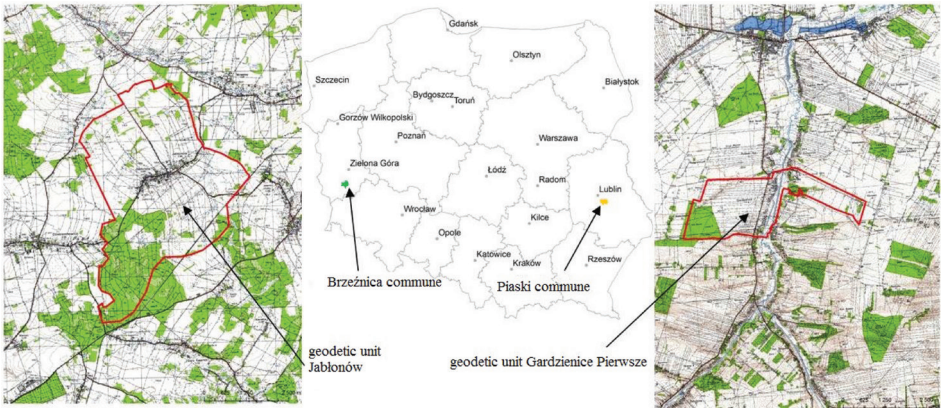

Figure 1. Location of the research areas

MATERIALS AND RESEARCH METHODS

The research was performed with the use of the following cartographic and descriptive materials:

1. Land and Building Register and classification contours database for Gardzienice Pierwsze and Jabłonów geodetic units,
2. soil-agricultural map of Gardzienice Pierwsze geodetic unit, prepared by Voivodship Office for Geodesy and Agricultural Areas and drafted on the basis of soil classification documents of 1954 and soil-agricultural research of 1977 (in the form of a raster and a vector map),
3. soil-agricultural map of Jabłonów geodetic unit, obtained from County Office in Żagań, Department of Geodesy, Cartography, Cadastre and Real Estate,
4. Web Map Service (WMS):
   - topographic map,
   - ortophotomap,
   - Database of Topographic Objects (BDOT),
   - raster digital terrain model (NMT), hypsometric version,
   - raster digital terrain model (NMT), shaded version,
5. local development plans for the research areas (descriptive and graphic part),
6. studies of conditions and directions of spatial development for Brzeźnica and Piaski communes.

Analysis of land use, land quality and plot structure was performed on the basis of the collected cartographic and descriptive materials. Agrarian structure of lands was assessed and the urgency of conducting arrangement-agricultural works in the research areas was determined. Spatial analyses were effected with the use of ArcGiS software, in particular with the use of Minimum Bounding Geometry tool, which determines plot parameters (length, width and elongation).

RESEARCH RESULTS AND DISCUSSION

Land use and soil quality structure

Land use structure in the studied geodetic units is a little different (Table 1). Low forestation (21%) in Gardzienice Pierwsze geodetic unit, as well as built-up and urbanised lands in Jabłonów geodetic unit (over 3 ha) need to be noted.

The quality of arable lands in the studied geodetic units was compared with the use of site index calculated pursuant to conversion factors applied for the purposes of agricultural tax. Gardzienice Pierwsze geodetic unit is located in the second tax bracket, while Jabłonów geodetic unit in the first, which was taken into consideration. It follows from this analysis that there are arable lands of better quality in Gardzienice Pierwsze, where site index for arable lands amounts to 1.24, and for grasslands 0.57. In Jabłonów geodetic unit the site index amounts to, respectively, 0.94 for arable lands and 0.77 for grasslands. Comparison of valuation classes of lands is presented in Figure 2.

Table 1. Structure of land use in the studied geodetic units

No.	Land type	Gardzienice Pierwsze		Jabłonów	
		Land area in ha	Land area in %	Land area in ha	Land area in %
1.	Arable land	410.6991	68.26	1,081.5812	56.06
2.	Permanent meadows	44.0749	7.33	83.3000	4.32
3.	Permanent pastures	1.1604	0.19	86.6731	4.49
4.	Orchards	0	0	79.4400	4.12
Total		**455.9344**	**75.78**	**1,330.9943**	**68.99**
5.	Forests	125.5077	20.86	519.1137	26.91
6.	Forest land as well as woody and bushy land	0.82	0.14	10.2597	0.53
Total		**126.3277**	**21**	**529.3734**	**27.44**
7.	Transport areas	14.1623	2.35	46.8395	2.43
8.	Railway	0	0	5.8300	0.30
9.	Lands under waters	1.1516	0.19	9.7331	0.50
10.	Built – up and urbanized areas	0	0	3.2116	0.17
11.	Wasteland	4.1023	0.68	3.3541	0.17
Total areas		**601.6684**	**100**	**1,929.3360**	**100.00**

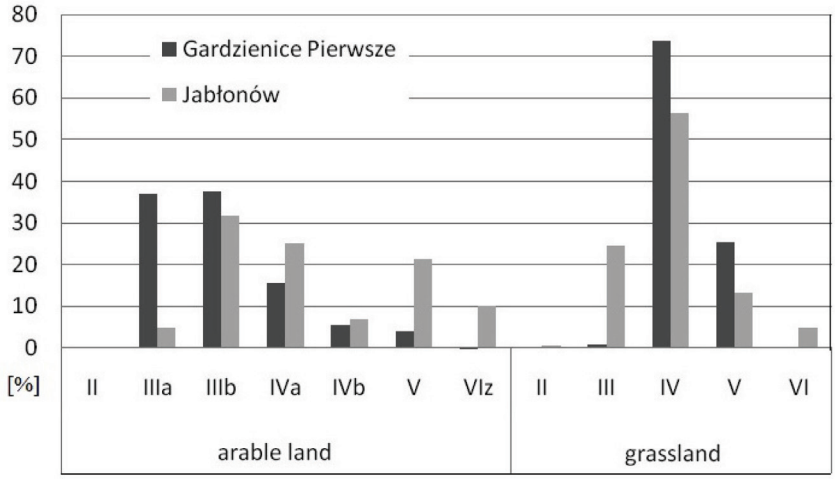

Figure 2. The percentage of valuation classes in the total area of arable land and grassland for Gardzienice Pierwsze and Jabłonów geodetic units

Spatial structure of plots

The most significant difference between the studied areas can be noticed after analysis of plot spatial structure (Table. 2). An average plot area in Gardzienice Pierwsze in Lubelskie Voivodship amounts to approximately 0.3 ha, while in Jabłonów in Lubuskie Voivodship it amounts to 1.3 ha. It should also be emphasized that plots smaller than 0.3 ha constitute 90% of the total number of plots in Gardzienice Pierwsze and only 26% in Jabłonów. Furthermore, in Jabłonów most frequent are the plots in the area group from 1 ha to 3 ha, which constitute approximately 47% of the total number of plots, and there are also plots larger than 30 ha (7 plots).

Table 2. The number of plots in each area groups for Gardzienice Pierwsze and Jabłonów geodetic units

Area groups [ha]	Gardzienice Pierwsze		Jabłonów	
	Number of plots	The percentage of the total number of plots	Number of plots	The percentage of the total number of plots
less than 0.01	101	4.7	6	0.4
from 0.01 to less than 0.05	271	12.6	86	5.9
from 0.05 to less than 0.1	539	25.2	70	4.8
from 0.1 to less than 0.2	444	20.7	147	10.0
from 0.2 to less than 0.3	242	11.3	78	5.3
from 0.3 to less than 0.5	231	10.8	136	9.3
from 0.5 to less than 1	205	9.6	145	9.9
from 1 to less than 3	101	4.7	696	47.3
from 3 to less than 5	7	0.3	47	3.2
from 5 to less than 10	2	0.1	20	1.4
from 10 to less than 20			17	1.2
from 20 to less than 30			15	1.0
from 30 to less than 40			5	0.3
from 40 to less than 100			1	0.1
over 100			1	0.1
Total	2,143	100.0	1,470	100.0

Width and elongation of plots were also analysed. Undoubtedly, the shape of plots in Gardzienice Pierwsze is often unfavourable (Fig. 3), where plots with a width of one metre and elongation of up to 1:750 occur in grasslands. Due to

fragmentation of lands many internal access roads appear. It follows from the analysis that 475 out of 1,773 plots (i.e. 26.8%) do not have a direct, formal access to a public road. The total area of plots without such access amounts to 99.73 ha, which represents 16.6% of the unit total area. It should also be emphasized that none of the plots that have no access to a public road are used as forests, and all of them constitute either arable lands or grasslands.

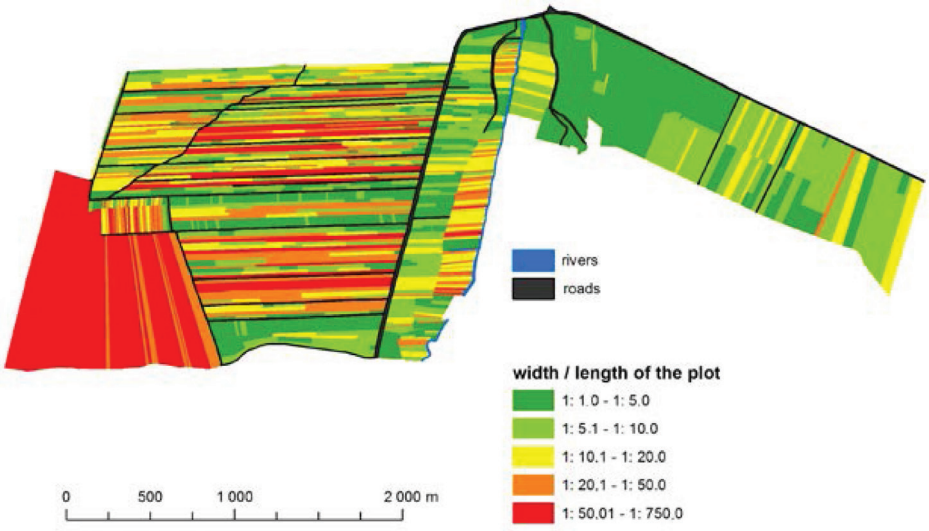

Figure 3. The shape of plots in Gardzienice Pierwsze geodetic unit

There is definitely better situation in Jabłonów geodetic unit, where plots of elongation of up to 1:5 constitute approximately 90% of the total number of plots (Fig. 4). Analysis of the access to public roads indicated that such problem arises only with respect to 48 plots, which is approximately 3% of the total number of plots.

Suggested arrangement-agricultural works

Gardzienice Pierwsze geodetic unit is characterised by favourable location as regards main communication routes. It also possesses many touristic, historic and landscape values, which may facilitate the development of agrotourism in this area. Nevertheless, this unit will surely preserve its agricultural character due to good quality and agricultural suitability of soils. This also prevents the increase of forestation level, which is relatively low, but introduction of afforestations along roads and enlargement of the existing forest complex could increase the landscape values of the unit.

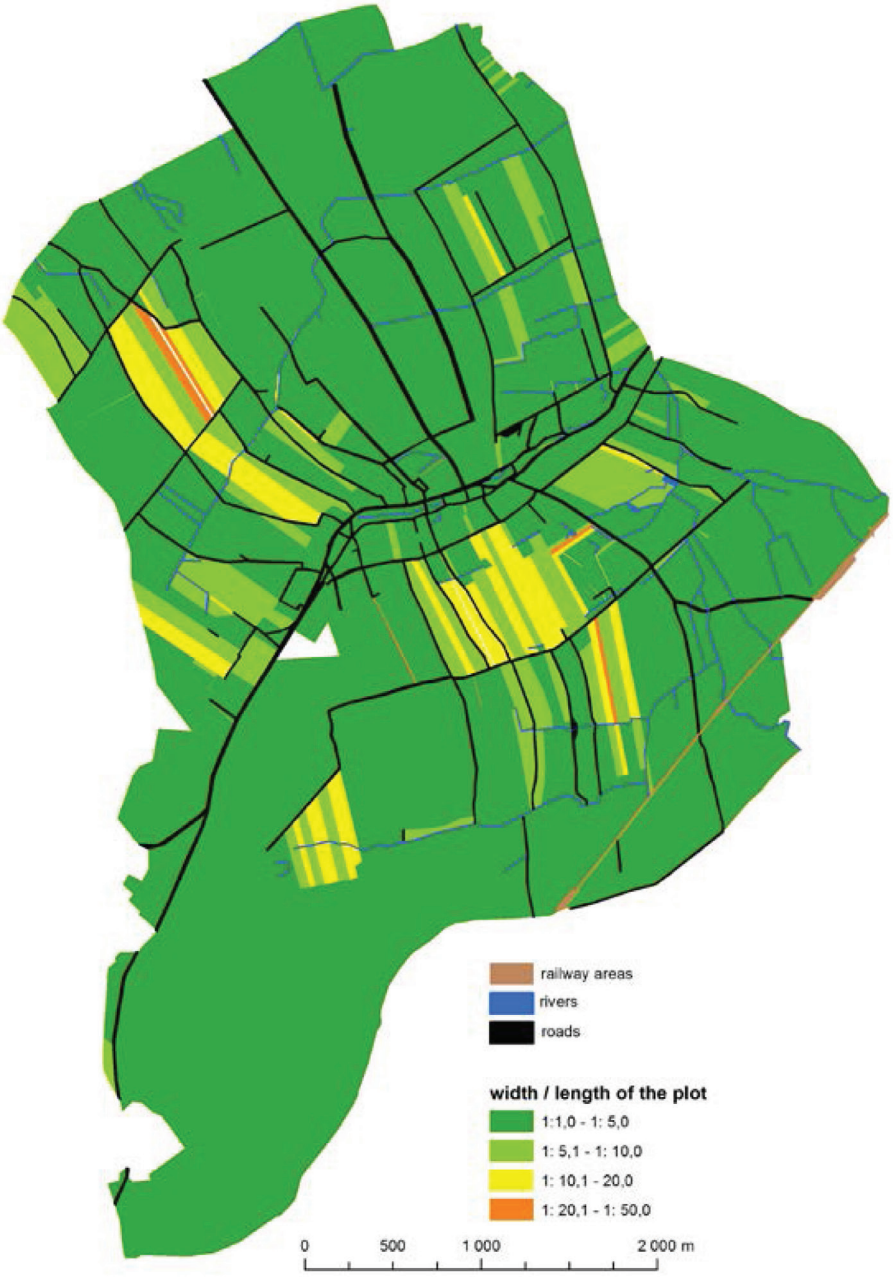

Figure 4. The shape of plots in Jabłonów geodetic unit

The existing fragmentation of lands significantly hinders effective agricultural production. The area, the shape and the elongation of plots adversely affect farmers' activities. Therefore, land consolidation could improve the conditions for agriculture by optimising land structure, limiting fragmentation and introducing new spatial order, which will facilitate rational land use in compliance with the existing environmental conditions.

This geodetic unit is also characterised by the lack of a functional network of roads for the purposes of agricultural transport, as the existing network does not provide access to all of the plots and it is not adapted to the needs of currently used agricultural machines (in terms of technical state and road width). A newly designed network of roads for the purposes of agricultural transport could reduce the costs of agricultural production connected with the use of agricultural machines and vehicles, which is very important in the case of areas subject to constant mechanical cultivation. Post-consolidation management could include paving and widening of some of the roads in accordance with the inhabitants' needs.

The shape of the unit, due to its more narrow eastern part, also hinders the effective use and management of lands. Therefore, the area subject to consolidation works should also include the adjacent geodetic units and the unit borders should be regulated.

Land consolidation works in Gardzienice Pierwsze geodetic unit could solve the discussed problems in a complex manner and could facilitate development of farms. Designation for non-agricultural purposes (e.g. homesteads, forestations) of lands of good quality, which occur in the unit, is inevitable, but requires intensive consultations with the inhabitants. Consolidation works could provide new spatial order, as well as address the other discussed social and ecological issues.

In Jabłonów geodetic unit the need for consolidation and exchange of lands does not apply to the whole unit area, but only to its part. At present there are six big farms (five with an area of approximately 100 ha and one with an area of approximately 60 ha), which keep buying smaller farms. The farmers buy lands adjacent to their plots in order to eliminate borders and thus increase their plots and their production capacity. It can, therefore, be concluded that land consolidation process takes place "spontaneously". Smaller farms are eliminated (purchased by larger farms), which improves the ownership structure. The most important actions that need to be taken in order to facilitate the development of this area include:

- consolidation and division of plots for development purposes, including designation of plots for public services,
- afforestation of poorest soils and wastelands, introduction of bushes and afforestations along roads,

- construction and reconstruction of access roads. Road projects should include strips designated for bushes and afforestations.

CONCLUSIONS

Arrangement-agricultural works in Poland are less frequent than in the older European Union member states. Polish countryside is old-fashioned and, therefore, the scope of the goals is larger. This follows from the fact that farmers are afraid of works that change their local environment, including, without limitation, structure of land use or modification of road network. These people seldom possess appropriate knowledge about the management and shaping of space.

Moreover, in Poland arrangement-agricultural works are often confused with land consolidation. This conviction is not correct, as land consolidation constitutes only one element of arrangement works. According to Woch (2008) the main purpose thereof is the improvement of land structure and the improvement of the quality of life of the local population. In Poland the adverse land structure occurs in the south-eastern, southern and central part of the country. As regards the other parts, i.e. the western part and the northern part, land consolidation should fulfil the two main goals: improve the land structure, as well as provide the appropriate basis for other tasks, such as improvement of roads quality, location of water reservoirs, designation of lands for forestation, bushes, recreational activities, introduction of green areas in lands designated for development etc.

Reshaping of the ownership structure and of the transport system can, simultaneously, strengthen the protection of natural environment and the landscape by, *inter alia*, unifying property in protected areas (Landscape Parks, Natura 2000 areas, etc.) and, consequently, more effective protection thereof. For example, Natura 2000 areas previously located on plots belonging to different owners that are parts of plot „patchwork" may be designated as consolidated areas in the process of consolidation, owned by Regional Directorate for Environmental Protection, while other owners may receive lands in convenient locations. Furthermore, activities that accompany the consolidation process include reclamation of degraded areas and designation of ecological lands. These arrangements strengthen the environmental effects.

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