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Specific features of development of selected agricultural problematic areas in the land consolidation process

Justyna WÓJCIK-LEŃ¹⁾ ABCDEF ✉,
 Katarzyna SOBOLEWSKA-MIKULSKA²⁾ ADEF

¹⁾ Rzeszów School of Engineering and Economics, ul. Miłocińska 40, 35-232 Rzeszów, Poland;
 e-mail: justynaa.wojcik@wp.pl, j.wojcik-len@wsie.edu.pl

²⁾ Warsaw University of Technology, Faculty of Geodesy and Cartography, Department of Cadastre and Land Management, Warsaw, Poland; e-mail: k.sobolewska@gik.pw.edu.pl

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Abstract

Development of the Polish agriculture and its production abilities are spatially diversified. At present, in Poland agricultural areas may be distinguished which may successfully compete with the agriculture in the European Union countries. However, areas where private farms run their businesses on the verge of profitability or below also exist in Poland. Those areas are called agricultural problematic areas (OPR), depression areas, areas not useful for agricultural purposes, marginal lands etc. It is estimated that OPR covers over 60–70% of our country.

Land consolidation is the process which improves the spatial structure of rural areas, including problematic areas. When this geodetic process is performed it is possible to interpret specific features of selected agricultural problematic areas and to propose alternative and the most effective ways of development of the discussed areas. As a result of those agricultural-and-development operations rural areas are becoming competitive and improve the living conditions. However, they are performed on a very small scale, in recent years this area is about 5900 hectares per year.

Key words: *land consolidation, problematic areas, rural areas, spatial structure of the land*

INTRODUCTION

Development of the Polish agriculture and its production abilities are spatially diversified. One of the reasons is the process of long-term transformations of the agricultural management within areas characterised by different social-and-economic conditions. At present, in Poland agricultural areas may be distinguished which may successfully compete with the agriculture in the European Union countries. However, areas where private farms run their businesses on the verge of profitability or below also exist in Poland. For those purposes they are the areas where all changes and system transformations are experi-

enced with the highest intensity. Following professional literature they are called agricultural problematic areas, areas not useful for agriculture areas, depression areas, areas of delayed development, areas not useful for agricultural purposes, marginal lands etc. [BAŃSKI 1999].

Factors which influence the generation of problematic areas, are, among others: the intensity of exploitation and irrational use of the natural resources. Besides, concentration of burdensome industrial production, location of waste dumps and dust emission which contribute to local pollution of arable fields are dangerous for the environment and the agriculture [JADCZYSZYN 2009]. Considering this attention

should be paid to areas characterised by the limited production potential, by lower incomes of inhabitants and delays in economic development which are endangered by marginalisation and, therefore, excluded from the areas of development.

All historical conditions of the social development contributed to destination of less useful areas, characterised by the lower production potential, for agricultural purposes [JADCZYSZYN 2009]. Besides, arable lands are highly fragmented, dispersion in rural areas [LEŃ 2017a, b] together with directing the agricultural production towards meeting the farmer's own demands. Such problems occur in different parts of Poland, e.g. in the South-Eastern part [LEŃ 2010; 2011; LEŃ, MIKA 2016a; NOGA, LEŃ 2010], in Central Poland [WÓJCIK, LEŃ 2015], as well as in Eastern Poland [KRÓL 2014].

Therefore it is necessary to adequately develop lands which are not useful for agricultural purposes – agricultural problematic areas, which will correspond to local natural-and-economic conditions, and contribute to revival of those areas [SAJNÓG, WÓJCIK 2013].

The process which improves the spatial structure of rural areas, including problematic areas, is the geodetic operation of land consolidation. As a result of those development and agricultural operations rural areas become competitive and farming on those areas generates financial profits and, therefore, it contributes to improvement of living conditions.

However, it should be remembered that all changes which are introduced must be in agreement with the natural resources since the rules of sustainable development (concerning, among others, protection of soils, waters, genetic resources of plants and animals, degradation of the environment, technical excellence and economic durability and social acceptance) are highly important for development of rural areas [SOBOLEWSKA-MIKULSKA 2004].

SPECIFIC FEATURES OF SELECTED PROBLEMATIC AREAS

Agricultural problematic areas are not clearly defined in professional publications [CHURSKI 2006]. It is connected with the domain of research and the approach of scientist who intend to analyse that issue in details. Such terms as: conflict areas, areas of scarcity, depression areas, difficult areas, area of production reserves, hazarded areas, poorly developed areas, areas of delayed development, marginal areas etc. are used by the authors of scientific publications [BAŃSKI 1999]. It is assumed that those areas are synonyms of the term “problematic areas”.

Problematic areas were firstly defined in the eighties. ZAGOŹDZON [1988] may be an example; describing this issue the author suggested that problematic areas, being a part of the geographical space were characterised by the occurrence of negative phenomena: “(...) from the social, economic and technical do-

mains, which resulted in certain internal anomalies (in the spatial structure) and the “area abnormality” [ZAGOŹDZON 1988].

It is also assumed that the presence of problematic areas contributes to generation of serious barriers for the country economy – for the social-and-economic policy. CIOK [1991] points that the term of problematic areas is understood as: “(...) areas of low effectiveness of social-and-economic and spatial structures and, therefore, areas which require – on the side of planning and regional policy – special actions needed for solving existing problems” [CIOK 1991]. It is important to notice that rural problematic areas also include such areas which are characterised by relatively low development possibilities and which require strong support from external resources for their economic development.

According to legal regulations – Article 2 item 7 of the act of March 27, 2003 r. on spatial planning and development, problematic areas should be considered as: „areas of peculiar phenomena in the field of spatial development or in relation to the occurrence of spatial conflicts, presented in a voivodeship development plan or determined in the documentation of conditions and directions of spatial development of a commune” [Ustawa... 2003].

As it turns out from performed research works different areas may be considered as agricultural problematic areas. Those areas are characterised, on the one hand, by the occurrence of negative natural phenomena, as well as negative demographic-social-and economic factors on the other.

The definition which seems to be reasonable from the perspective of implementation of land consolidation works was proposed by WÓJCIK-LEŃ [2016] – agricultural problematic areas are constantly used for agricultural purposes but they do not generate incomes, due to [WÓJCIK-LEŃ 2016]:

I. location, in relation to market and job opportunities, including:

- the tax district,
- the high level of unemployment,
- the high population density,
- the low structure of incomes;

II. the terrain relief with consideration of:

- locations on areas with high slope values,
- disadvantageous directions of slopes,
- erosion hazard;

III. soil conditions with respect to their quality and usefulness, with consideration of:

- the low class of soils,
- the poor complex of the agricultural usefulness,
- the excessive moisture or the high dryness of soils.

LAND CONSOLIDATION AS THE GEODETIC TOOL FOR DEVELOPMENT OF RURAL AREAS

The above definition of agricultural problematic areas refers to rural areas where the land consolidation

process is the geodetic action which can highly improve the spatial structure of rural areas.

Land consolidation was the first instrument serving for the development of rural areas and the agriculture. The basic definition and objective of land consolidation are included in the act of March 26, 1982 of land consolidation and exchange, where land consolidation is defined as: "(...) development-and-agricultural operations aiming at transformation of the spatial system of lands located within rural areas in such a way that more favourable farming conditions are created by improvements of area structure of farms, rational arrangement of land expanse and adaptation of real estate boundaries to the water melioration system, roads and the terrain relief." [Ustawa... 1982].

The 2014–2020 Rural Areas Development Programme promotes the land consolidation operations as geodetic works which aim at: "(...) delineation of new cadastral parcels of new arrangement, in order to reduce the number of small and distributed parcels of one farm and to increase the average size of parcels. The land consolidation projects also include works concerning post-consolidation area development which – in particular – aim at creation of the functional network of access roads to arable and forest lands and implementation of tasks aiming at regulation of water relations within the areas of land consolidation works." [MRiRW 2014].

At present, the objective of land consolidation is to create more favourable conditions of farming and forestry [Ustawa... 1982]. It is a group of planning and technical operations which should result in improvements of living and working conditions in rural areas. Investments in the field of renewal of rural areas and development of the technical and social infrastructure, as well as tasks related to the protection of the environment and maintenance of natural living foundations are also important. Another important aspect concerns the reduction of production costs in the agriculture and forestry, being the result of reduced inputs of labour and elimination of structural barriers. Abiotic factors, such as the terrain relief, types of soils, rainfalls – water, the air temperature, winds, are highly important for the agriculture. Development of rural areas also defines demographic, economic, natural-and-landscape and public aspects.

That is why, in the course of land consolidation operations – particular attention should be paid to agricultural problematic areas and to their adequate development. Information on problem areas should be considered as a group of factors when typing areas for land consolidation work [LEN *et al.* 2016; LEŃ, MIKA 2016b]. It is reasonable to promote alternative economic functions, and, therefore the most attractive ways of development of the discussed areas, which may be, first of all, destined for [WÓJCIK-LEŃ 2016]:

- forestation,
- non-agricultural and non-forest purposes, such as housing development, transport infrastructure, agro-tourism, recreation etc.,

- ecological sites (after transformation of lands),
- cultivation of energy crops [SAJNÓG, WÓJCIK 2013],
- creation of hunting plots [BYDŁOSZ *et al.* 2013],
- other purposes.

METHODOLOGY OF RESEARCH

During the experiments, selected agricultural problematic areas were characterised for the needs of rational area development in the land consolidation process.

The basic criteria, proposed by WÓJCIK-LEŃ [2016], as well as detailed criteria concerning the selection and delineation of problematic areas in the course of land consolidation works, were assumed. Point weights were assigned to those criteria, according to the assumed rule that the less the favourable feature value is (such as location, erosion hazard or poor soil classes) the higher is the weight value [WÓJCIK-LEŃ 2016].

I criterion – location – 30 points:

- 1) tax district – division into tax districts,
- 2) the rate of unemployment – division into intervals, (%),
- 3) the population density – division into intervals (individuals·km⁻²),
- 4) the structure of incomes – division into levels of incomes.

II Criterion – terrain relief – 40 points:

- 1) slope (the terrain slope study) – division into intervals (in %),
- 2) direction of slopes – division into basic directions, in degrees, according to the wind rose,
- 3) erosion hazard – division into levels of erosion intensity.

The digital terrain model (DTM) was the main database. Measurement data were used in Arc/Info ASCII GRID formats using GIS tools, QGIS software.

III Criterion – soil conditions with respect to the quality and usefulness of soils – 30 points:

- 1) soil classes – division into arable lands and green areas,
- 2) the agricultural usefulness complexes – the division of complexes was systematised according to the index of validation of the agricultural space (WRPR),
- 3) water relations – were determined on the basis of the above data with consideration of the moisture criteria with respect to soil-and-agricultural complexes.

According to performed research works, weights were assigned to the above criteria and the synthetic index W_{OPRn} , which allows to parameterise the criterion of selected agricultural problematic areas was calculated according to formula (1) [WÓJCIK-LEŃ 2016].

$$W_{OPRn} = \frac{\sum_{i=1}^n (k_n p_n)}{P_w} \quad (1)$$

where: W_{OPRn} = the synthetic index allowing to parameterise the criterion of the selected agricultural problematic areas, k_n = the weight of the delineated group of areas (depending on the criterion), p_n = the size of the delineated group of areas (depending on the criterion), P_w = the size of the analysed area.

Then the total synthetic index was calculated (2) which allows to parameterise the criterion of selected agricultural problematic areas [WÓJCIK-LEŃ 2016]:

$$SW_{OPRn} = W_{OPR_1} + W_{OPR_2} + \dots + W_{OPR_n} \quad (2)$$

where: SW_{OPRn} = the total synthetic index allowing to parameterise the criterion of selected agricultural problematic areas, W_{OPRn} = the synthetic index allowing to parameterise the criterion of selected agricultural problematic areas.

DETAILED EXPERIMENTS USING THE EXAMPLE OF THE OSTROŻANY LAND CONSOLIDATION OBJECT

The Ostrożany Land Consolidation Object is located in Siemiatycze District, in the Podlaskie voivodeship (Fig. 1), within the approximate distance of 16 km from the town of Siemiatycze, on the border of Drohiczyn and Grodzisk municipalities. It covers six cadastral districts, including Ostrożany and Smorczewo villages which are located within the administrative borders of Drohiczyn municipality; Stadniki, Jaszczółty, Morze and Lubowicze villages are located within the administrative borders of Grodzisk municipality.

According to the assumed methodology of research the analysed object is characterised by the following features and point weights, with respect to the assumed methodology and the criterion of specification (selection) of agricultural problematic areas (Tab. 1, 2, 3 and Fig. 2, 3, 4).

As it turns out from performed experiments and above tables the Ostrożany village is located in the III

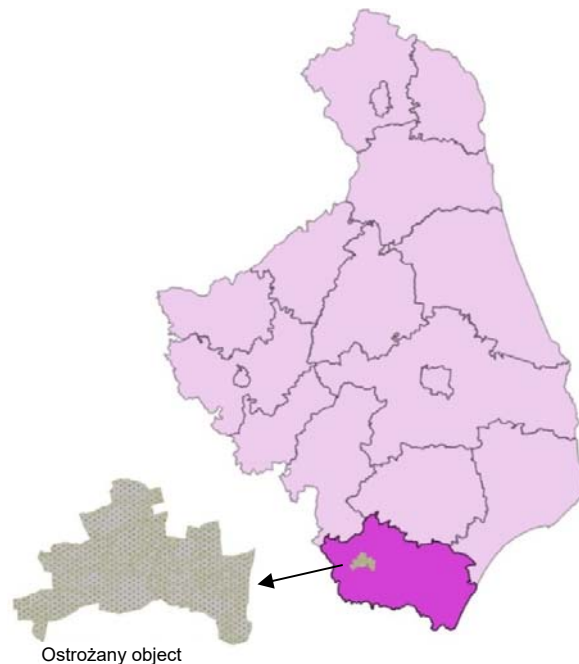


Fig. 1. Location of the Ostrożany land consolidation object - in the Podlaskie voivodeship and the Siemiatycze district; source: own elaboration

tax district. The analysed area is characterised by the low population density of the moderate unemployment rate (the total of 21 points). It is the plain area with small values of slopes (94.2% of the entire areas are the areas of slope below 3°). The performed experiments proved that 37.3% of the total areas is free from the surface water erosion, and 44.2% of the area hazarded by erosion. For the assumed terrain relief criterion (0–40 points) the analysed object gained 13.40 points, i.e. 33.5% of the total number of points. In Ostrożany soils of the low class of soils are prevailing. Soils of the IV and V classes are dominating in the structure of arable fields and their total areas equals to 59.5% of the total area of arable lands of the analysed object. Those soils are characterised by the excessive moisturising (45.9% of the total village area). For the assumed criterion, soil conditions – the total equal to 16.68, what equals to 55.6% of the total of points. As a result of performed research works the analysed object gained 51.08 points.

Table 1. I criterion – location for the Ostrożany object (30 points)

Tax district acc. to Rozporządzenie MF... [2001]				Unemployment rate acc. to Central Statistical Office of Poland				Population density acc. to Central Statistical Office of Poland				Structure of incomes acc. to Central Statistical Office of Poland and data from the Municipal Office			
feature	weight (0–10)	size, ha	index	feature, % 2014	weight (0–7)	size (ha)	index	feature persons km ⁻² 2014	weight (0–7)	size, ha	index	feature	weight (0–6)	size, ha	index
I	4	–	8.00	7–10	4	–	5.00	0–100	3	1118.52	3.00	0–1000	3	–	5
II	6	–		11–14	5	1118.52		101–200	5	–		1001–2000	4	–	
III	8	1118.52		15–18	6	–		>201	7	–		2001–3000	5	1118.52	
IV	10	–		>19	7	–						>3001	6	–	

Source: own elaboration based on WÓJCIK-LEŃ [2016].

Table 2. II criterion – terrain relief for the Ostrożany object (40 points)

Slope (study of the terrain slope) acc. to digital terrain model JÓZEFACIUK and JÓZEFACIUK [1990]				Direction of slope acc. to digital terrain model wind rose				Erosion hazard acc. to JÓZEFACIUK and JÓZEFACIUK [1990]			
feature degrees, (percentage)	weight (0–15)	size, ha	index	feature main directions in degrees	weight (0–10)	size, ha	index	feature (erosion intensity level)	weight (0–15)	size, ha	index
<3° (<5%)	3	1 054.11	3.18	0–45	10	293.37	7.21	0 (does not exist)	0	417,39	3.01
3–6° (6–10%)	6	62.59		45–90	8	100.03		1 (very weak)	3	494,71	
6–10° (10–18%)	9	1.83		90–135	6	69.01		2 (weak)	6	1,45	
10–15° (18–27%)	12	–		135–180	4	108.64		3 (moderate)	9	–	
>15° (>27%)	15	–		180–225	4	214.87		4 (strong)	12	–	
				225–270	6	126.51		5 (very strong)	15	–	
				270–315	8	99.80		area excluded from analysis (forests)		204.97	
				315–360	10	106.25					

Source: own elaboration based on WÓJCIK-LEŃ [2016].

Table 3. III criterion – soil conditions with respect to their quality and usefulness for the Ostrożany test object (30 points)

Soil classes acc. to District Office (Starost) – Land and Buildings Registration [Rozporządzenie RM... 2012]				Complexes of agricultural usefulness acc. to index of validation of the agricultural space (WRPR) IUNG – soil-and-agricultural maps WODGIK – soil database				Water relations acc. to IUNG – soil-and-agricultural maps [WITEK (ed.) 1994]			
feature	weight (0–6)	size, ha	index	feature (soil-and-agricultural usefulness complex)	weight (0–12)	size, ha	index	feature (moisture criteria with respect to soil-and-agricultural complexes)	weight (0–6)	size, ha	index
I	1	–	4.04	1 – wheat, very good soils	3	–	4.68	soils often excessively moisturised (complex 9, 8)	6	219.07	4.08
II	2	–		2 – wheat, good soils	4	293.82		soils of relatively permanent trend to excessive moisturising (complex 2)	4	293.82	
IIIa	3	56.44		3 – wheat soils with defects	6	–		soils of advantageous moisture relations (complex 1)	2	–	
IIIb	3.5	81.17		4 – rye, very good soils (wheat-and-rye soils)	5	196.37		soils of relatively poor trends for excessive drying (complex 4)	2	196.37	
IVa	4	326.55		5 – good rye soils	7	37.49		often drying soils (complex 6, 5, 3)	4	69.04	
IVb	4.5	136.54		6 – poor rye soils	9	31.55		usually highly dry soils (complex 7)	6	7.7	
V	5	42.56		7 – very poor rye soils	12	7.70					
VI	6	5.16		8 – strong pasture-and-corn soils	6	212.16					
Iz	1	–	3.88	9 – poor corn-and-pasture soils	9	6.91					
IIz	2	–		10 – mountain wheat soils	5	–					
IIIz	3	32.58		11 – mountain rye soils	6	–					
IVz	4	119.23		12 – mountain oat-and-potato soils	9	18.31					
Vz	5	12.63		13 – mountain oat-and-pasture soils	10	–					
VIz	6	0.21		1z – very good and good	4	–					
				2z – moderate	7	99.99					
				3z – poor and very poor	11	3.23					
			Ls	1	203.48						
			Tz	0	7.51						

Explanations: soil classes I–VI connect to arable lands, classes Iz–VIz connect to grasslands.

Source: own elaboration based on WÓJCIK-LEŃ [2016].

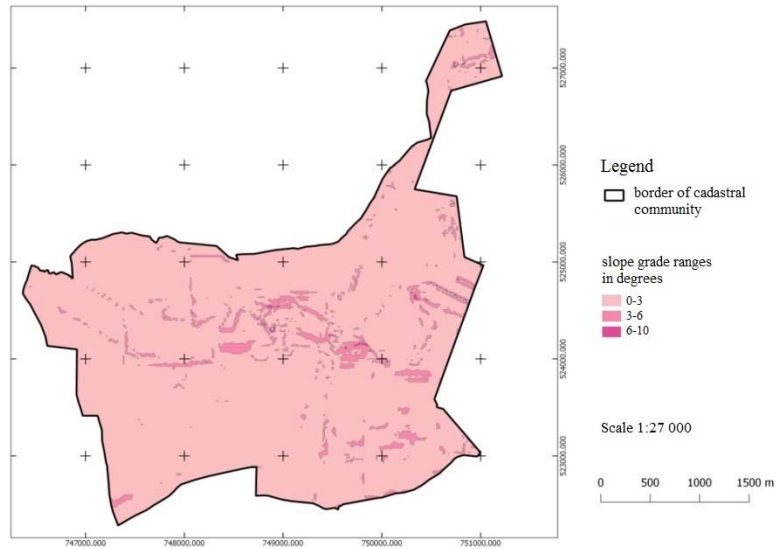


Fig. 2. The Ostrożany district – the slope (the terrain slope study); source: own elaboration

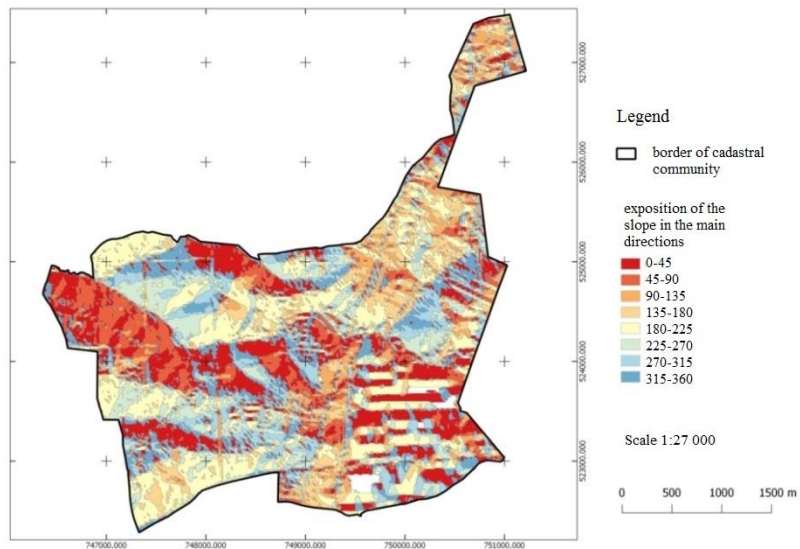


Fig. 3. The Ostrożany district – main directions of slope, according to the wind rose; source: own elaboration

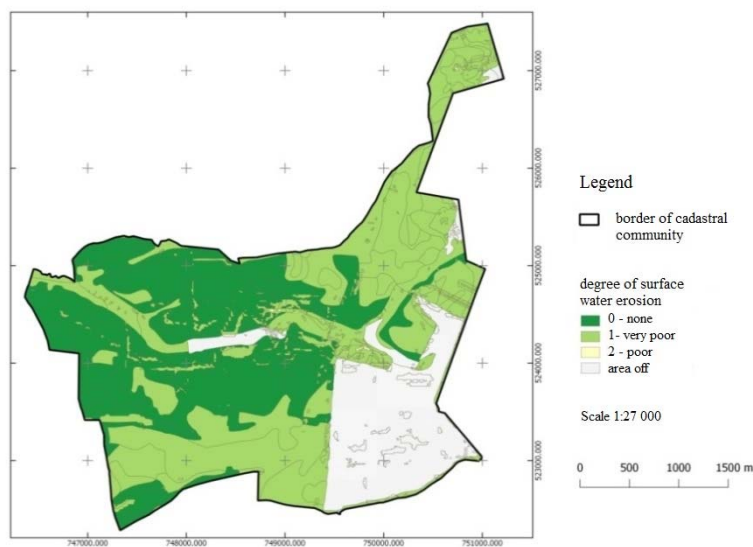


Fig. 4. The Ostrożany district – erosion hazard (the surface water erosion level); source: own elaboration

PROPOSALS OF DESIGNING SOLUTIONS OF LAND CONSOLIDATION WITH CONSIDERATION OF THE ASSUMED SPECIFIC CRITERIA OF SELECTED PROBLEMATIC AREAS

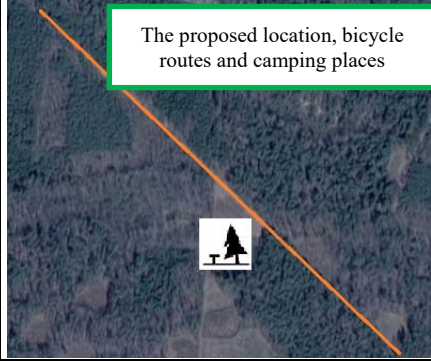
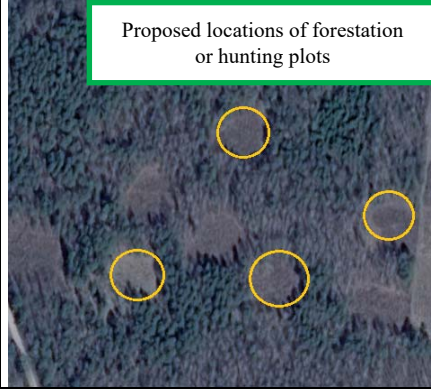

Land consolidation plays an important role in development of rural areas; this was, among others, in the economic, social or environmental spheres. The land consolidation process brings a series of benefits for the local society. After the detailed analysis of geodetic and cartographic documentation it turns out that agricultural problematic areas, as well as the possibilities of alternative development of those areas, were not considered during land consolidation operations.

In relation to this, the analysis of the above provisions for the Ostrożany object, points to the presence of for issues, according to the assumed criteria; i.e.:

- location:
 - 1) the distance from urban centres;
 - 2) the low class of soils,
 - 3) the poor complex of the agricultural usefulness,
 - 4) soils which are often excessively moisturised, soils of relatively permanent trend of excessive moisturising.

Specific features of the analysed object stress that the most advantageous ways of alternative development of agricultural problematic areas include:

Table 4. Selected proposals of alternative development with consideration of the assumed criteria (district Ostrożany)

Criterion of a problem		Selected proposals of development	Examples of visualised development
Location	tax district rate of unemployment population density structure of incomes	destination of lands for non-agricultural and non-forest purposes, recreation areas, i.e. planned bicycle routes and camping places	
Terrain relief	slope (terrain slope study)	–	–
	slope direction	–	–
	erosion hazard	–	–
Soil conditions with respect to quality of soils and agricultural usefulness	soil classes	forestation, creation of hunting plots	
	complexes of the agricultural usefulness	forestation, creation of hunting plots	
	water relations	transformation of agricultural lands into areas for energetic purposes (e.g. for plantation of energy-crop willow)	

Source: own elaboration.

Ref. 1) destination of lands for non-agricultural and non-forest purposes-agro-tourist or recreation areas, i.e. planning locations of bicycle routes, pedestrian passages or routes for riding a horse and camping places. Inhabitants are becoming convinced that agro-tourism and recreation areas are the attractive form of business activities in rural areas, in particular in areas of low incomes of farms [DUDZIŃSKA *et al.* 2014; WILKOWSKI, SOBOLEWSKA-MIKULSKA 2002].

Delineation of areas planned for agro-tourism, tourism and recreation should be an element of the land consolidation project, leading to:

- taking care of the image of the entire village, as well as preservation of its existing nature, e.g. by reconstruction of conventional (historical) buildings,
- development of accommodation facilities or restoration of the old ones,
- ensuring the transport possibilities (the quality of roads, public transport, car parking places),
- creation or improvements of conditions of recreational objects, including:
 - location of fitness trails in forests, in areas covered by trees and bushes,
 - bicycle routes around attractive (landscape, historical) places,
 - camping areas, places for fishing and beaches around water reservoirs,
- creation of cultural attractions in the village and its vicinities (interesting sightseeing places, churches, museums, building museums),
- development of unused or left buildings (new types of use),
- ensuring the access to services and, therefore, creation of employment opportunities for local inhabitants.

Ref. 2) and 3) destination of areas for forestation, creation of hunting plots, since forest cover slightly above 18% of the total area of the village. It would be useful to build bicycle routes located close to forests; this would allow to admire the attraction of the Podlasie District.

Ref. 4) transformation of lands for the needs of cultivation of energy crops, such as energy-cop willow, since the analysed area is characterised by the excessive moisturising, what positively influences the biomass production. Energy-crop willow was created several years ago by crossing and selecting several species of willows. As a result the plant was created which is characterised by the very high mass increase, the high combustible value and low requirements concerning soils. Wet soils of arable lands and green areas of IIIa, IIIb and IVa and V classes are recommended for those purposes.

CONCLUSIONS

Land consolidation is the process which improves the spatial structure of rural areas, including problematic areas. When this geodetic process is performed it

is possible to interpret specific features of selected agricultural problematic areas and to propose alternative and the most effective ways of development of the discussed areas. As a result of those agricultural-and-development operations rural areas are becoming competitive and farming operations generate financial benefits and improve the living conditions.

However, it should be noticed that within the land consolidation process, specific features and development of problematic areas are not considered; those issues are considered as marginal problems. It is caused by inadequate legal regulations and by the law level of the social awareness. The basic discrepancies also result from the extent of environmental protection and development of the rural landscape. This leads to the necessity to modernise the act of March 26, 1982 on land consolidation and exchange [Ustawa... 1982] with respect to: determination of new objective of land consolidation, as well as operations which concern the alternative development of problematic areas when the land consolidation project is performed.

It is necessary to develop new technical standards (instructions) since the current standards are not fully adequate for practical operations performed with respect to development of agricultural problematic areas during land consolidation operations. Land consolidation is an investment which must be widely considered as the complex solution for all issues related to the sustainable management of real estates in rural areas.

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Justyna WÓJCIK-LEŃ, Katarzyna SOBOLEWSKA-MIKULSKA

Specyfika zagospodarowania wybranych obszarów problemowych rolnictwa podczas procesu scalenia gruntów

STRESZCZENIE

Rozwój rolnictwa na obszarze Polski, a także jego możliwości produkcyjne, są przestrzennie dość zróżnicowane. Obecnie na terenie naszego kraju można wyszczególnić obszary rolnicze, które mogą konkurować pod wieloma względami z rolnictwem w innych krajach Unii Europejskiej. Istnieją jednak również obszary, na terenach których prywatne gospodarstwa indywidualne prowadzą produkcję rolniczą na granicy lub poniżej opłacalności. Nazywa się je obszarami problemowymi rolnictwa (OPR), obszarami depresyjnymi, obszarami nieprzydatnymi rolniczo, gruntami marginalnymi itp. Szacuje się, że OPR pokrywają ponad 60–70% powierzchni naszego kraju.

Procesem poprawiającym strukturę przestrzenną obszarów wiejskich, a tym samym obszarów problemowych, jest scalenie gruntów. Dzięki temu geodezyjnemu procesowi obszary wiejskie stają się konkurencyjne i podnoszą standard życia mieszkańców tych obszarów. Scalenia wykonywane są jednak na zbyt małą skalę, ostatnio obejmowały obszar ok. 5900 ha w skali roku.

Słowa kluczowe: *obszary problemowe, obszary wiejskie, scalenie gruntów, struktura przestrzenna gruntów*