

ORIGINAL ARTICLE

Land use and agricultural plans as a tool for comprehensive implementation of spatial planning regulations for rural areas – A case study of Różan commune in Poland

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Abstract

This paper emphasizes the importance of land use and agricultural plans in the spatial development of rural areas. The management of rural areas is one of the most important areas of action of the European Union. Planning and implementing a policy aimed at sustainable and multifunctional rural development is a major challenge for the Member States and their regions, as it involves numerous spatial changes. The Polish spatial planning policy lacks documents comprehensively regulating the management and shaping of rural areas, which is a factor that hinders their proper development. This necessitates the development of land use and agricultural plans which outline several solutions (land use and agricultural activities) to facilitate comprehensive management of rural areas. However, since there are no legal regulations in this area, they are not mandatory and therefore not widely adopted. This paper aims to set the objectives for a land use and agricultural plan for rural areas of the Różan commune, the implementation of which will aim at multifunctional and sustainable development of rural areas. The proposed indications will have a positive impact on the development of agriculture and non-agricultural functions, improvement of living and working conditions in the countryside, and protection of the natural environment in the commune. Due to the wide scope of spatial work included in the land use and agricultural plan, it is stated that this document can be used as an effective tool supporting comprehensive spatial planning in rural areas, significantly supporting the implementation of the provisions of local spatial development plans and other schemes. Comprehensive land consolidation is a special type of land use and agricultural activities, which brings multifaceted benefits.

Key words: land use and agricultural plan, spatial planning, development of rural areas, land consolidation

1 Introduction

Developing rural areas and improving living conditions for rural residents is currently one of the fundamental priorities of European Union (EU) countries. The EU's Common Agricultural Policy (CAP) takes a multifaceted approach to this issue, formulating development goals based on multifunctional and sustainable development. For some time now, rural areas have not been viewed solely as places

of food production but are embraced in a broader context (Akincza and Sawilow, 2011; Bielska and Kupidura, 2013). They perform several different functions, ranging from economic and cultural to ecological. They are a place for non-agricultural activities, business development, tourism, and recreation (Biernat-Jarka, 2009). Significantly, farmers' needs are not overlooked in this process, with a focus on improving agricultural production conditions and promoting environmentally friendly agriculture (Markuszczyńska,

2012; Wójcik, 2012). The rural development process in Poland, including agriculture, is hampered by a defective agrarian structure. Additionally, demographic, infrastructural, and institutional structures also require thorough transformation. These structures are characterized by a certain inertia, stemming from Poland's complex history and the subsequent challenges of adapting agriculture to the new market economy conditions. As shown by examples from Western European countries, effective reorganization of these structures is possible through comprehensive initiatives that achieve cumulative effect at multiple levels (Woch, 2007). The transformation of rural areas conducted in this manner, which aims to achieve the development goals of the EU agricultural policy, necessitates rational planning solutions. These solutions enable comprehensive and rational utilization of land use and agricultural plans (Akincza and Sawilow, 2011; Markuszewska, 2012). The Polish spatial planning system at the local level needs documents comprehensively regulating the management of rural areas. The two basic planning documents at the commune level – the study of spatial development conditions and directions (to be replaced by the General Plan of the Commune in 2026) and the local spatial development plan – address the management of rural areas and the planning of management and agricultural activities only marginally. A separate group of strategic documents fulfils this role better than the aforementioned documents, i.e., the municipalities' management and agricultural plans and the village management and agricultural projects drawn up based on them (Markuszewska, 2012; Bielska and Kupidura, 2013). Given the above, the authors attempt to answer the question: How should spatial planning regulations be implemented in rural areas with an unfavourable structure of registered plots and farms to ensure their rational management?

The study aims to develop guidelines for land use and agricultural plans, the implementation of which will aim at multifunctional and comprehensive development of rural areas, including agriculture, improvement of living and working conditions in the countryside, and protection of the natural environment. The developed guidelines should also be helpful for municipal authorities when preparing future planning and programming studies. The basis for establishing assumptions for the plan is the analysis and diagnosis of the current state of the commune. The research was conducted in the commune of Różan in the Mazowieckie Voivodeship in central Poland, and the obtained results were generalized and used to develop solutions applicable to rural lowland areas.

Determining the arrangements of the commune's land use and agricultural plan is a complex and labour-intensive process, requiring an extremely detailed analysis and diagnosis of the current state, which should include all the conditions impacting the development of rural areas. The specific nature of the area must be considered, its potential identified, and the optimum development opportunities identified at a given time. This requires specialist knowledge in various thematic areas and access to complex and sometimes difficult-to-access data. In this study, reference was mainly made to research into spatial features and conditions, so the final proposed assumptions for the land use and agricultural plan also relate primarily to these aspects.

2 Characteristics of the area, materials, and research methods

The research was conducted in three stages:

- i. Analysis of the literature on rural development conditions in Poland and the European Union countries, the role of land use and agricultural plans in the spatial planning process, and their scope. A review of scientific and grey literature and statistical data was conducted to characterize rural development and its latest trends, challenges, and problems. Analyzing the existing legal acts on the spatial planning process allowed us to identify the purpose

and possibilities of land use and agricultural plans.

- ii. Diagnosis of the current state of socio-economic, environmental, and spatial conditions is significant from the point of view of multifunctional development of the examined area of the Różan commune. An analysis of planning and strategic studies concerning the commune of Różan was carried out. In addition, the sources of data on the area were:

- materials of the State Geodetic and Cartographic Resource from the District Geodetic and Cartographic Documentation Centre, District Starosty in Maków Mazowiecki: vector of the registration map and vector of the soil-agricultural map, acquired on 12.04.2022;
- thematic cartographic studies prepared by IUNG-PIB in Puławy;
- Local Data Bank – Central Statistical Office, including data from the Census of Agriculture 2020;
- The Topographic Objects Database BDOT10k;
- site inventory.

Based on the materials collected, an analysis and diagnosis of the current state of the commune was carried out, which included:

- assessment of agricultural productive space;
- assessment of the commune's provision of social, tourist, and technical infrastructure;
- determination of potential for functional development.

ArcMap computer software was used to carry out various spatial analyses, which enabled both the visualization of spatial data and the determination of descriptive statistics.

- iii. Development of general indications for the municipal land use and agricultural plan. Using the literature review and the assumptions for the land use and agricultural plan for the rural areas of the commune of Różan, developed based on the diagnosis of the current state, general guidelines for land use and agricultural plans were formulated. The implementation of these guidelines will aim at multifunctional and comprehensive development of lowland rural areas, including agriculture, improvement of living and working conditions in the countryside, and protection of the natural environment.

2.1 Characteristics of the research area

The study covered the urban-rural commune of Różan, which is one of the ten communes of the county of Maków Mazowiecki, located in the north-eastern part of the Mazowieckie Voivodeship (Figure 1), and which is divided into 19 cadastral precincts (Figure 2). The commune of Różan is located to the east at a distance of approximately 20 km from the county seat, the town of Maków Mazowiecki. It is located at the intersection of two essential transport routes: national roads No. 60 and No. 61. This provides a perfect transport connection with the regional city of Ostrołęka (approx. 27 km) and the capital of Poland – Warsaw (approx. 90 km). The analyzed commune also has an extensive network of communal and district roads.

The Różan commune is a perfect example of the multifunctional development of rural areas. It was chosen due to the great diversity of development. Agricultural production remains an important activity, but new, non-agricultural functions, such as single-family housing or summer development, are also emerging.

The area of the commune of Różan is incredibly attractive in terms of natural and landscape values. The Narew River, which crosses the area from northeast to southwest, along with its valley, forms an appealing tourist route. Its natural and varied landscape is the most valuable natural and scenic area of the commune and the primary factor driving the development of summer housing. The high natural value of the Narew River Valley is confirmed by its legal protection as the Lower Narew Valley Natura 2000 Area (PLB14.0014). Additionally, the presence of large forest complexes

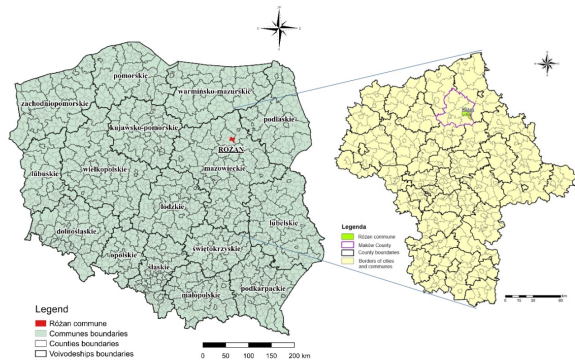


Figure 1. Location of the Różan commune in Poland and the Masovian Voivodeship (Source: Own study based on The Topographic Objects Database (BDOT10k))

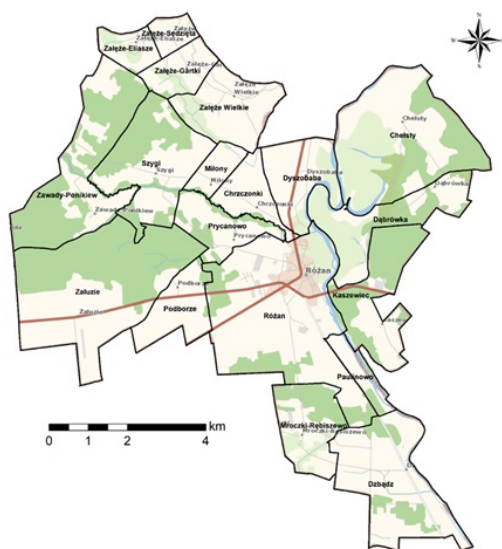


Figure 2. Division of the Różan commune into geodetic districts (Source: Own study using the WMTS viewing service (The Database of General Geographical Objects (BDOO) base map) and BDOT10k – geoportall.gov.pl)

further enhances the commune’s natural and landscape values.

The Różan commune is relatively poor in natural resources. In its area, there is only one documented deposit of natural resources – sand and gravel. The deposit area is 1.97 ha, while its thickness ranges from 6.3 to 14.0 m (Resolution, 2021).

3 Research results and discussion

3.1 Conditions for the development of rural areas in Poland and the countries of the European Union

The EU’s CAP takes a multifaceted approach to rural development, formulating development objectives based on multifunctional and sustainable development. The new CAP, in force since 2023, guarantees greater effectiveness in environmental and climate protection and improving farm profitability and income, with further support for sustainable rural development. The reformed policy is based on ten key objectives, which include guaranteeing a decent income for farmers, improving competitiveness, empowering farmers in the food supply chain, tackling and mitigating climate change, caring for the environment, protecting landscapes and biodiversity, supporting generational renewal, dynamic rural development, protecting food quality and health, and supporting knowledge transfer and innovation (European Commission, 2022).

The rural development process in Poland, including agriculture, needs to be improved by efficient agrarian structures. As shown by examples from Western European countries, effective reorganization of these structures is possible through comprehensive initiatives that achieve cumulative effect at multiple levels (Woch, 2007). The transformation of rural areas in this manner, which also aims to achieve the development goals of the EU agricultural policy, necessitates rational planning solutions. These solutions enable the comprehensive and efficient application of land use and agricultural activities (Akincza and Sawilow, 2011; Markuszewska, 2012). According to the definition of the Polish Standard (Polish Standard, 1997), these activities are considered to be technical and organizational measures that take into account natural, economic, legal, and social conditions, and whose aim is to adjust the spatial structure of a given area for the needs of rational use of agricultural production space.

In the Polish literature, it is unanimously accepted (Koreleski, 2009; Bielska and Kupidura, 2013; Pijanowski et al., 2021) that the basic land use and agricultural procedure is land consolidation, the procedures of which are standardized in the Act of 26 March 1982 on land consolidation and exchange (Act, 1982). As noted by Dacko (2006) and Atkocevičienė et al. (2019), land consolidation has become essential in rural development, especially in Western European countries. The disproportion between the Western EU countries and the Central and Eastern European Member States is evident in this aspect, as land consolidation issues have only recently started to play a more significant role in solving spatial problems Atkocevičienė et al. (2019).

Western European countries such as Denmark, the Netherlands, Germany or France have a much longer tradition of implementing land use and agricultural work (including land consolidation) for rural development (Hartvigsen, 2014; Hartvigsen et al., 2019; Water Drive, 2019; Jiang et al., 2022) than Central and Eastern European countries, where there is significantly less experience in land consolidation in general, primarily due to their historical conditions (Sroka, 2015; Ossowska and Janiszewska, 2015). Also, it is important that land consolidation in Western European countries has for some time now taken on a much broader meaning than just agricultural development. It is implemented alongside other measures that consider various aspects of socio-economic and environmental life in the countryside (e.g., road network construction, water reclamation, anti-erosion measures, land afforestation, and others) as so-called comprehensive countryside management (CCM).

Through a holistic approach, comprehensive countryside management aims to achieve the most significant possible cumulative effect in terms of economic, environmental, and social development in order to create attractive living and working conditions for the rural population (Dacko, 2006; Bielska and Kupidura, 2013).

Functional changes in rural areas, resulting from the departure from the traditional agricultural way of perceiving them in favour of multifunctional and sustainable development, are associated with the necessity to transform and modernize rural areas (Markuszczyńska, 2012). The aim is to make more efficient use of the agricultural production space by considering non-agricultural functions (e.g., economic, tourist, recreational), and ensuring the protection and rational management of natural and environmental resources while achieving the best possible socio-economic outcomes. Striving for a rapid improvement of this disadvantageous situation even enforces the need for rational planning solutions, especially those related to managing rural space locally, e.g., through land use and agricultural work (Markuszczyńska, 2012). Proposals for comprehensive, multi-faceted countryside management, including the full range of land use and agricultural work to be carried out within a single planning process, include the land use and agricultural plan of municipalities (hereafter also: 'land use and agricultural plan' or 'LAP') and the land use and agricultural plan of villages developed on their basis, in a more detailed version (Woch et al., 2018).

To date, no legal basis has been developed to standardize the drawing up of a land use and agricultural plan comprehensively and to systematize the relationship between the different types of work. This means that although land use and agricultural plans and projects may be adopted by a resolution of the municipal council, becoming an act of local law, they are only of an optional nature, and thus the commune has no legal obligation to prepare them (Akinca and Sawilow, 2011; Bielska and Kupidura, 2013; Markuszczyńska, 2012; Woch et al., 2018). The legal basis for the adoption of these documents is provided by the Act of 8 March 1990 on municipal self-government (Act, 1990), specifically under the wording of Article 7 of the same Act, which regulates the commune's tasks carried out in order to meet the collective needs of society, and Article 18(2)(6), according to which the exclusive jurisdiction of the municipal council includes the adoption of economic programs, which undoubtedly include land use and agricultural plans (Markuszczyńska, 2012). The voivodeship draws up this document, which comprises self-governmental budgetary units conducting geodetic and geodetic and land use activities supervised by the voivodeship marshal (Act, 1989).

The land use and agricultural plan integrates activities and work in areas such as agriculture, environmental protection, tourism and recreation, infrastructure, education, or community development, whose overarching goal is to create a harmonious and sustainable living and working environment for the inhabitants of rural areas. The aforementioned should take place in close connection with the currently applicable municipal development strategy and any planning studies regulating spatial planning and rural development issues (Akinca and Sawilow, 2011; Bielska and Kupidura, 2013; Woch et al., 2018).

Until now, two documents were primarily responsible for shaping the commune's spatial policy: the study of spatial development conditions and directions (hereafter referred to as 'study') and the local spatial development plan (hereafter referred to as 'local plan'). As a result of the spatial planning reform in 2023 in Poland, there has been a significant reorganization of the spatial planning system, resulting from the amendment of the Act on Spatial Planning and Development (Act, 2003). One of the most critical new solutions included in the Act is the repeal of the provisions concerning the study of the conditions and directions of the spatial development of the commune, replacing them with a new planning tool, the Municipal General Plan (hereafter referred to as 'General Plan' or 'GP'). This means that the main objective of the study, which is to define

the principles for implementing the commune's spatial policy, will now be one of the main tasks of the GP.

The findings of the General Plan, as in the case of the study, will be binding for the municipal authorities when drawing up local plans, which invariably remain the primary tool for spatial planning at the local level. In addition, the General Plan will be obligatorily enacted for the entire commune (excluding closed areas), with the rank of a local law act, and its findings will also be binding for decisions on land development conditions (LDC) (Act, 2003). This is a fundamental difference from the study, which is an internal management act without the force of general law and does not serve as a basis for issuing LDC decisions. Amongst other things, the master plan will mandatorily define planning zones – areas specifying the use of the land covered by the plan, delimited in a disjointed manner, meaning that a given area may not be included in more than one zone. Article 13c. Para. 2 (Act, 2003) provides a list of zones that may be incorporated into the plan, which include:

- multi-functional zone with multi-family residential development;
- a mixed-use zone with single-family residential development;
- multi-functional zone with homestead development;
- service zone;
- zone of large-area trade;
- economic zone;
- agricultural production zone;
- infrastructure zone;
- green and recreation zone;
- zone of cemeteries;
- mining zone;
- open space zone;
- traffic zone.

The compilation of all planning zones included in the General Plan of a given commune, together with their detailed description (e.g., the functional profile of the zone, the value of maximum above-ground development intensity and height, maximum share of development area, minimum value of share of biologically active area), is referred to as the municipal catalogue of planning zones and will be obligatorily included in the document defined in the Act as municipal urban planning standards. In addition, the GP will also be able to determine the so-called development supplement areas. This should be understood as areas where no local plans are in force but which the commune intends to use for residential development. This means that an LDC decision will only be able to be issued for land located within a development completion area with certain exceptions referred to in Article 61 (1a) and (2) (Act, 2003) (e.g., for the construction of a building consisting in reconstruction, extension or superstructure). The premise of designating such areas is to prevent uncontrolled urban sprawl (Government Portal, 2023). This solution can be an essential tool for improving the rational use of rural space and protecting agricultural land and environmentally valuable areas subject to increasing urban pressure. One of the fundamental problems of Polish spatial management so far has been the designation by municipalities in their studies of an excessively large area of land for development, which has contributed to its irrational spread (Zaborowski, 2021). Expanding dispersed development into open (agricultural, natural) areas results in the decline or complete loss of the possibility for these areas to fulfil their nourishing and natural functions and leads to an irreversible loss of rural values of space (Kowalewski et al., 2018). Therefore, the proposed solution necessitates linking the issuance of LDC decisions to the location in the area of the development complement to the GP. It also requires compliance with the GP in terms of development functions and urban planning parameters and indicators to prevent the location of development 'in an empty field', which often forces municipalities to incur additional costs related to the provision of adequate communication, technical or social infrastructure (Government Portal, 2023).

As a mandatory spatial planning instrument, the General Plan of the Commune sets the general framework for the other planning documents, particularly the local plans. However, it should be noted that both studies are primarily an investment planning tool. Admittedly, the General Plan is intended to set out the general objectives, principles, and guidelines for shaping the spatial policy in the commune, which may also include issues related to rural areas and agriculture (e.g., the functional profile of the agricultural production zone or the open zone). However, it will not detail the principles of development and technical equipment of agricultural areas, nor will it specify the land use and agricultural work to be carried out. The municipalities' land use and agricultural plans along with the village land use and agricultural projects (LUAP) drawn up on their basis are essential supplements to the concretizations of these studies. These documents comprehensively regulate issues in the field of rural spatial management (Bielska and Kupidura, 2013), focusing a great deal of attention on the design of land use and agricultural work (Markuszczyńska, 2012) while at the same time complying with the objectives and principles set out in GPs and local plans.

The legislator in the Spatial Planning and Development Act (Act, 2003) has provided a deadline of 31 December 2025 for the development of Master Plans. From then on, spatial planning studies will become invalid. This is a relatively brief period, given that, as of today, only some of the reform-implementing acts have yet to be enacted. With the expiry of the study, the condition for the adoption of local plans or the issuing of an LDP decision will be the entry into force of the General Plan in the commune. This means that the absence of a GP will make it impossible to carry out any work of an investment nature on its territory (Kokoszewska, 2023). Therefore, shortly, it will be in the interest of the municipalities to proceed with the preparation and enactment of the General Plan of the commune as soon as possible, which makes it possible to assume that over the next few years (the time needed to enact the GP plus the time of the local plan procedure) the level of coverage by local plans in Poland will not improve significantly. Moreover, as it is widely known, most municipalities in Poland currently still need an up-to-date local plan, i.e., the primary document regulating the commune's spatial policy. In 2022, the share of the area covered by valid local spatial development plans in the total area amounted to only 32.3% (Statistics Poland, 2023a).

However, the abovementioned conditions should allow rural development. Therefore, an optimal solution would be the application of a mechanism opposite to the classic one (Figure 3), whereby a commune, despite the absence of an appropriate local spatial development plan, can develop a land use and agricultural plan. The findings of this plan then need to be incorporated into newly developed local plans (Woch et al., 2018).

Also importantly, a land use and agricultural plan's preparation and implementation process should involve a wide range of stakeholders, including farmers, farmers' organizations, government representatives, local communities, and other interested parties. Public participation in spatial planning decision-making processes should be guaranteed through the consultation arrangements and mechanisms set out in the amendments to the Spatial Planning and Development Act (Act, 2003). Public consultations can include diverse perspectives and needs, the development of standard best solutions, and the most pertinent decisions, and contribute to building the local community and a sense of belonging to the place where one lives (Woch et al., 2018).

The land use and agricultural plan outlines a broad spectrum of possible actions and undertakings, enabling the improvement and optimization of the modernization process and shaping of space in rural areas. Based on a detailed analysis, the study identifies key areas for improvement, together with an indication of the type and scope of land use and agricultural work to be carried out and the determination of a rational sequence of their execution (Akinca and Sawilow, 2011; Bielska and Kupidura, 2013; Witkowska, 2019).

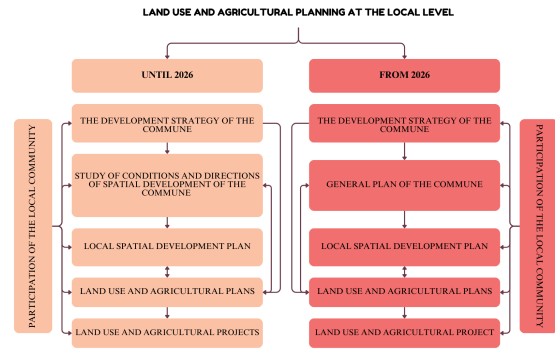


Figure 3. Organizational chart of land use and agricultural planning at the local level (Source: Own study)

In addition, according to Pijanowski et al. (2021), land use and agricultural work should become a key strategy for preparing rural spaces for progressive climate change. However, despite numerous functionalities and properties characterized by LUAP, which can positively impact proper space management, especially those related to rural areas, the Polish legislation lacks statutorily defined relations between land use and agricultural plans and other spatial and strategic planning instruments.

The correlation and interdependence of these documents are essential for rationalizing agricultural production space and sustainable and multifunctional development of rural areas. Therefore, land use and agricultural plans should be regulated by law as soon as possible. This would establish a legal basis for defining the procedure for their adoption, analogous to the process of drawing up the General Plan or the local plan, making them mandatory documents for each rural and urban-rural commune.

Funding for implementing municipal land use and agricultural plans or village land use and agricultural projects can be provided from the municipal budget, the budget of the Provincial Self-Government, the state budget, and the European Union (Witkowska, 2019).

In Poland, good practice in drawing up land use and agricultural plans is held by the Lower Silesian Office of Geodesy and Agricultural Areas in Wrocław (Geoport Lower Silesia, 2022).

3.2 Diagnosis of the current state in the Commune of Różan

The diagnosis of the current state of the socio-economic, environmental, and spatial factors presented below contains synthetic results of the research, most significant, in the opinion of the authors, from the point of view of possibilities for multifunctional and sustainable development of the examined area. The diagnosis of the current state was carried out only for the rural part of the Różan commune.

Assessment of Agricultural Production Space

The land use structure is dominated by agricultural land, which occupies 63.26% of the total area of the rural part of the commune. The second largest land use group is forest land, which occupies 31.59% of the total area. Detailed data on the land use structure are presented in Table 1. The signs given in Table 1:

- Agricultural land:
 - R: arable land
 - S: orchards
 - Ł: meadows
 - Ps: pastures
 - Br: built-up agricultural land
 - Wsr: land under ponds

Table 1. Land use structure for individual precincts of the Różan commune (Source: Own study based on the land and building registry – as of April 2022)

No.	Precinct name	Unit	Total	Agricultural land					Lzr	N	Total	Forest land		Land under waters	Built-up and urbanized land					Misc. areas			
				R	S	Ł	Ps	Br				Wsr	W		Ls	Lz	Total	B	Ba		Bi	Bp	dr
1	Chelsty	ha	930.03	284.49	-	149.39	94.14	10.22	-	0.15	-	67.22	271.08	-	271.08	30.81	1.37	0.09	1.97	1.90	16.25	21.58	0.95
		%	100.00	30.59	-	16.06	10.12	1.10	-	0.02	-	7.23	29.15	-	29.15	3.31	0.15	0.01	0.21	0.20	1.75	2.32	0.10
2	Chrzczonki	ha	193.24	150.00	6.34	-	10.91	6.65	-	0.42	-	0.19	11.78	-	11.78	0.82	-	-	0.97	-	5.17	6.14	-
		%	100.00	77.62	3.28	-	5.64	3.44	-	0.22	-	0.10	6.10	-	6.10	0.42	-	-	0.50	-	2.68	3.18	-
3	Dąbrówka	ha	427.70	97.12	0.10	90.44	60.55	3.46	-	0.34	3.46	29.18	109.46	-	109.46	13.49	0.52	-	6.19	0.11	13.29	20.10	-
		%	100.00	22.71	0.02	21.15	14.16	0.81	-	0.08	0.81	6.82	25.59	-	25.59	3.15	0.12	-	1.45	0.03	3.11	4.70	-
4	Dyszobaba	ha	325.56	169.31	1.35	95.7	66.93	13.29	-	0.07	0.29	5.84	266.66	-	266.66	29.29	1.85	-	3.99	0.21	9.45	15.50	-
		%	100.00	52.01	0.42	29.4	20.56	4.08	-	0.02	0.09	1.79	81.91	-	81.91	9.00	0.57	-	1.22	0.07	2.90	4.76	-
5	Dzbażdż	ha	669.74	423.34	2.58	0.45	36.17	18.44	-	2.15	0.79	8.94	492.87	-	492.87	33.40	2.87	-	13.78	-	13.75	30.40	-
		%	100.00	63.21	0.39	0.07	5.40	2.75	-	0.32	0.12	1.34	73.59	-	73.59	4.99	0.43	-	2.06	-	2.05	4.54	-
6	Kaszewiec	ha	450.26	83.75	-	9.31	51.89	6.71	-	-	5.05	3.42	160.13	-	160.13	16.47	0.94	6.54	1.10	-	13.06	21.64	-
		%	100.00	18.60	-	2.07	11.53	1.49	-	-	1.12	0.76	35.56	-	35.56	3.66	0.21	1.45	0.24	-	2.90	4.81	-
7	Miłony	ha	113.06	89.03	0.42	-	10.19	4.43	-	0.30	-	0.15	104.52	-	104.52	0.21	-	-	-	-	2.16	2.16	-
		%	100.00	78.75	0.37	-	9.01	3.92	-	0.26	-	0.13	92.45	-	92.45	0.18	-	-	-	-	1.91	1.91	-
8	Mroczi- Rębiszewo	ha	334.21	160.30	1.00	26.99	15.74	6.07	-	1.11	-	2.66	213.86	-	213.86	111.90	-	1.18	1.43	-	5.84	8.45	-
		%	100.00	47.96	0.30	8.08	4.71	1.82	-	0.33	-	0.80	63.99	-	63.99	33.48	-	0.35	0.43	-	1.75	2.53	-
9	Podborze	ha	257.19	220.60	1.20	-	1.00	5.79	-	0.04	-	0.01	228.64	-	228.64	19.94	0.65	-	0.32	-	7.62	8.60	-
		%	100.00	85.77	0.47	-	0.39	2.25	-	0.02	-	0.01	88.90	-	88.90	7.75	0.25	-	0.13	-	2.96	3.34	-
10	Zawady- Ponikiew	ha	733.11	263.62	0.36	28.03	15.64	6.75	-	0.26	-	3.57	318.23	-	318.23	0.73	0.07	-	-	-	15.96	16.03	-
		%	100.00	35.96	0.05	3.82	2.13	0.92	-	0.04	-	0.49	43.41	-	43.41	0.10	0.01	-	-	-	2.18	2.19	-
11	Prycanowo	ha	247.01	168.44	2.48	0.75	14.68	6.15	-	0.08	-	1.29	193.86	-	193.86	47.24	0.05	0.20	-	-	4.74	4.99	-
		%	100.00	68.19	1.00	0.30	5.94	2.49	-	0.03	-	0.52	78.48	-	78.48	19.12	0.02	0.08	-	-	1.92	2.02	-
12	Szygi	ha	592.04	271.37	1.70	28.44	19.53	9.77	-	0.30	-	1.74	332.84	-	332.84	244.96	0.08	-	0.08	-	12.61	12.77	-
		%	100.00	45.84	0.29	4.80	3.30	1.65	-	0.05	-	0.29	56.22	-	56.22	41.38	0.01	-	0.01	-	2.93	3.44	-
13	Załęże- Ełlasze	ha	127.82	71.26	0.63	8.37	29.23	4.90	-	1.23	-	1.56	117.18	-	117.18	7.19	0.51	-	-	-	2.93	3.44	-
		%	100.00	55.75	0.50	6.55	22.87	3.83	-	0.96	-	1.22	91.68	-	91.68	5.63	0.40	-	-	-	2.29	2.69	-
14	Załęże- Gartki	ha	178.75	138.39	0.41	10.92	12.20	4.27	-	1.71	-	0.48	168.38	-	168.38	7.73	-	-	0.08	-	2.56	2.64	-
		%	100.00	77.42	0.23	6.11	6.82	2.39	-	0.96	-	0.27	94.20	-	94.20	4.33	-	-	0.04	-	1.43	1.48	-
15	Sędziąta	ha	90.22	61.01	0.23	4.11	6.17	2.94	-	0.60	-	0.18	75.23	-	75.23	9.70	-	-	2.43	-	2.86	5.28	-
		%	100.00	67.63	0.25	4.55	6.84	3.26	-	0.66	-	0.20	83.39	-	83.39	10.75	-	-	2.69	-	3.17	5.86	-
16	Załęże	ha	369.57	278.99	2.11	2.24	46.59	11.80	-	2.54	-	1.61	345.88	-	345.88	17.30	0.10	-	0.73	-	5.54	6.37	0.02
		%	100.00	75.49	0.57	0.60	12.61	3.19	-	0.69	-	0.44	93.59	-	93.59	4.68	0.03	-	0.20	-	1.50	1.72	0.005
17	Załuże	ha	113.88	429.11	5.47	0.76	3.09	21.46	-	0.06	-	1.27	461.22	-	461.22	636.45	0.60	-	1.70	-	13.91	16.21	-
		%	100.00	38.52	0.49	0.07	0.28	1.93	-	0.01	-	0.11	41.41	-	41.41	57.14	0.05	-	0.15	-	1.25	1.45	-
18	Paulinowo	ha	114.42	2733	0.28	-	17.53	4.44	-	-	-	3.96	53.55	-	53.55	17.80	0.39	-	1.87	-	3.26	5.51	-
		%	100.00	23.89	0.25	-	15.33	3.88	-	-	-	3.46	46.81	-	46.81	15.56	0.34	-	1.63	-	2.85	4.82	-
Total commune		ha	7267.81	3387.48	26.66	369.76	512.18	147.52	0.00	11.37	9.60	133.27	4597.84	0.00	2296.05	165.14	10.00	8.02	36.62	2.22	150.96	207.82	0.96
		%	100.00	46.61	0.37	5.09	7.05	2.03	0.00	0.16	0.13	1.83	63.26	0.00	31.59	2.27	0.14	0.11	0.50	0.03	2.08	2.86	0.01

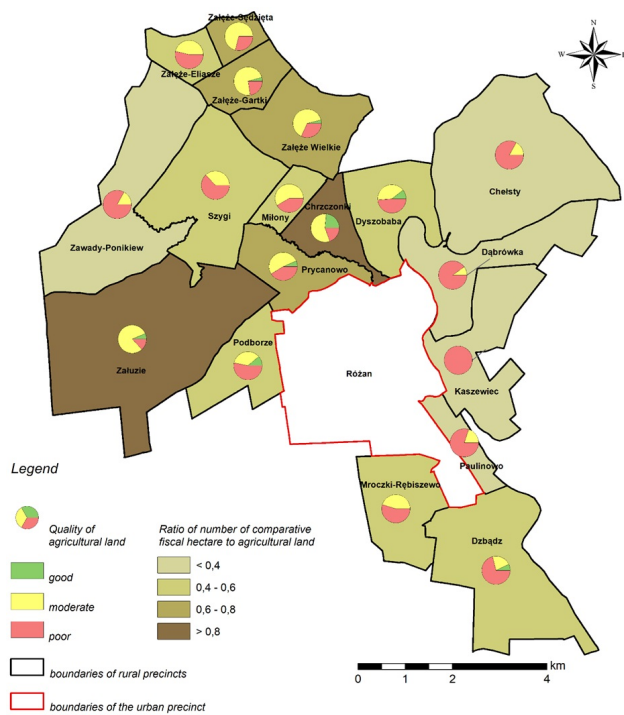


Figure 4. Quality of arable land and grassland in the individual precincts of the Różan commune (Source: Own study)

- W: land under ditches
- Lzr: wooded and shrub land on agricultural land
- N: wastelands
- Forest land:
 - Ls: forests
 - Lz: wooded and shrub land
- Built-up and urbanized land:
 - B: residential areas
 - Ba: industrial areas
 - Bi: other built-up areas
 - Bp: areas designated for development
 - dr: roads

From the point of view of agricultural development, soil classification of land, which determines the quality of soils in terms of their use value, is of fundamental importance in the production and development of crops (Skłodowski, 2014). When assessing the quality of the soil environment in the commune of Różan, the arable land of classes IIIa–IIIb and grassland of class III were considered the best. The arable land of classes IVa–IVb and grassland of class IV were considered medium quality, and the arable land of classes V–VIz and grassland of classes V–VI were considered the weakest. Based on the analysis of the data on soil quality, it should be concluded that the commune is characterized by average conditions for plant and animal production. The most favourable soil conditions are found in the farms located in the northern part of the commune. In contrast, the lowest quality land is found mainly in the area located by the Narew River valley. The quality of arable land and grassland expressed as the ratio of the number of converted hectares to their total area for the individual precincts of the Różan commune is presented in Table 2, and the spatial differentiation of land quality is shown in Figure 4.

Another key factor when assessing agricultural production space is the area structure of farms. In the area of the commune of Różan (rural area including the town of Różan, there are 397 farms, with a total area of 5149.75 ha (Statistics Poland, 2023b)). The average size of a single farm is 12.97 ha. The most considerable

Table 2. The quality of arable land and grassland expressed as the ratio of the number of converted hectares to their total area for the individual precincts of the Różan commune (Source: Own study based on the land and building registry – as of April 2022)

No.	Precinct name	Arable and grassland areas (ha)	Number of comparative fiscale hectare	Ratio of number of comparative fiscale hectare to arable and grassland areas
1	Chelsty	528.02	138.92	0.26
2	Chrzczonki	160.90	141.25	0.88
3	Dąbrówka	248.11	60.42	0.24
4	Dyszobaba	245.82	146.48	0.60
5	Dzbądz	459.96	194.86	0.42
6	Kaszewiec	144.96	27.52	0.19
7	Miłony	99.22	57.92	0.58
8	Mroczi-Rębiszewo	203.03	98.84	0.49
9	Podborze	221.60	129.30	0.58
10	Zawady-Ponikiew	307.28	89.36	0.29
11	Prycanowo	183.87	111.97	0.61
12	Szygi	319.33	139.40	0.44
13	Załęże-Eliasze	108.87	53.27	0.49
14	Załęże-Gartki	161.51	120.95	0.75
15	Załęże-Sędzięta	71.29	48.98	0.69
16	Załęże-Wielkie	327.82	223.54	0.68
17	Załużie	432.96	361.21	0.83
18	Paulinowo	44.87	13.47	0.30
Total commune		4269.42	2157.67	0.51

number of farms fall into the area group of 1 to 5 ha, constituting 37.3% of the total number of farms and occupying 11.7% (603.59 ha) of the total used land area. Agricultural properties, not included in farm holdings, occupy 1.5% of the commune's area, mainly old farm plots primarily used for recreational purposes (Figure 5).

The area structure in the area of the commune of Różan is characterized by the predominance of small and medium-sized farms, which limits the possibilities for agricultural land use and affects the inhibition of farm development. The size of a farm's agricultural land affects its productivity and production efficiency. According to the report "The structure of Polish agriculture compared to the European Union," prepared by the Foundation of the European Fund for the Development of Polish Rural Areas and the Association of Polish Economists, over 1.2 million farms in Poland (almost 90% of all Polish farms, which use about 50% of the total land) do not provide income satisfying the needs of farming families. The main reason is, of course, the insufficient area of cultivated land, but also the relatively low level of farming intensity (volume of production per unit area) (Poczta and Rowiński, 2019).

The next factor limiting the development potential of agriculture in the commune of Różan is plot fragmentation. As noted by Noszczyk and Chaba (2014), this is a widespread problem of spatial structure in Poland, most often manifested by a substantial number and small areas of plots, irregular shapes, and narrow and elongated plots. The research on spatial shaping of land plots in Różan included just the analysis of their basic spatial-technical parameters: number, area, width, and elongation.

The rural area of the commune of Różan is divided into a total of 7897 registered plots with a total area of 7267.81 ha. The assessment of the spatial arrangement of the plots excluded those which, according to the land and buildings register, constitute real estate under roads and waters. A total of 7245 parcels with a total area of

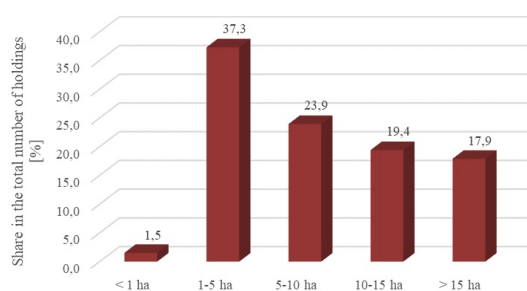


Figure 5. Quantitative structure of agricultural holdings in individual area groups in the Różan commune (Source: Own study based on [Statistics Poland \(2023b\)](#))

6939.99 ha were included in the analysis.

The districts located by the Narew River valley have a significantly higher number of registered plots. These areas offer favourable conditions for the development of summer buildings, leading to numerous real estate divisions for this purpose. The most numerous group in the commune comprises plots with an area of less than 0.30 ha. There are 4760 of them (51.9% of all plots), and they occupy 452.74 ha, 6.52% of the total area. This group mainly includes plots under built-up and urbanized land, but many agricultural properties are also present. A detailed summary of the location of registered plots is presented in Table 3.

Width is another parameter included in the spatial shape analysis of the plot. Like area, this factor determines the land use possibilities and affects the cultivation costs. It is assumed that the minimum width of a plot for tractor cultivation should be between 30 and 50 m ([Gniadek, 2013](#)). The most considerable number of plots in the studied commune, as many as 4478 (61.81%), have widths smaller than 30 m, unfavourable for mechanical cultivation. They occupy an area of 1183.63 ha, which is 17.06% of the total area.

The last parameter subjected to the analysis of the spatial shape of the plot is its elongation, measured by the ratio of width to length. It is assumed that the optimum elongation of a plot with a minimum area of 1 ha should be 1:5, while a higher elongation of the plot may be acceptable, provided it is large enough ([Gniadek, 2013](#)). The analysis results of the elongation of registered plots in the commune of Różan were classified into five distinct groups. The first group is represented by parcels with an elongation of 1:1–1:2, of which there are 1202 total (16.59%), and which cover an area of 1541.07 ha (22.21%). This group includes built-up, forest, and agricultural properties. For cultivation purposes, plots with such an elongation are of little use due to less effective working time and increased coastal losses. The most substantial number of plots (2051) has an elongation between 1:2 and 1:5. Their total area is 2110.59 ha, which represents 30.41% of the analyzed area. Properties with an elongation of less than 1:4 should be considered inefficient for production purposes. In contrast, 442 plots with an elongation ratio greater than 1:4 can be considered nearly optimal. Another group comprises plots with a ratio between 1:5 and 1:10, considered optimal for cultivation purposes, provided they are large enough. There are 1483 plots with a given elongation (20.47%), which cover an area of 1564.74 ha (22.55%). The last two groups (parcels of land with an elongation of 1:10–1:20 and > 1:20) include a total of 2509 parcels (about 35%), which cover about 25% of the total area. These are mainly agricultural parcels that are characterized by over- or under-elongation. Table 4, and Table 5 present characteristics of the width and elongation of parcels of land.

Based on the studies on the spatial shape of the registered plots of the commune of Różan, it can be concluded that the commune has a defective spatial structure. It is characterized by many small areas of plots and narrow and excessively elongated plots. Deficiencies in the fundamental spatial and technical parameters of the

plots of land limit agricultural production and reduce farm profitability. However, they can also hinder the development of other functions. Villages: Dąbrówka, Dyszobaba, Kaszewiec, and Załuże are mainly characterized by an inappropriate spatial structure. In these villages, there is an urgent need to reorganize the spatial arrangement of plots and eliminate deficiencies in the spatial structure. The current unfavourable land layout can be improved through comprehensive land consolidation efforts.

Assessment of the commune's provision of social, tourist and technical infrastructure

The rural areas of the commune are characterized by a relatively small number of social infrastructure facilities (Table 6). The town of Różan is the centre of the commune, providing it with administrative, educational, cultural, and social services. The town has the following facilities: school facilities (kindergartens, primary school, secondary school), a municipal office, a post office, medical facilities and pharmacies, a parish church, cultural and sports facilities, a hotel, restaurants, and other public facilities.

The commune of Różan offers favourable conditions for tourism development, with its main attractions being the area's natural and landscape values and advantageous geographical location. The picturesque Narew River valley, which is part of the Natura 2000 and ECONET-PL network of protected areas, plays a crucial role in developing the commune's tourist and recreational functions. It is characterized by high natural and landscape values (high biodiversity, numerous oxbow lakes) and favourable conditions for the development of active tourism, e.g., canoeing and fishing. Large forest complexes are excellent places for walks, relaxation, and picking mushrooms and forest fruits. Despite the high natural and landscape values, the commune's tourist infrastructure is only of average quality.

A prevalent form of development in the commune is individual recreational buildings (cottages). Summerhouses are mainly concentrated in the area of six villages: Dąbrówka, Dyszobaba, Dzbądz Chełsty, Kaszewiec, Paulinowo. Each village is characterized by its proximity to the Narew River and the current local development plan, except for Dąbrówka. The local plans of these villages designate numerous areas for recreational development but also, e.g., include land allocated for sports and recreational services or the creation of cycle paths.

All villages in the commune of Różan are supplied with water from the water supply system. There are four water treatment stations in rural areas. The length of the distribution active water supply network was 84.8 km in 2020 ([Statistics Poland, 2023b](#)). The number of water supply connections leading to residential and collective dwellings was 730, and the percentage of the rural population using municipal water supply was 99.6%. Compared to the water supply network, the sewerage network in the rural part of the commune is insufficiently developed. The length of the active sewerage network in 2020 was 4.7 km, to which 6.2% of residential buildings were connected and used by 9.3% of the total rural population ([Statistics Poland, 2023b](#)). None of the villages in the commune of Różan has a gas grid connection, so the inhabitants of the villages supply themselves with gas cylinders (exchange points are located in a dozen places in the commune) or set up individual gas tanks. However, according to the amendment to the Study of 12 February 2021, the construction of a 1st-degree reduction and measurement station is planned in the town of Różan. The distribution of the gas network in the area of the commune of Różan ([Resolution, 2021](#)), as well as several current conditions (e.g., political, economic, planning, or environmental) allow us to assume that this task will not be implemented in the next few years. The commune area has no centralized heating network, and the inhabitants satisfy their heating needs independently from individual sources.

The road network in the area of the commune of Różan (according to the SKDR layer from BDOT10k) consists of national roads (9.93 km), county roads (26.18 km), municipal roads (50.85 km),

Table 3. Characteristics of the area of cadastral plots in the individual precincts in the Różan commune (Source: Own study based on the land and building registry – as of April 2022)

No.	Precinct name	Plot area Unit	≤ 0,30 ha		(0,30 – 1,00)ha		(1,00 – 5,00)ha		> 5,00 ha		Total	
			Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots
1	Chełsty	pcs./ha	394	47.44	252	140.29	187	399.27	40	282.94	873	869.94
		%	45.13	5.45	28.87	16.13	21.42	45.90	4.58	32.52	100.00	100.00
2	Chrzczonki	pcs./ha	18	2.00	33	19.88	30	75.31	12	90.07	93	187.25
		%	19.35	1.07	35.48	10.62	32.26	40.22	12.90	4.8.10	100.00	100.00
3	Dąbrówka	pcs./ha	1579	167.31	415	196.98	25	37.35	-	-	2019	401.64
		%	78.21	41.66	20.55	49.04	1.24	9.30	-	-	100.00	100.00
4	Dyszobaba	pcs./ha	407	54.59	175	93.52	63	101.86	2	37.40	647	287.37
		%	62.91	19.00	27.05	32.54	9.74	35.45	0.31	13.02	100.00	100.00
5	Dzbażd	pcs./ha	613	73.10	139	78.47	155	377.72	14	93.14	921	622.44
		%	66.56	11.74	15.09	12.61	16.83	60.68	1.52	14.96	100.00	100.00
6	Kaszewiec	pcs./ha	231	32.93	180	104.77	31	57.05	12	226.15	454	420.90
		%	50.88	7.82	39.65	24.89	6.83	13.56	2.64	53.73	100.00	100.00
7	Miłony	pcs./ha	7	1.08	12	7.14	22	58.35	6	44.42	47	110.99
		%	14.89	0.97	25.53	6.43	46.81	52.57	12.77	40.02	100.00	100.00
8	Mroczi-Rębiszewo	pcs./ha	30	5.02	40	23.07	75	182.24	15	118.05	160	328.37
		%	18.75	1.53	25.00	7.02	46.88	55.50	9.38	35.95	100.00	100.00
9	Podborze	pcs./ha	50	6.86	48	27.53	76	176.33	6	38.75	180	249.46
		%	27.78	2.75	26.67	11.04	42.22	70.68	3.33	15.53	100.00	100.00
10	Zawady-Ponikiew	pcs./ha	41	6.12	54	32.66	145	354.09	39	323.55	279	716.42
		%	14.70	0.85	19.35	4.56	51.97	49.43	13.98	45.16	100.00	100.00
11	Prycanowo	pcs./ha	40	6.46	84	46.74	58	125.21	9	62.63	191	241.04
		%	20.94	2.68	43.98	19.39	30.37	51.95	4.71	25.98	100.00	100.00
12	Szygi	pcs./ha	124	16.32	162	90.80	134	286.81	25	184.65	445	578.57
		%	27.87	2.82	36.40	15.69	30.11	49.57	5.62	31.91	100.00	100.00
13	Załęże-Eliasze	pcs./ha	9	1.60	28	16.83	37	81.85	4	24.61	78	124.89
		%	11.54	1.28	35.90	13.48	47.44	65.54	5.13	19.71	100.00	100.00
14	Załęże-Gartki	pcs./ha	8	1.59	22	13.86	38	93.92	8	66.80	76	176.17
		%	10.53	0.90	28.95	7.87	50.00	53.31	10.53	37.92	100.00	100.00
15	Załęże-Sędzięta	pcs./ha	12	1.65	25	14.26	22	48.52	3	22.93	62	87.36
		%	19.35	1.89	40.32	16.32	35.48	55.54	4.84	26.25	100.00	100.00
16	Załęże-Wielkie	pcs./ha	43	7.32	93	56.14	113	240.45	9	59.82	258	363.72
		%	16.67	2.01	36.05	15.43	43.80	66.11	3.49	16.45	100	100.00
17	Załużcie	pcs./ha	55	8.33	40	26.34	167	375.80	35	689.40	297	1099.86
		%	18.52	0.76	13.47	2.39	56.23	34.17	11.78	62.68	100.00	100.00
18	Paulinowo	pcs./ha	99	13.03	49	24.71	16	28.55	1	7.33	165	73.61
		%	60.00	17.70	29.70	33.57	9.70	38.78	0.61	9.95	100.00	100.00
Total commune		pcs./ha	3760	452.74	1851	1013.98	1394	3100.65	240	2372.62	7245	6939.99
		%	51.90	6.52	25.55	14.61	19.24	44.68	3.31	34.19	100.00	100.00

Table 4. Characteristics of the width of cadastral plots in the individual precincts in the Różan commune (Source: Own study based on the land and building registry – as of April 2022)

No.	Precinct name	Plot width Unit	≤ 30.00 m		30.01–50.00 m		50.01–80.00 m		> 80.00 m		Total	
			Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots
1	Chełsty	pcs./ha %	456 52.23	115.54 13.28	211 24.17	153.47 17.64	103 11.80	197.56 22.71	103 11.80	403.36 46.37	873 100.00	869.94 100.00
2	Chrzczonki	pcs./ha %	27 29.03	9.59 5.12	26 27.96	23.79 12.70	14 15.05	38.28 20.44	26 27.96	115.60 61.73	93 100.00	187.25 100.00
3	Dąbrówka	pcs./ha %	1780 88.16	272.37 67.82	149 7.38	51.98 12.94	58 2.87	37.66 9.38	32.00 1.58	39.62 9.87	2019 100.00	401.64 100.00
4	Dyszobaba	pcs./ha %	558 86.24	179.39 62.43	68 10.51	47.88 16.66	12 1.85	15.25 5.31	9 1.39	44.84 15.60	647 100.00	287.37 100.00
5	Dzbażdż	pcs./ha %	530 57.55	108.29 17.40	251 27.25	130.51 20.97	84 9.12	166.69 26.78	56 6.08	216.95 34.86	921 100.00	622.44 100.00
6	Kaszewiec	pcs./ha %	348 76.65	111.49 26.49	55 12.11	29.27 6.95	24 5.29	17.70 4.21	27 5.95	262.44 62.35	454 100.00	420.90 100.00
7	Miłony	pcs./ha %	10 21.28	3.95 3.56	14 29.79	16.58 14.94	8 17.02	14.61 13.16	15 31.91	75.85 68.34	47 100.00	110.99 100.00
8	Mroczi-Rębiszewo	pcs./ha %	40 25.00	15.72 4.79	37 23.13	36.96 11.25	29 18.13	46.67 14.21	54 33.75	229.02 69.75	160 100.00	328.37 100.00
9	Podborze	pcs./ha %	64 35.56	30.94 12.40	54 30.00	55.85 22.39	45 25.00	95.22 38.17	17 9.44	67.46 27.04	180 100.00	249.46 100.00
10	Zawady-Ponikiew	pcs./ha %	47 16.85	17.40 2.43	46 16.49	50.84 7.10	70 25.09	133.49 18.63	116 41.58	514.69 71.84	279 100.00	716.42 100.00
11	Prycanowo	pcs./ha %	63 32.98	21.28 8.83	58 30.37	44.89 18.62	29 15.18	36.19 15.02	41 21.47	138.68 57.53	191 100.00	241.04 100.00
12	Szygi	pcs./ha %	169 37.98	47.25 8.17	100 22.47	92.70 16.02	89 20.00	122.33 21.14	87 19.55	316.29 54.67	445 100.00	578.57 100.00
13	Załęże-Eliasze	pcs./ha %	20 25.64	8.62 6.90	19 24.36	22.58 18.08	19 24.36	28.33 22.69	20 25.64	65.36 52.33	78 100.00	124.89 100.00
14	Załęże-Gartki	pcs./ha %	18 23.68	14.67 8.33	17 22.37	20.93 11.88	15 19.74	29.07 16.50	26 34.21	111.50 63.29	76 100.00	176.17 100.00
15	Załęże-Sędzięta	pcs./ha %	14 22.58	5.55 6.35	17 27.42	7.95 9.10	13 20.97	16.73 19.15	18 29.03	57.13 65.39	62 100.00	87.36 100.00
16	Załęże-Wielkie	pcs./ha %	89 34.50	49.81 13.69	76 29.46	67.65 18.60	39 15.12	58.85 16.18	54 20.93	187.41 51.53	258 100	363.72 100.00
17	Załużcie	pcs./ha %	146 49.16	150.38 13.67	103 34.68	227.16 20.65	18 6.06	65.87 5.99	30 10.10	656.45 59.68	297 100.00	1099.86 100.00
18	Paulinowo	pcs./ha %	99 60.00	21.40 29.07	33 20.00	10.24 13.91	20 12.12	10.57 14.36	13 7.88	31.39 42.65	165 100.00	73.61 100.00
Total commune		pcs./ha %	4478 61.81	1183.63 17.06	1334 18.41	1091.23 15.72	689 9.51	1131.08 16.30	744 10.27	3534.06 50.92	7245 100.00	6939.99 100.00

Table 5. Characteristics of the elongation of cadastral plots in the individual precincts in the Różan commune (Source: Own study based on the land and building registry – as of April 2022)

No.	Precinct name	Plot elongation Unit	1:1–1:2		1:2–1:5		1:5–1:10		1:10–1:20		> 1:20		Total	
			Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots	Number of plots	Total area of plots
1	Chelsty	pcs./ha %	158 18.10	109.87 12.63	283 32.42	338.09 38.86	206 23.60	223.19 25.66	150 17.18	154.35 17.74	76 8.71	44.44 5.11	873 100	869.94 100.00
2	Chrzczonki	pcs./ha %	16 17.20	20.29 10.84	31 33.33	65.98 35.23	32 34.41	65.14 34.79	10 10.75	32.44 17.33	4 4.30	3.40 1.81	93 100	187.25 100.00
3	Dąbrówka	pcs./ha %	194 9.61	35.33 8.80	432 21.40	76.12 18.95	424 21.00	102.78 25.59	463 22.93	79.77 19.86	506 25.06	107.62 26.80	2019 100	401.64 100.00
4	Dyszobaba	pcs./ha %	48 7.42	37.61 13.09	136 21.02	39.26 13.66	141 21.79	57.14 19.88	115 17.77	49.71 17.30	207 31.99	103.64 36.07	647 100	287.37 100.00
5	Dzbądz	pcs./ha %	299 32.46	80.27 12.90	327 35.50	164.85 26.49	139 15.09	211.70 34.01	86 9.34	106.04 17.04	70 7.60	59.57 9.57	921 100	622.44 100.00
6	Kaszewiec	pcs./ha %	52 11.45	134.19 31.88	131 28.85	164.33 39.04	89 19.60	32.54 7.73	105 23.13	55.64 13.22	77 16.96	34.21 8.13	454 100	420.90 100.00
7	Miłony	pcs./ha %	7 14.89	20.27 18.26	19 40.43	53.93 48.59	6 12.77	15.21 13.71	12 25.53	19.74 17.79	3 6.38	1.84 1.65	47 100	110.99 100.00
8	Mroczi-Rębiszewo	pcs./ha %	23 14.38	18.00 5.48	62 38.75	169.09 51.49	48 30.00	101.10 30.79	21 13.13	33.72 10.27	6 3.75	6.47 1.97	160 100	328.37 100.00
9	Podborze	pcs./ha %	40 22.22	22.65 9.08	45 25.00	68.36 27.40	43 23.89	91.55 36.70	37 20.56	52.32 20.97	15 8.33	14.59 5.85	180 100	249.46 100.00
10	Zawady-Ponikiew	pcs./ha %	72 25.81	171.64 23.96	105 37.63	263.55 36.79	60 21.51	191.56 26.74	35 12.54	81.78 11.42	7 2.51	7.89 1.10	279 100	716.42 100.00
11	Prycanowo	pcs./ha %	32 16.75	41.62 17.27	74 38.74	116.38 48.28	39 20.42	49.52 20.54	28 14.66	25.60 10.62	18 9.42	7.93 3.29	191 100	241.04 100.00
12	Szygi	pcs./ha %	78 17.53	143.13 24.74	141 31.69	185.63 32.08	95 21.35	158.88 27.46	66 14.83	60.21 10.41	65 14.61	30.72 5.31	445 100	578.57 100.00
13	Załęże-Eliasze	pcs./ha %	16 20.51	34.35 27.50	26 33.33	34.59 27.70	16 20.51	28.20 22.58	19 24.36	27.01 21.62	1 1.28	0.74 0.59	78 100	124.89 100.00
14	Załęże-Gartki	pcs./ha %	16 21.05	25.47 14.46	28 36.84	66.58 37.79	16 21.05	48.02 27.25	9 11.84	12.16 6.90	7 9.21	23.95 13.59	76 100	176.17 100.00
15	Załęże-Sędzięta	pcs./ha %	20 32.26	14.09 16.12	18 29.03	38.22 43.75	16 25.81	29.78 34.09	3 4.84	2.77 3.17	5 8.06	2.50 2.86	62 100	87.36 100.00
16	Załęże-Wielkie	pcs./ha %	29 11.24	26.01 7.15	87 33.72	162.01 44.54	64 24.81	101.05 27.78	46 17.83	50.55 13.90	32 12.40	24.11 6.63	258 100	363.72 100.00
17	Załużcie	pcs./ha %	41 13.80	574.91 52.27	46 15.49	78.48 7.14	32 10.77	51.08 4.64	64 21.55	177.29 16.12	114 38.38	218.10 19.83	297 100	1099.86 100.00
18	Paulinowo	pcs./ha %	61 36.97	31.38 42.63	60 36.36	25.13 34.13	17 10.30	6.32 8.59	22 13.33	10.50 14.26	5 3.03	0.29 0.39	165 100	73.61 100.00
Total commune		pcs./ha %	1202 16.59	1541.07 22.21	2051 28.31	2110.59 30.41	1483 20.47	1564.74 22.55	1291 17.82	1031.60 14.86	1218 16.81	691.99 9.97	7245 100	6939.99 100.00

Table 6. Social infrastructure of the individual precincts of the Różan commune (Source: Own study based on data from the Commune Office and field inventory – 12.04.2022)

No.	Precinct	Church, chapel	Village community room / fire station	Playground	Fitness equipment	Playing field	Fire Brigade	Shop	Hotel, bar, restaurant	Petrol station
1	Chełsty		X		X	X	X			
2	Chrzczonki									
3	Dąbrówka									
4	Dyszobaba			X	X	X				
5	Dzbaźdz		X	X	X	X		X		
6	Kaszewiec								X	
7	Miłony			X						
8	Mroccki-Rębiszewo		X		X	X	X			
9	Paulinowo									
10	Podborze			X	X	X				
11	Prycanowo									
12	Szygi		X	X	X		X			
13	Załęże-Eliasze				X					
14	Załęże-Gartki		X		X					
15	Załęże-Sędzięta			X	X					
16	Załęże-Wielkie		X	X	X					X
17	Załuzie		X	X	X	X	X	X		
18	Zawady-Ponikiew	X								
Total commune		1	7	8	11	6	4	2	1	1

other roads (197.58 km) – Figure 6. The total length of all roads is 284.54 km. The road network analysis in terms of surface shows that there are 73.08 km of hard-surfaced roads (including 72.50 km of bituminous pavement), a total of 28.59 km of gravel paved roads, and 182.87 km of dirt roads.

Potential for the development of individual areas of the Różan commune

On the basis of the analysis and diagnosis of the existing state of the commune of Różan, the main potential for the development of each precinct has been identified, as shown in Table 7.

3.3 General guidelines for the commune's land use and agricultural plan and discussion

Based on the results of the conducted analyses and the established potential for village development, proposals have been prepared for the land use and agricultural plan for the rural areas of the commune of Różan, especially those with a defective structure of registered plots and farms.

- i. Due to the unfavourable structure of plots and farms, the basic land use and agricultural procedure is recommended for land consolidation and subsequent post-agrarian development (comprehensive land consolidation). The implementation of consolidation work is regulated by the Act of 26 March 1982 on land consolidation and exchange (Act, 1982). The scope of consolidation, along with post-consolidation development, encompasses several land use and agricultural procedures possible as part of one project. Through rational planning and execution, these actions can bring many beneficial changes in rural areas. In this context, rational planning and implementation involve creating opportunities for the proper organization of farms while preserving the natural environment and striving for the comprehensive spatial development of a given locality, resulting from the implementation of the findings of planning documents. The land consolidation process facilitates the rational organization of space, allowing us to fully utilize the agricultural potential. On the other hand, in areas with an unfavourable spatial structure, which are additionally characterized by a low potential for agricultural development

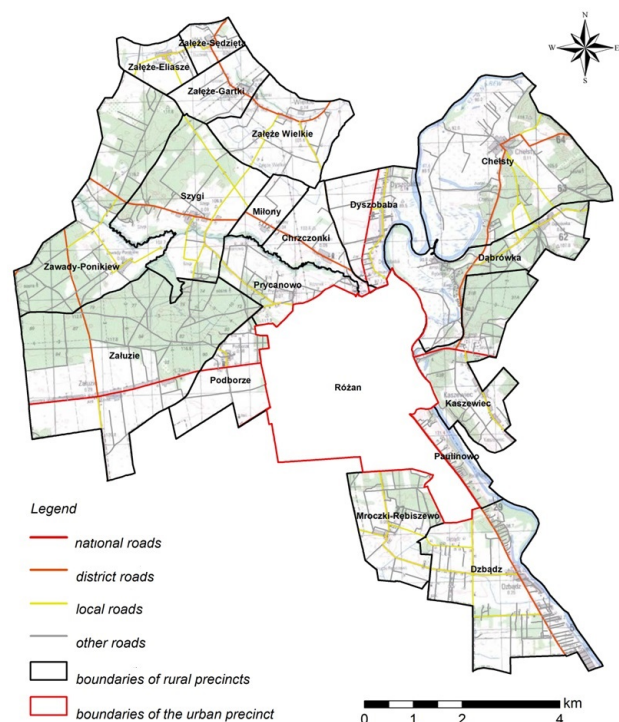


Figure 6. Roads according to their ownership status in the Różan commune (Source: Own study based on BDOT10k and the WMTS service of viewing raster topographic maps for Poland (geoportal.gov.pl))

Table 7. Development potential of the individual precincts of the Różan commune (Source: Own study)

No.	Precinct name	Proposed directions of development	Percentage of agricultural land [%]	Percentage of forests [%]	Percentage of best quality soils [%]	Percentage share of plots over 5 ha [%]	Ratio of number of comparative fiscale hectare to arable and grassland areas
1	Chelsty	housing (including residential). tourism and recreation	65.12	29.15	-	4.58	0.26
2	Chrzczonki	agriculture	90.3	6.10	23.55	12.90	0.88
3	Dąbrówka	housing (including residential). tourism and recreation	66.85	25.59	-	-	0.24
4	Dyszobaba	housing (including residential). tourism and recreation. agriculture	81.91	4.33	10.47	0.31	0.60
5	Dzbańdz	housing (including residential). tourism and recreation	73.59	16.88	7.01	1.52	0.42
6	Kaszewiec	housing (including residential). tourism and recreation ⁴	35.56	55.97	-	2.64	0.19
7	Miłony	agriculture	92.45	5.46	0.53	12.77	0.58
8	Mroczyki-Rębiszewo	agriculture. forest management	63.99	33.48	0.89	9.36	0.49
9	Paulinowo	residential. touristic and recreational	46.81	15.56	-	0.61	0.30
10	Podborze	agriculture	88.90	7.75	11.09	3.33	0.58
11	Prycanowo	agriculture	78.48	19.12	6.31	4.71	0.61
12	Szygi	agriculture. forest management	56.22	41.38	-	5.62	0.44
13	Załęże-Eliasze	agriculture	91.68	5.63	-	5.13	0.49
14	Załęże-Gartki	agriculture	94.20	4.33	4.30	10.53	0.75
15	Załęże-Sędzięta	agriculture	83.39	10.75	-	4.84	0.69
16	Załęże Wielkie	agriculture	93.59	4.68	3.81	3.49	0.68
17	Załużie	housing. agriculture. forest management	41.41	57.14	6.29	11.78	0.83
18	Zawady-Ponikiew	forest management	43.41	54.31	0.57	13.98	0.29

(poor soil quality, low share of agricultural land), the process of land consolidation may facilitate the arrangement of space for the development of non-agricultural functions. Moreover, the introduction of environmental programs contributed to the afforestation of low-quality agricultural land where agricultural production was unprofitable. The decline in agricultural land should also be linked to unfavourable demographic processes, including the ageing of the rural population and the migration outflow from peripheral areas. In the areas affected, some farms have been liquidated. The polarization of the agrarian structure and intense pressure from other economic functions have led to farmland shrinkage and changes in the share of particular land categories (Wilkin et al., 2018). Such areas are often distinguished by attractive natural and landscape values, a significant barrier to consolidation work (Siuta and Żukowski, 2018). On the other hand, these plots have favourable conditions for the development of agritourism as well as the construction of recreational (holiday) and residential buildings, already under way on very narrow plots of land. Consequently, this may lead to further aggravation of spatial chaos. As Bielska (2012) notes, agriculture and other non-agricultural functions have no chance to develop properly without the redevelopment of space by means of land consolidation. However, as Przegon (2007) adds, any land consolidation should demonstrate a positive or neutral environmental effect. Therefore, consolidation work must be included comprehensively to safeguard and protect environmental values.

ii. Including neighbouring concessions with similar characteristics and development potential in a single consolidation procedure is a beneficial measure. This approach can reduce overall costs since comprehensive land consolidation requires undertaking holistic and comprehensive measures that consider the needs of neighbouring villages and often extend beyond the boundaries of one precinct (Bielska, 2012; Siuta and Żukowski, 2018). The benefits that land consolidation and post-consolidation development can bring (Dacko, 2006; Bielska, 2012; Bielska and Kupidura, 2013; Land Management Plan, 2020) in rural areas include:

- improving the distribution of land;
- reducing the fragmentation of plots of land and adapting their boundaries to the system of water drainage facilities, roads, and relief;
- the creation of compact agricultural land complexes, reduction of boundary losses, and additional production on land previously used as balks;
- improved conditions for fieldwork;
- reduction of production costs and higher labour productivity (reduced working time, increased income);
- increased market value of plots of land and farms;
- establishment of a functional network of agricultural transport roads with appropriate technical parameters and surface conditions, as well as providing each post-consolidation plot with access to a public road;
- improvement of water conditions (carrying out detailed land

reclamation, modernization of watercourses and drainage ditches);

- creating conditions for the development of non-agricultural sources of income (tourism and recreation, including agri-tourism);
- development of technical and social infrastructure, as the local community indicates.

iii. In terms of improving water conditions and water management, the following measures should be considered:

1. Carrying out regular maintenance work along the entire length of the natural watercourses in the commune. These treatments should include cutting unnecessary trees and shrubs, mowing grasses, de-silting and cleaning the channels and performing other tasks conducive to facilitating the flow of water. The critical issue of keeping up-to-date data in the real estate cadastre should also be highlighted. This is particularly evident in the case of lands permanently covered by flowing waters (Hanus and Benduch, 2023).

2. Considering the prohibitions and restrictions under the Water Law of 20 July 2017 (Act, 2017) for areas at direct risk of flooding and the principles of their development resulting from the provisions of planning documents, e.g., low unmanaged greenery, meadows, and pastures as the preferred form of land use, prohibition of buildings intended for permanent human residence.

3. Carrying out an inventory of the technical condition of the existing network of drainage ditches throughout the commune to identify the need for investment work in the reconstruction, modernization, and maintenance of drainage ditches. Reconstruction and modernization measures are recommended primarily for drainage ditches in poor technical condition. They should include cutting redundant trees and bushes, mowing grasses, clearing overgrowth, and improving technical parameters, including profiling and deepening ditch slopes and bottoms. In the case of ditches in good technical condition, there is no need to carry out reconstruction. It is only recommended that regular maintenance work, mainly of mowing grasses and de-silting the bottom of the channels, be carried out. Maintaining the network of drainage ditches in good condition will result in proper regulation of water relations in terms of irrigation of soils in dry periods and drainage of excess water from excessively wet areas, thus minimizing the risk of local flooding and inundation. In addition, culverts under agricultural transport roads would need to be cleared or replaced.

4. Preserve existing, create new, and restore lost small retention reservoirs and keep them in good condition. Ponds, mid-field ponds, and other small water bodies perform several critical ecological functions (Dudzińska et al., 2016; Farmer, 2020), the primary one being to increase local water retention, manifesting itself in water storage and slowing down runoff, which is particularly important in the face of ongoing climate change and intensified extreme weather phenomena. In turn, during periods of drought, they have a beneficial effect on the water relations of adjacent land by recharging groundwater, which improves the moisture content of soils and prevents them from becoming excessively dry. Furthermore, small retention reservoirs diversify, enrich the rural landscape, and increase biodiversity, with mid-field ponds being a critical habitat for many animal species. In addition, the ponds within the village development have recreational potential which could be exploited through their restoration (cleaning up the area around the reservoir, desludging the bottom and slopes of the reservoir, making fortifications to the foot of the slope and the slopes of the reservoir) and then appropriate development (e.g., nature trails, gazebos, small size architecture, lighting, designated fishing spots).

iv. To preserve, enhance, and adequately protect the natural and landscape values, the following is proposed:

1. To continuously strive to preserve the natural values of the

legally protected areas in the study area (commune) designated as a Natura 2000 area by strictly enforcing the protection principles.

2. To carry out a detailed natural inventory, including in particular the areas valuable in terms of nature and predisposed to be covered by legal protection, as well as in terms of a precise inventory of plants and animals occurring in the entire commune, allowing for the determination of a specific number of protected plant and animal species and the specification of their primary feeding and breeding sites.

v. To properly shape the natural environment and protect agricultural land in the commune, the following is recommended:

1. Proper protection and prohibition of development and afforestation of agricultural land of high quality and suitability for agriculture (soil quality class III) and limitation of change of use for non-agricultural purposes of agrarian land of class IV.

2. Carrying out appropriate agrotechnical procedures (cultivating fields across or diagonally to the slopes, carefully selecting crop species, avoiding monocultures, using catch crops and inter-crops) and creating margins of dense grass and shrub vegetation to counteract erosion processes.

3. Afforestation of forest enclaves, inferior quality soils (classes V, VI, and VIz) where agricultural production is unprofitable, land set aside, and covered with trees and shrubs forming complexes with existing forests. In planned afforestation, efforts should focus on creating large and compact forest complexes, levelling the agroforestry border, and rationally shaping the forest edge zone. The agroforestry border separates areas with different types of use – agriculture and forestry (Łupiński, 2008). The proximity of agricultural and forest areas may have a negative impact on these areas. Such spatial interactions may contribute to a reduction in crop yields or lead to disturbances in the composition of natural species in forest vegetation. To ensure that the degree of conflict between the agricultural and forest ecosystems is as low as possible, the priority is to shape the forest edge zone rationally, for example, through planning a strip of low (shrub) vegetation, creating a gentle transition between the agricultural and forest complexes, or designing transport routes on the border of agricultural land and forests. There are environmental and economic arguments in favour of this solution (Łupiński, 2008). Together with the land use and agricultural plan, a project of the agroforest border should be developed, which will comprehensively determine the intended use of land for afforestation.

4. Preservation of existing and planning of new linear trees and bushes along roads, natural watercourses, drainage ditches, and balks. They perform an essential natural and aesthetic function, increasing the environmental biodiversity and enriching the landscape of rural areas (Karg, 2003; Nowak-Rzasa, 2010). The above-mentioned spatial forms also have a beneficial effect on the protection of agricultural land. They prevent wind and water erosion by weakening the wind force and reducing surface water runoff. In addition, they improve moisture conditions (increase soil retention), prevent snow drifts on roads, protect waters from pollution from agricultural fields, and co-create a local network of ecological corridors between natural ecosystems. The existing linear tree and shrub plantings in the commune should be identified during the field inventory and then designated for proper maintenance – provided there are no significant limitations (e.g., they prevent the proper flow of water in watercourses or ditches, or pose a threat to traffic safety on the road). The plantings should form a harmonious arrangement with other valuable natural elements. When creating new tree and shrub belts, species characteristic of the local landscape should be used.

vi. In terms of improving agricultural production space, the following are indicated:

1. Identify all changes in use and land set aside in the commune and their development. Updating the land and building records

database is also crucial for the comprehensive use of this data (Cienciała et al., 2023). Determining the development direction for these lands should be preceded by a thorough analysis of their location, the degree of vegetation cover, the type of use of adjacent lands, and the intended use of the land as outlined in planning documents. It is proposed that the set-aside areas located in the village development zone, or its close vicinity should be excluded from agricultural production for investment purposes by the applicable planning documents of the commune. It is recommended to restore arable land and grassland areas that have been fallow for a relatively short time for agricultural use, especially those relatively well-located, surrounded by other arable land, and on soils of better quality than classes VI and VIz. Restoring land to agricultural use will require appropriate maintenance (e.g., cutting out growing vegetation) and agrotechnical measures (e.g., discing, cultivating, ploughing, harrowing). In turn, the land set aside for afforestation should be earmarked for land that has not been cultivated for an extended period, overgrown with trees and shrubs, located close to existing forest areas or in forest enclaves, and on soils of extremely poor quality where agricultural production is unprofitable.

2. Development of wasteland depending on its potential:

- wastelands characterized by natural usefulness (e.g., by increasing biodiversity) and landscape values, such as natural, water-filled depressions – left in their current natural use;
- wasteland constituting forest enclaves or located near forest areas – afforestation or leaving for natural succession;
- wasteland located in the village development zone, e.g. existing ponds – development for recreation;
- wasteland within the development area – intended for investment purposes by the applicable municipal planning documents.

3. Reclamation of areas requiring this procedure, e.g. sand and gravel excavations.

vii. In order to create more favourable economic conditions in agriculture, there is a need to rationally shape the agricultural transport road network. As part of this assumption, it would be necessary to undertake activities related to the reconstruction and modernization of roads. The need to implement improvement work should result from a previously conducted qualitative and quantitative inventory of existing roads. Road modernization should primarily provide appropriate technical parameters (including widening the road lane) and hardening the surface. First, improving the roads that are most exposed to loads and high traffic intensity of agricultural vehicles and machines would be necessary. The reconstruction and modernization of agricultural transport roads should be complemented by activities related to modernizing culverts on drainage ditches and the design and arrangement of roadside trees and shrub strips (on one or both sides). Moreover, the modernization of the agricultural transport road network, which has been developed comprehensively, may be used to designate new tourist routes. Creating a functional network of agricultural transport roads may be one of the corrective actions carried out as part of comprehensive land consolidation work.

viii. Planning the exclusion of land from agricultural use for investment purposes, including residential, recreational, and service development, by the goals and principles in the primary planning documents shaping the commune's spatial policy.

ix. In order to improve the quality of life and expand infrastructure in the countryside, a field inventory should be carried out, and numerous consultations should be organized with representatives of the Commune Office and the local community of each village in order to jointly determine the existing problems and learn about the expectations and most essential needs of residents in terms of providing social and technical infrastructure. Examples of investments in the field of village renewal may include,

among others, the modernization of municipal and district roads, the construction of sidewalks and bicycle paths, the renovation of village community centres and fire stations, the construction of a sewage system, and the construction or modernization of sports fields and playgrounds. Sources of financing activities aimed at improving the quality of life in the countryside through the construction and modernization of social and technical infrastructure may include funds obtained from the commune's funds, provincial and government subsidies, or from European Union funds, among others.

x. As part of the development of the tourist and recreational offer, it is proposed to consider the following activities:

1. The construction of a network of hiking and bicycle trails in the commune will connect the commune's most critical areas and natural and landscape objects. This assumption also includes constructing a network of connected bicycle paths, which will continue in neighbouring communes.

2. Arrangement of recreational and camping areas with elements of small scale architecture along the planned tourist routes. Information boards marking rest areas and educational boards with maps and descriptions of places and facilities attractive in nature, landscape, and culture should also be placed along the trails.

3. Supporting agritourism activities as a form of recreation for potential tourists. The development of agritourism can significantly enrich the commune's recreational and accommodation offer for visitors and become an additional source of income for farmers. Special meetings should be organized with rural residents about the prospects and benefits of running agritourism activities, and information and assistance should be provided in obtaining financial aid for the launch and development of agritourism farms (e.g., under the Common Agricultural Policy under the LEADER initiative).

4. Improving the tourist accommodation base in attractive towns and building a network of hiking and cycling trails throughout the commune. The local plans of individual districts specify several locations with service functions, including trade and catering permits. By the principle of sustainable development, investments based on eco-development, harmoniously integrated with the surrounding space and nature, should be promoted.

The implementation of the aforementioned assumptions for the land use and agricultural plan of rural areas of the commune, especially those with an unfavourable spatial structure of plots and farms, will contribute to the sustainable and multifunctional development of rural areas in the field of agriculture, forest management, non-agricultural functions and improvement of the condition of the natural environment. The document will develop the goals and directions of activities specified in the commune's planning documents and will comprehensively regulate spatial planning issues in rural areas. It should be noted that it will only be possible to carry out a portion of the land use and agricultural work included in the land use and agricultural plan simultaneously across the entire commune, as it requires significant time and financial resources. As a result, the task of each plan is also to determine the degree of demand for land use and agricultural work in individual areas and to establish a rational sequence in implementing individual solutions.

4 Summary and Conclusions

The takeover of land from agriculture or forestry by other economic sectors should be considered a natural consequence of socioeconomic development (Aliyu et al., 2020). What is disturbing, however, is that virtually continuously since the mid-1990s, mainly agricultural lands with high utility values have been used for purposes unrelated to producing agri-food raw materials. Legal provi-

sions protecting these valuable resources, which co-create natural capital, are ineffective in practice (Wilkin et al., 2018). One of the possible, and at the same time, available tools for quickly and effectively taking the necessary corrective actions is the preparation of agrarian plans for municipalities.

The area of agricultural land in the Masovian Voivodeship, similarly to the entire country, is decreasing, and this decline is accelerating. This process is related to the takeover of agricultural land for residential development, among others. Continuing this trend may permanently and irreversibly reduce the agricultural production potential of the region. The widespread construction of roads, primarily national and provincial roads, causes deterioration of traffic conditions.

The internal conditions of Mazovia, and above all, the enormity of needs in the field of shaping rural space, necessitate the development of land use and agricultural plans in the communes of the Masovian Voivodeship.

Based on the analyses and the described conditions and directions of rural areas development in the example of the Różan commune, it should be stated that a rational, long-term spatial policy depends on local governments. Effective coordination of spatial planning at the local level, setting the overarching directions and principles for spatial development in municipalities, and ensuring good quality planning documents may help to mitigate the unfavourable trend of agricultural land loss.

As shown in this study, the Różan commune, as well as the entire region of Mazovia in which the commune is located, is highly diverse and has an unfavourable agrarian structure, with its main weakness being the fragmentation of the area structure of farms. Moreover, many villages have fragmented and excessively elongated plots, which adversely affect the efficiency of agricultural production and may have a negative impact on the value of farms and individual plots when they are put up for sale (Bielska, 2012).

The example of the Różan commune also highlights the importance of conducting a reliable analysis of the existing situation for the development of agriculture in particular, and more broadly, of rural areas. Based on the analysis, actions aimed at their development should be proposed.

To sum up, the analysis carried out in the Różan commune and the experience of Lower Silesia, as well as Mazovia, allow us to conclude that:

- The land use and agricultural plan can be an excellent tool for the comprehensive implementation of spatial planning regulations for rural areas while effectively supporting the implementation of the provisions of planning documents. Therefore, comprehensive spatial planning in rural areas should be carried out based on closely related land use and agricultural plans, local spatial development plans, and other planning studies.
- The critical means of preparing rural space for ongoing structural changes should be land use and agricultural activities.
- Due to the broad scope of information and the role of land use and agricultural plans, they should become legally regulated documents and be obligatory for every rural and urban-rural commune.
- An essential point in the development of the land use and agricultural plan is the field inventory, which should be comprehensive and include all elements affecting rural areas' development. An exciting and increasingly popular solution for conducting an inventory may be using uncrewed aerial vehicles (drones), which enable quick and precise data collection, generating time and economic savings.
- Rural areas in the Różan commune require several land use and agricultural measures, such as land consolidation, afforestation, and a functional network of agricultural transport roads necessary to achieve primary goals and maximum benefits.
- Without an adequately shaped spatial structure, rural areas' multifunctional and sustainable development is practically impossi-

ble. Therefore, the initiative to arrange agrarian work should be in the interest of the commune and its inhabitants.

- Land consolidation should be comprehensive, i.e., consider agricultural, economic, and natural measures, which allows for implementing most land use and agricultural work as part of one procedure.
- Systematic and comprehensive development of rural areas is only possible if land use and agricultural work is consistently performed in a rationally defined sequence. Therefore, one of the tasks of the land use and agricultural plan is to determine the level of demand for land use and agricultural work for each registration district covered by the study.

Additionally, and equally important for local governments at all levels, the arrangements included in the commune's land use and agricultural plan may constitute the basis for applying for co-financing projects from the Common Agricultural Policy funds, particularly for obtaining EU funds for work related to the transformation of agricultural production space.

However, it should also be considered that there is a need to obtain financial resources to develop these plans. Another limitation to the rapid implementation of the proposed solutions related to development of the land use and agricultural plan in each commune may be the administrative and legal procedures, as well as the time required to carry them out. It is worth noting that currently, the land use and agricultural plan should consider the provisions of the general plan of the commune, which will require updating. Obtaining specialists in this field who could responsibly perform the implementation work may also be a significant challenge. According to the authors, the listed limitations and challenges can be slowly removed, but research in this area should undoubtedly be continued, focusing on the use of machine learning to improve the analytical and design work necessary to develop the land use and agricultural plans, among others.

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References

- Act (1982). Act of 26 March 1982 on land consolidation and exchange. Act. Journal of Laws, 2023, item 1197, Poland.
- Act (1989). Act of 17 May 1989 on Geodetic and Cartographic Law. Act. Journal of Laws, 2024, item 1151, Poland.
- Act (1990). Act of 8 March 1990 on Municipal Self-Government. Act. Journal of Laws, 2024, item 609, 721, Poland.
- Act (2003). Act of 27 March 2003 on Spatial Planning and Land Development. Act. Journal of Laws, 2023, item 977, 1506, 1597, 1688, 1890, 2029, 2739, Poland.
- Act (2017). Act of 20 July 2017 on Water Law. Act. Journal of Laws, 2023, item 1478, 1688, 1890, 1963, 2029, Poland.
- Akincza, M. and Sawilow, E. (2011). Gospodarka ziemią w planowaniu urzędzenioworolnym na Dolnym Śląsku (land management in agricultural planning in Lower Silesia). *Infrastruktura i Ekologia Terenów Wiejskich*, (4):119–127.
- Aliyu, Y. A., Youngu, T. T., Abubakar, A. Z., Bala, A., and Jesulowo, C. I. (2020). Monitoring and forecasting spatio-temporal LULC for Akure rainforest habitat in Nigeria. *Reports on Geodesy and Geoinformatics*, 110(1):29–38, doi:10.2478/rgg-2020-0009.
- Atkocevičienė, V., Juknelienė, D., Valčiukienė, J., and Orechovaitė, D. (2019). Comparative analysis of the selected land consolidation projects. *Baltic surveying*, 11(2):8–16, doi:10.22616/j.balticsurveying.2019.011.
- Bielska, A. (2012). Wpływ procesu scalenia gruntów na wielofunkcyjny, zrównoważony rozwój obszarów wiejskich (The im-

- part of land consolidation on the multifunctional, sustainable development of rural areas). *Infrastruktura i Ekologia Terenów Wiejskich*, (1/II):5–14.
- Bielska, A. and Kupidura, A. (2013). *Kształtowanie przestrzeni na obszarach wiejskich (Shaping space in rural areas)*. Oficyna Wydawnicza Politechniki Warszawskiej.
- Biernat-Jarka, A. (2009). Rozwój obszarów wiejskich w unii europejskiej (Rural development in the European Union). *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, 11(4):32–36.
- Cienciąła, A., Sajnog, N., and Sobolewska-Mikulska, K. (2023). Unreliability of cadastral data on parcel area and its effect on sustainable real estate valuation. *Reports on Geodesy and Geoinformatics*, 116(1):39–46, doi:10.2478/rgg-2023-0009.
- Dacko, A. (2006). Tworzenie warunków do rozwoju terenów wiejskich poprzez scalanie gruntów – Aspekt teoretyczny (Creating conditions for the development of rural areas through land consolidation – A theoretical aspect). *Infrastruktura i Ekologia Terenów Wiejskich*, (2/2):29–39.
- Dudzińska, A., Szpakowska, B., and Szumigala, P. (2016). Zbiorniki i ciek wodne w krajobrazie rolniczym (Reservoirs and watercourses in the agricultural landscape). *Więś i Rolnictwo*, 171(2):199–210.
- European Commission (2022). Common agricultural policy. Retrieved February, 2022; <https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy>.
- Farmer (2020). Śródpolne oczka wodne skutecznie zapobiegają suszy rolniczej (Mid-field ponds effectively prevent agricultural drought). Farmer, retrieved June, 2022; <https://www.farmer.pl/fakty/srodpolne-oczka-wodne-skutecznie-zapobiegaja-suszy-rolniczej,97158.html>.
- Geoportall Lower Silesia (2022). Municipalities' land-use plans. Retrieved March, 2022; <https://geoportall.dolnyslask.pl/imap/?gmap=gp60&gmap=gp60>.
- Gniadek, J. (2013). Ocena przestrzennego ukształtowania działek różniczan na przykładzie mściwojowa (Assessment of the spatial layout of the plots of differential dwellers on the example of Mściwojów). *Infrastruktura i Ekologia Terenów Wiejskich*, II(3):133–143.
- Government Portal (2023). Draft Act amending the Act on spatial planning and development and certain other acts. Retrieved March, 2022; <https://www.gov.pl/web/premier/projekt-ustawy-o-zmianie-ustawy-o-planowaniu-i-zagospodarowaniu-przestrzennym-oraz-niektorych-innych-ustaw>.
- Hanus, P. and Benduch, P. (2023). Technical aspects and consequences of establishing the shoreline in Poland. *Reports on Geodesy and Geoinformatics*, 116(1):85–92, doi:10.2478/rgg-2023-0014.
- Hartvigsen, M., Versinskas, T., Vidar, M., Mitic Arsova, K., Van Holst, F., and Gorgan, M. (2019). FAO recommendations on land consolidation legislation. In *Annual World Bank Conference on Land Poverty Washington DC, March*, pages 25–29.
- Hartvigsen, M. B. (2014). Land consolidation and land banking in Denmark: tradition, multi-purpose and perspectives. *Danish Journal of Geoinformatics and Land Management*, 47:51–73, doi:10.5278/ojs.tka.v12i4.7.987.
- Jiang, Y., Tang, Y.-T., Long, H., and Deng, W. (2022). Land consolidation: A comparative research between Europe and China. *Land Use Policy*, 112:105790, doi:10.1016/j.landusepol.2021.105790.
- Karg, J. (2003). *Zadrzewienia śródpolne, strefy buforowe i miedze (Mid-field woodlots, buffer zones and baulks)*. Min. Rolnictwa i Rozwoju Wsi, Biblioteczka Krajowego Programu Rolnośrodowiskowego, Agencja Reklamowo-Wydawnicza "Ski-graf", Warsaw, Poland.
- Kokoszewska, K. (2023). Uchwalenie planu ogólnego do 2026 roku – czy jest możliwe? (Adoption of the general plan by 2026 – is it possible?). Technical report, <https://www.lex.pl/uchwalenie-planu-ogolnego,28839.html>.
- Koreleski, K. (2009). Ochrona i kształtowanie terenów rolniczych w systemie kreowania krajobrazu wiejskiego (Protection and shaping of agricultural areas in the system of creating a rural landscape). *Infrastruktura i ekologia terenów wiejskich*, (4):5–20.
- Kowalewski, A., Markowski, T., and Śleszyński, P. (2018). Studia nad chaosem przestrzennym (Studies on spatial chaos). *Studia KPZK PAN*, 182(1–3).
- Land Management Plan (2020). Land Management Plan of Gzy Commune, Mazovia Office of Geodesy and Agricultural Devices in Ostrołęka. Prepared at the request of the Department of Digitisation, Geodesy and Cartography of the Marshal's Office of the Mazowieckie Voivodeship, Ostrołęka, Poland.
- Łupiński, W. (2008). Kształtowanie granicy rolno-leśnej jako element planowania przestrzeni na terenach wiejskich (Shaping the agro-forestry boundary as part of space planning in rural areas). *Czasopismo Techniczne. Środowisko*, 105:187–195.
- Markuszewska, I. (2012). Plany urządzeniowo-rolne gmin jako narzędzie planowania prac scaleniowych (Municipalities' land-use plans as a planning tool for consolidation work). *Problemy ekologii krajobrazu*, 33:235–241.
- Noszczyk, T. and Chaba, D. (2014). Analiza struktury władania, użytkowania i rozdrobnienia działek we wsi Lipnik (Analysis of the structure of ownership, use and fragmentation of plots in the village of Lipnik). *EPISTEME: Czasopismo Naukowo-Kulturalne*, 2(22):5–14.
- Nowak-Rzasa, M. (2010). Zadrzewienia śródpolne jako cenny element krajobrazów rolniczych (Mid-field afforestation as a valuable element of agricultural landscapes). *Acta Scientiarum Polonorum Administratio Locorum*, 9(4):99–106.
- Ossowska, L. and Janiszewska, D. A. (2015). Zróżnicowanie zasobów ziemi w krajach unii europejskiej (Diversification of land resources in European Union countries). *Problems of World Agriculture/Problemy Rolnictwa Światowego*, 15(30):102–111.
- Pijanowski, J. M., Bogdał, A., Książek, L., Wojewodzic, T., Kowalik, T., Wałęga, A., Zarzycki, J., Zadrozny, P., Nicia, P., Strużyński, A., et al. (2021). *Środowiskowe i społeczne efekty scaleń gruntów (Environmental and social effects of land consolidation)*. Wydawnictwo Uniwersytetu Rolniczego w Krakowie, Poland.
- Poczta, W. and Rowiński, J. (2019). *Struktura polskiego rolnictwa na tle Unii Europejskiej (Structure of Polish agriculture compared to the European Union)*. CeDeWu.
- Polish Standard (1997). Land management in agriculture. Terminology, Polish Committee for Standardisation (PN-R-04151).
- Przegon, W. (2007). Ochrona środowiska w projektach scaleniowych gruntów (Environmental protection in land consolidation projects). *Czasopismo Techniczne. Architektura*, 104(7-A):269–275.
- Resolution (2021). Resolution on adopting amendments to the Study of Conditions and Directions of Spatial Development of the city and commune of Różan. No. XXXIV.216.2021, Poland.
- Siuta, J. and Żukowski, B. (2018). Polskie dylematy scalania gruntów i urządzania terenów wiejskich. część 1. scalanie gruntów (Polish dilemmas of land consolidation and rural land management. Part 1. Land consolidation). *Inżynieria Ekologiczna*, 19(3):1–16.
- Skłodowski, P. (2014). *Podstawy gleboznawstwa z elementami kartografii gleb (Fundamentals of soil science with elements of soil mapping)*. Publishing House of the Warsaw University of Technology.
- Sroka, W. (2015). Historyczne uwarunkowania dominacji drobnych gospodarstw rolnych w rolnictwie europy środkowo-wschodniej (Historical determinants of the dominance of smallholders in Central and Eastern European agriculture). *Problemy drobnych gospodarstw Rolnych*, (4):61–73.
- Statistics Poland (2023a). General Agricultural Census 2020, Statistics Poland, Local Data Bank. Retrieved May, 2023; <https://bdl.stat.gov.pl>.
- Statistics Poland (2023b). Statistics Poland, Local Data Bank. Retrieved May, 2023; <https://bdl.stat.gov.pl>.

- Water Drive (2019). Multifunctional land consolidation in Denmark 2020–2021. Website by BORN. Retrieved March, 2022; <https://water-drive.eu/multifunctional-land-consolidation-in-denmark-2020-2021>.
- Wilkin, J., Bański, J., Hałasiewicz, A., Jadczyzyn, T., Jasiński, J., Korta, G., Milczarek-Andrzejewska, D., and Taszakowski, J. (2018). *Ziemia ginącym i podlegającym degradacji zasobem rolnictwa i obszarów wiejskich (Land a vanishing and degrading agricultural and rural resource)*. Fundacja na rzecz Rozwoju Polskiego Rolnictwa.
- Witkowska, E. (2019). Rola planów urządzeniowo-rolnych w rozwoju gminy, Wojewódzkie Biuro Geodezji i Terenów Rolnych w Gdańsku (The role of agricultural management plans in the development of a municipality, Voivodship Office of Geodesy and Agricultural Areas in Gdańsk). In *Refereed paper delivered at the Conference entitled "Spatial Planning in Local Authorities. Construction law"*.
- Woch, F. (2007). Organizacja przestrzenna gospodarstw rolniczych oraz jej wpływ na efektywność gospodarowania (Spatial organization of farms and its impact on management efficiency). *Studia i Raporty IUNG-PIB, Współczesne uwarunkowania organizacji produkcji w gospodarstwach rolniczych*, 7:117–137.
- Woch, F., Pijanowski, J., and Kuryłowicz, T. (2018). Kompleksowe zarządzanie obszarów wiejskich jako szansa dla rozwoju wsi (Comprehensive countryside management as an opportunity for rural development). *Polish Journal of Agronomy*, (33):16–32.
- Wójcik, J. (2012). Prace urządzeniowo-rolne w aspekcie polityki UE na przykładzie wsi Padew Narodowa (Management and agricultural works in the aspect of EU policy on the example of the village of Padew Narodowa). *Infrastruktura i Ekologia Terenów Wiejskich*, (1/II):79–91.
- Zaborowski, T. P. (2021). Przeszacowanie powierzchni terenów osadniczych w studiach uwarunkowań i kierunków zagospodarowania przestrzennego gmin w świetle zmian ustawowych z 2015 roku. Przypadek Radomskiego Obszaru Funkcjonalnego (Overestimation of settlement areas in general land-use plans in light of the 2015 Legal Amendments. the case of Radom functional urban area). *Studia Miejskie*, (42):61–85.