

Landscape analysis for sustainable land use policy: A case study in the municipality of Popielów, Poland

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ABSTRACT

Analysing landscape units and their characteristics is essential for understanding the interaction between landscape assessment and land use policy. By identifying the groups, types and sub-types of landscape character units, we attempt to qualify the characteristics and values of the landscape in the municipality of Popielów, Poland. Due to a variety of natural and cultural heritages in the research area, land use policy requires a holistic approach, and preserving landscape values remains a top preservation task. Priority landscapes were calculated by assessing three evaluation criteria: unique cultural values, unique natural values and representativeness. The results showed that land use policy and development plans have negative, neutral and positive impacts on priority landscapes. Negative impacts largely occurred on agricultural landscapes through the introduction of new functions, such as the area of exploitation, service buildings and production facilities. Neutral impacts included new residential housing, tourism services and production in small villages. Positive changes in the landscape included the expansion and increased connectivity of forest areas.

1. Introduction

Landscape delimitation, management and typology are common research topics in Europe (Aldred and Fairclough, 2003; Kistowski, 2007; Múcher et al., 2010) and in the world (Leathwick et al., 2003). One of the pioneering works in this research area was on landscape delimitation in Estonia, developed by Johannes Gabriel Granö in 1922 (Peil et al., 2004). Granö identified 22 landscape districts in Estonia based on homogeneous regions identified by cartographic methods with the use of orthographical, hydrographical, administrative and anthropo-geographical borderlines (Granö, 1922). In his approach, he used eyesight and other senses (Granö, 1929) and concentrated mainly on finding typical areas separated by diffuse border areas (Granö, 1924). His work provided the most systematic and scientifically grounded regionalisation of the Estonian landscapes, covering the entire territory of the country (Peil et al., 2004).

Following the birth of the European Landscape Convention and ratification by other countries, we observed the development of landscape protection law as well as related research and management tools. For example, landscape typologies have been developed for the Czech Republic (Kolejka and Lipský, 2014), Slovakia (Kozová et al., 2009) and Great Britain (Landscape Character Assessment, 2002).

The typology of the Czech landscape was developed by Löw et al.

(2005) and was based on three data layers to identify landscape mesotypes: natural features, social-economic conditions and cultural objects (Kolejka and Lipský, 2014). Landscape units comprised 160 classes at the scale of 1:200 000 and were identified by three-digit-codes: the first position represents the class of the settlement area, the second one gives information about land use, and the third one shows the georelief class (Löw et al., 2006).

Landscape Atlas of The Slovak Republic (2002) illustrates the natural landscape structure at a scale of 1: 500 000. The work is focused on identifying complex, synthetic natural landscape units with an emphasis on possible natural vegetation, called potential geosystems (Kolejka and Lipský, 2014). The territory of Slovakia is divided into 85 geoecological regions mapped and defined on the basis of a combination of bioclimatic conditions, geology and land form (Miklós et al., 2006).

Natural England developed a set of profiles for England's 159 National Character Areas (NCAs) based on wildlife, natural features and land use distributions. For each NCA, a document consisting of a description, opportunities, key facts and data, landscape changes and an ecosystem service analysis was published. One of the purposes of NCAs is to enable people and organizations based within particular landscapes to work collaboratively for the best interests of the natural environment. To work within the borders of NCAs, the British method of

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Landscape Character Assessment was developed. The method, known for its complex character, is divided into four steps: defining the purpose and scope of the assessment, desk study, field study, classification and description. Community groups, private practices, developers, landowners and employees of local authorities can benefit from this approach. To assess landscape character, the following five principles should be followed:

1. Landscape is everywhere, and all landscape and seascape has character;
2. Landscape occurs at all scales, and the process of Landscape Character Assessment can be undertaken at any scale;
3. The process of Landscape Character Assessment should involve an understanding of how the landscape is perceived and experienced by people;
4. A Landscape Character Assessment can provide a landscape evidence base to inform a range of decisions and applications;
5. A Landscape Character Assessment can provide an integrated spatial framework where a multitude of variables come together to give us distinctive landscapes (Tudor, 2014).

Landscape Character Assessment can also be integrated with other landscape approaches. Atik et al. (2015) present a moderate and technical approach based on an evaluation of different biophysical layers (Wascher, 2005) and an interpretive approach based on the visual and perceptible qualities of a landscape (Swanwick, 2002). They assume that elaborating LCA studies into landscape plans and calling for their integration within spatial planning has potential for use in the Turkish planning system. Innovative approaches are still required to combine public participation and planning processes with landscape quality objectives by means of LCA (Atik et al., 2015).

The project ELCAI (Wascher, 2005) shows a variety of landscape typologies or classifications and demonstrates the need for a common and geo-referenced classification system for landscapes of Europe (Mücher et al., 2010). The methodology to distinguish European landscapes, called LANMAP, was developed to meet this need (Mücher et al., 2010). LANMAP covers Pan-Europe and distinguishes landscapes on four levels based on climate, altitude and parent material (the fourth level includes 350 landscape types). However, a major emphasis on geographic landscape features and the absence of guidelines as to how this approach can be applied to lower levels of governance makes this method hard to implement for wider landscape approaches at the regional and local scales.

1.1. Background of landscape assessment in Poland

Since 2003, the Act on Planning and Development (2003 Journal of Laws, item 717) has been the main act describing the planning system at national, regional and local levels. The act briefly describes that when planning at national levels (National Spatial Development Concept), architectural and landscape values should be considered. It was not necessary to consider landscape values in the planning documents at the regional (Spatial Development Plan for the Voivodeship) and local levels (Local Development Framework including the general land use policy and Local Land Use Plan with a detailed plan for land use zones). The legal position of Poland explains the low number of research papers in the field of landscape planning. In project ELCAI, Poland was presented as one of the few countries that has not developed a national method of landscape character type mapping and/or landscape character assessment (Wascher, 2005). An analysis of 144 case studies in the field of landscape change drivers in 23 countries from 1990 to 2015 shows that Poland is located in the class of “2–3 studies per country” (Plieninger et al., 2016). Poland accepted the European Landscape Convention, compiled in Florence on 20 October 2000 (2006 Journal of Law, item 98), in 2004. It took almost 12 years to start the implementation.

Following the European Landscape Convention, an act was passed on 24 April 2015 that amended certain acts in connection with the strengthening of landscape protection tools (2015 Journal Of Laws, item 774). Subsequently, Poland planned to conduct a landscape audit at the regional scale covering the entire country (Myga-Piątek and Nita, 2015; Habuda, 2015; Chmielewski, 2013), which would be a legal document respected on regional and local levels. According to this act, the definition of landscape is very broad: landscape is defined as a “space perceived by people, containing environmental elements and creation of civilization, shaped as a result of acting environmental factors and human impact” (Klimczak, 2014). The Act also defines priority landscapes as “particularly valuable to society because of [their] natural, cultural, historical or aesthetic sites and as such demanding preservation.” This definition enables the use of different criteria to distinguish priority landscapes and refers to different scales. Executing an audit presumes action at both the country and regional levels. Shaping and preserving the environment, including landscapes, is handled at the local scale through land use policy. It is also necessary to distinguish and manage landscapes at the local scale (Krajewski, 2012, 2014). Adequately designing land use policy in the context of environmental preservation and sustainable development has been a popular research topic in the last decade, especially considering landscape management and extreme urban pressure (Van Eetvelde and Antrop, 2009; Krajewski and Raszka, 2011). In Poland, this issue is considered mainly in terms of the influence of spatial policy on landscape at the local scale (Heldak and Raszka, 2011; Kubacka, 2012; Heldak and Raszka, 2013a, b). The negative influence of local land use policy on landscapes has been observed in other countries (Boamah, 2013), and tools for sustainable landscape management have been developed in various fields. Ecological studies aim to inform land-use planning by providing clues for optimal ecosystem patterning to support nature conservation (Geneletti, 2005), such as measuring spatial road disturbance (Freudenberger et al., 2013). To determine how many planning objectives have been completed, local agri-environmental measures have been developed (Bastian and Luetz, 2015). Agricultural landscape management methods have been used for local planning (Dramstad et al., 2002). An integrated concept of landscape assessment and spatial planning in the context of landscape visual quality (Bulut and Yilmaz, 2008; Frank et al., 2013) was developed using indicators (Sowińska-Świerkosz and Chmielewski, 2016). The current trend in international research is linking landscape assessment with the ecosystem service concept (Frank et al., 2012; Groot et al., 2015).

Although landscape research in Poland is not highly developed compared to other European landscape studies, it is well worth noting its background. The history of landscape-focused research in Poland started in the 1940s, when “landscape cultivation” was described by Wodziczko (1946). In 1973, Bogdanowski analysed cultural landscapes and divided the landscape into architectural-landscape units. The main criteria to identify landscape units involved the “lay of the land” and land cover. Cultural landscapes were divided into harmonious and in-harmonious (Paprzycka, 2005). In 1990, Bogdanowski published the first Polish method for dividing landscape units and architectural-landscape interiors (a method known as JARK-WAK). In that time, Poland did not have a national landscape typology. Based on an international literature review, Majchrowska (2013) describes the following features of good landscape typology:

- A widely accepted theoretical base,
- Goal-oriented research,
- Harmonizing quality methods with a formal, quantitative and standardized approach,
- Flexible and transparent methodology,
- Development with help from stakeholders and practitioners.

The most current typology in Polish landscape-focused research is the “Typology of Poland’s current landscapes” (Chmielewski et al.,

2015). This typology is based on experience with previous typologies used within Poland and proposes a hierarchy of landscape structures divided by groups, types and subtypes.

In this paper, we use a Polish landscape typology to distinguish landscape units at the local scale. This process allows for the discussion of methods of identification and assessment of priority landscapes. The aim of the paper is to analyse the landscape characteristics and possible landscape changes and spatial conflicts across our study area. In this way, we are able to confront local-scale land use policy with priority landscape preservation, including natural (with features typical of untouched ecological systems) and cultural landscapes (understood as part of geographical land shaped by human impact, developed by natural-cultural impacts, with a specific structure and perceived as a regional landscape feature) (Nita and Myga-Piątek, 2006). We define landscape characteristics using landscape typology, and we identify possible landscape changes using development maps. We present results and predicted counteractions of those changes likely to appear at the local scale.

2. Data and methods

For the research area, we selected the municipality of Popielów (175.57 km²), located in the north-west region of Opolskie Voivodeship (Fig. 1). In the selection of a study area, we considered environmentally protected areas and a variety of protection forms in the municipalities of the Opolski district (Table 1). We consider four different forms of protection (National Park, Landscape Park, Nature Reserve and Natura 2000) for which protection plans are being prepared. Landscape analysis can also have an impact on land use policy in the formation of guidelines for environmental protection and can become a basis for formulating protection tasks. Across the analysed municipalities,

Popielów is marked by a large variety of protection forms (Landscape Park, Natura 2000 Special Protection Areas and Special Areas of Conservation), and 74 percent of its area is environmentally protected.

The municipality of Popielów is located in the north-western part of the Opolski district and Opolskie Voivodeship in southwest Poland. The geographical position of Popielów is within the region of Silesian Lowland (318.5), at the junction of 3 mesoregions. The south-west part is in Pradolina Wrocław, parts of the central and the eastern parts are found in the plains of Opole, and part of the north-western region is in the plains of Oleśnicka (landscape region classification as developed by Kondracki, 2000). The topography changes at a moderately low level between 0 and 20 m (150–170 as). The municipality is located within an ecological corridor of international importance (19 M Odra Valley), a biocentrum of international importance (17 M Odra Valley) and an area of national importance (10 K Bory Stobrawskie) included in the ECONET-POLSKA (Liro et al., 1995, according to the method and nomenclature of the European Ecological Network EECONET). This local corridor completes the structure of the regional corridor, Opole-Katowice (Górny and Jędrzejewski, 2011). To perform the delimitation of landscapes, we used a method developed for the purpose of the landscape audit (Solon et al., 2015). The spatial data used in analyses were collected from various sources (Table 2).

For this study, a typology of Polish landscapes was adopted based on the diversity of land cover, treated as a background landscape and developed for the audit landscape (Chmielewski et al., 2015). This landscape typology adopted a hierarchical structure, first distinguishing three groups of landscapes dependent on the degree of anthropogenic transformation. The second level of classification was divided into 15 types depending on the prevailing land cover. The third level included 49 landscape sub-types, identified on the basis of differences in spatial structure. The most characteristic element was the background

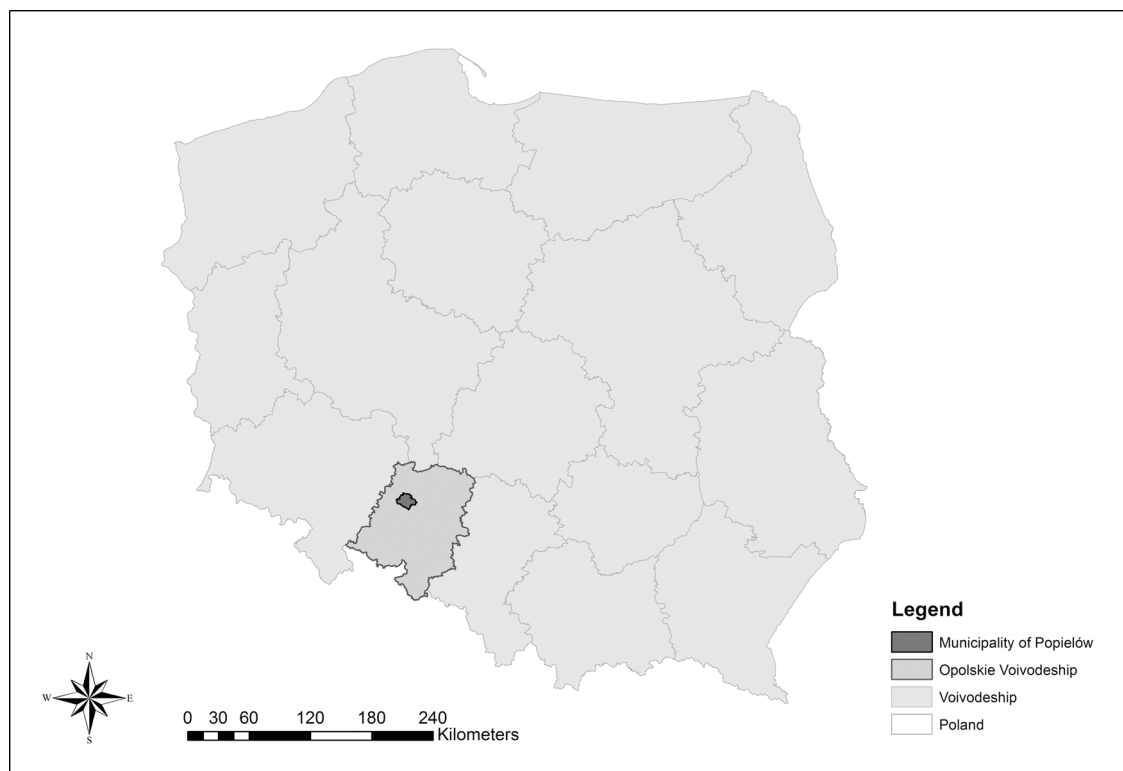


Fig. 1. Location of the study area—the municipality of Popielów, Opolskie Voivodeship, Poland (own elaboration based on data from Central Documentation Centre of Geodesy and Cartography).

Table 1

Area and variety of environmental protection forms in the municipalities of the Opolski district. The table does not include municipalities without any protection forms.

Name of the municipality in the Opolski District	Area of environmentally protected area in the municipality [%]	Variety of environmental protection forms
Dąbrowa	8	Natura 2000 Special Protection Areas, Natura 2000 Special Areas of Conservation, Nature Reserve
Chrzastowice	10	Natura 2000 Special Areas of Conservation, Nature Reserve
Murów	100	Landscape Park
Dobrzeń Wielki	24	Natura 2000 Special Protection Areas, Landscape Park
Łubniany	23	Landscape Park
Niemodlin	9	Natura 2000 Special Areas of Conservation
Tułowice	20	Natura 2000 Special Areas of Conservation, Nature Reserve
Popielów	74	Natura 2000 Special Protection Areas, Natura 2000 Special Areas of Conservation, Landscape Park
Prószków	0	Nature Reserve
Turawa	12	Natura 2000 Special Protection Areas

Table 2

Research procedure and data sources.

Levels of analysis	Elements of characterization	Data source
General information	Administrative position	State Register of Borders (Central Documentation Centre of Geodesy and Cartography), Geoportal 2
	Physical-geographical position Position in the system of ecological corridors	The boundaries subprovinces, macro- and physico mesoregions by Kondracki (2000) ECONET-POLSKA (Liro et al. 1995), Ecological Corridors System (General Directorate of Environmental Protection; Górny and Jędrzejewski, 2011)
Identification of landscape types and preliminary delimitation	Land cover structure	Database of topographic objects and Cadastral Data (Central Documentation Centre of Geodesy and Cartography), supplementary orthophotomap; Map of conditions - Annex graphic to Local Development Framework for the municipality of Popielów, 2015
Detailing the limits of landscape units	Types of forest habitats	Forest Data Bank
	Position in the system of nature preservation areas	General Directorate of Environmental Protection, Regional Directorate Environmental Protection, Central Register Form Conservation of Nature
Priority landscape identification	Elements of cultural heritage, nature preservation areas	Local Development Framework for the municipality of Popielów, 2015 (cultural values), Regional Directorate Environmental Protection (natural values)
Identification of spatial conflicts	Location of new investments, location of priority landscape units	Map of development - Annex graphic to Local Development Framework for the municipality of Popielów, 2015

landscape, understood as a structural element (or group of similar types of structural elements), which was highlighted due to its coverage of the dominant surface within the landscape. The background landscape was common for all the farthest points of the border landscape or was the background of most of the other elements of the spatial landscape ([Myga-Piątek and Solon, 2014](#)).

2.1. Identification of landscape types and preliminary delimitation

To identify landscape types, we used data on land cover structure and considered the concept that the landscape background might be agricultural land, forest, housing areas, etc. To identify landscape subtypes, we used orthophotomap (2015) and cadastral data (2016). To characterize rural landscape subtypes, we analysed the size, shape and location of the fields. To specify subtypes of forest landscape, we used data on forest habitats. After the first stage of analysis of the structure of land cover boundaries, landscape units were pre-defined.

2.2. Detailing the limits of landscape units

After the typological pre-identification of landscape units, we observed the location of existing formal borders (administrative, geodetic and existing protected areas) within the study area. We then checked whether these formal borders overlapped with the pre-designated borders of landscape types. It was then possible to adjust the landscape boundaries, where necessary, to the existing formal boundaries to delimit the landscape in the easiest and most effective way. The

adjustment of landscape borders was performed in such a way as to avoid changing the background of the landscape or the landscape structure. In this case, we have mainly taken into account the existing boundaries of protected areas as the greater part of the municipality of Popielów lies within a protected area. It should be noted that the boundaries between two landscape types have conventional, not formal, characters and are divided by transition zones of varying widths ([Solon et al., 2015](#)).

2.3. Priority landscape identification

We selected the following criteria based on landscape definitions in the European Landscape Convention ([Florence, 2000](#)) and a literature review. The ELC defines landscape as an area shaped by natural and human factors. We interpret natural values to be a result of natural factors and cultural values to be a result of human factors. The assessment of natural ([Dramstad et al., 2002](#); [Bastian and Luetz, 2006](#); [Frank et al., 2012](#); [Brown and Brabyn, 2012](#)) as well as cultural values ([Dramstad et al., 2002](#); [Brown and Brabyn, 2012](#); [Sowińska-Świerkosz and Chmielewski, 2016](#)) is a focal point in landscape assessment research. The criteria for representativeness were chosen to identify units with features typical for the region. We identified representativeness as the main, or most extended, landscape that comprises a number of landscape units ([Molina et al., 2016](#)). Representative landscape type means that the landscape unit has a character that is perceived by people as typical of the region ([Krause, 2001](#)) and that is distinguishable from other kinds of landscapes ([Antrop, 2000](#)). A quantitative

Table 3
Quantitative assessment of landscape value criteria.

Characteristics of natural value	Points
Lack of nature-protected areas within landscape unit.	1
Nature protection area within landscape unit.	2
Two or more forms of nature protection within landscape unit.	3
Characteristics of cultural value	Points
Lack of conservation areas.	1
Conservation area within landscape unit.	2
Two or more conservations areas within landscape unit.	3
State of representativeness	Points
Landscape type covers area of 0%–10%	1
Landscape type covers area of 10%–29%	2
Landscape type covers area of 30%–100%	3

approach is presented in Table 3. The following evaluation criteria were used to identify priority landscapes:

Unique natural values - a landscape of unique natural value was characterized by a unique set of characteristics of natural value, especially where perceived as valuable for the community, very rare or not seen anywhere else in the community. It included areas covered by forms of nature protection (e.g., national and landscape parks, nature reserves, protected landscape areas, Natura 2000 sites, ecological sites and landscape-nature protected complex areas), evaluated on a scale of 1–3 for each unit;

Unique cultural value - a landscape of unique cultural value was characterized by a unique set of characteristics of cultural value, providing high individuality, uniqueness, distinctiveness, or high rarity (or not seen anywhere else in the community), including areas under conservation protection, evaluated on a scale of 1–3 for each unit;

Representativeness - this included landscapes typical of the municipality, with features typical of the region in relation to its identity and particular subtype and characterized by optimal functioning of the landscape, evaluated on a scale of 1–3 for each unit.

Although a weighted sum can be used for criteria that are more important and those that degrade the landscape (Lee et al., 1999), in our approach, all values have equal importance for a particular landscape, so the points for each criterion could be summed:

$$LV_{total} = LVN + LVC + R,$$

where LV_{total} is the total landscape value, LVN is the natural landscape value, LVC is the cultural landscape value, and R is the representativeness of landscape type. The total landscape value was calculated for each landscape unit.

2.4. Identification of spatial conflicts

In landscape planning, many different interests for limited space must be weighed against each other (Groot, 2006). We assessed land

use changes that have negative, natural or positive influences on landscape. We identified land uses changes that have positive influences on landscape as changes that are ecologically, socially, and economically beneficial (Leita and Ahern, 2002). A map of priority landscapes was superimposed on the attachment graphic of the Local Development Framework for the municipality of Popielów (2015). The result was an image allowing us to determine whether policy is consistent with the community landscape approach. This also indicates the location of threats to priority landscapes. All analyses were performed at a scale of 1:10,000 using the program ArcGIS.

3. Results and discussion

According to land cover structure, we identified two groups of landscape types and three landscape types within the study area: marshy-meadow, rural and forest. Land cover structure is based on a database of topographic objects at a scale of 1:10,000. It enables us to outline the borders of rural and forest landscapes. Popielów has an agroforestral character as it is covered by forest and agricultural land (Table 4). Other areas (e.g., housing) that appear within the land use structure were included in the rural landscape as they do not meet the criteria for landscape background.

3.1. Identification of landscape types

According to the “Typology of Poland’s current landscapes” (Chmielewski et al., 2015), we identified the following types and subtypes of the landscape (Fig. 2A–D):

Group A: Natural landscapes of cultural (usually extensive) use, functioning mainly as a result of natural processes, modified by human activity only in varying degrees; they represent 53% of the study area.

Landscape type: A2. marshy-meadow - mostly treeless (5%). A2a, including extensively used wetland meadows dominated by

Table 4
Land use structure in the municipality of Popielów (own study based on Local Development Framework for the municipality of Popielów, 2015).

Land use	Area [ha]	Area [%]	Landscape type
Farmland including	8247 ha	47%	Rural (B6)
- agricultural land	5829 ha	33%	
- orchards	10 ha	0%	
- meadows and pastures	2408 ha	14%	Partly classified as marshy-meadow (A2) and partly as rural landscape (B6)
Forests and woodlands	8294 ha	48%	Forest (A3)
Other areas e.g., housing estates, water, waste	1016 ha	6%	Included in other landscape types
Total area of the municipality	17,557 ha	100%	

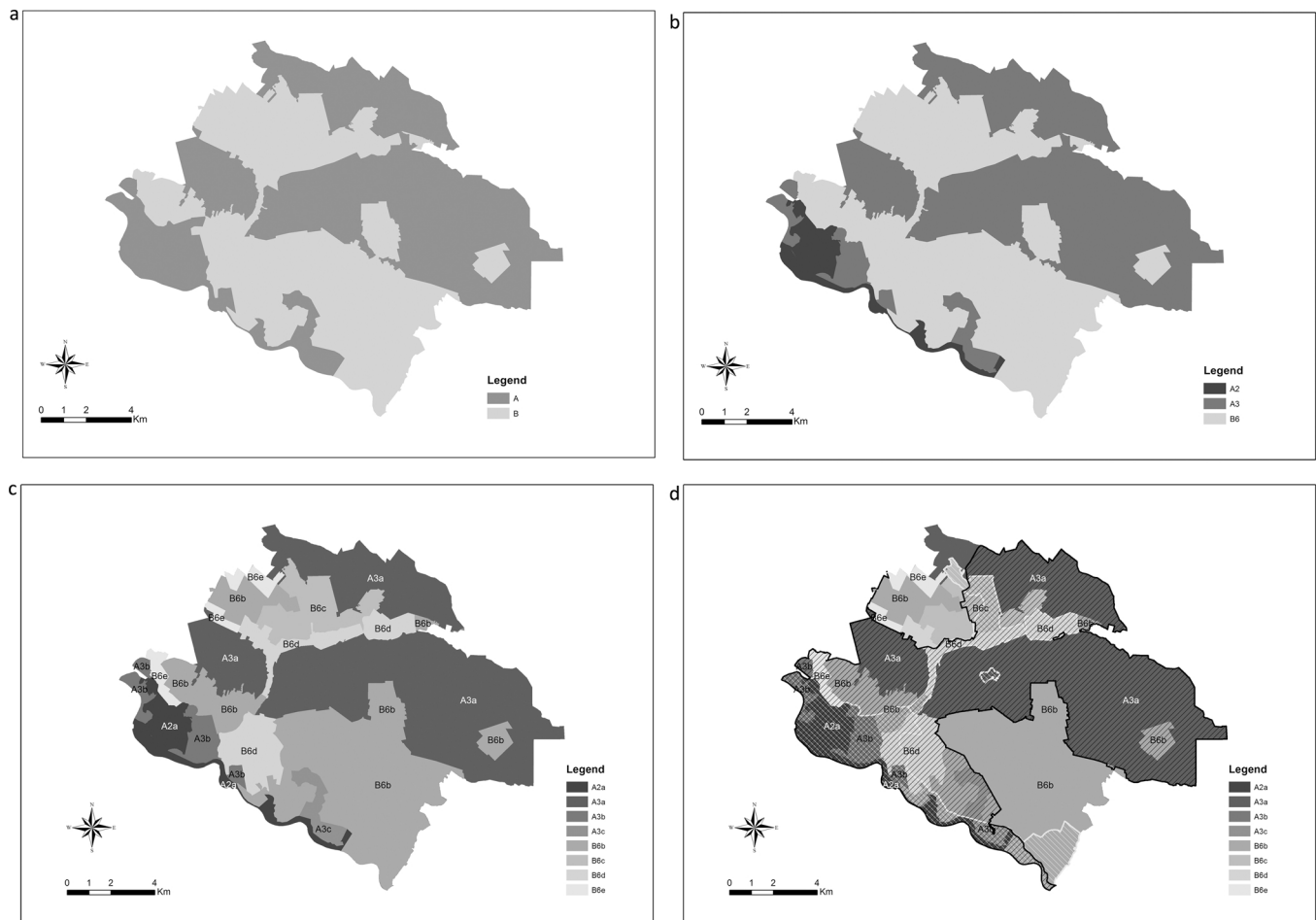


Fig. 2. A) Landscape groups in the municipality of Popielów. A - natural landscapes of cultural (usually extensive) use, functioning mainly as a result of natural processes, modified by human activity only in varying degrees. B - natural and cultural landscapes formed as a result of the joint action of natural processes and the conscious modification of land cover and spatial structure by man. B) Landscape types in the municipality of Popielów. A2 - marshy-meadow - mostly treeless; A3 - forest; B6 - rural (agricultural). C) Landscape sub-types in the municipality of Popielów. A2a - including extensively used wetland meadows dominated by *Cnidion dubii*; A3a - with a predominance of coniferous forest habitats; A3b - with a predominance of deciduous forest habitats; A3c - with a predominance of riparian habitats, wetland and alder; B6b - predominantly longitudinal structures of arable fields, meadows and pastures; B6c - predominantly a mosaic spread of small-sized agricultural lands; B6d - with a predominance of a mosaic spread of agricultural land forming an average field size; B6e - with a predominance of large-scale fields and/or meadows and pastures. D) Landscape sub-types after delimitation in the municipality of Popielów. A2a - involving extensively used wet meadows dominated by *Cnidion dubii*; A3a - with a predominance of coniferous forest habitats; A3b - predominantly forest habitats; A3c - with a predominance of riparian habitats, wetland, alder; B6b - predominantly longitudinal structures of arable fields, meadows and pastures; B6c - predominantly a mosaic spread of small-sized agricultural lands; B6d - predominantly a mosaic spread of average-sized agricultural lands; B6e - predominantly large-scale fields and/or meadows and pastures.

Cnidion dubii (5%).

Landscape type: A3. forest (48%)

A3a, with a predominance of coniferous forest habitat (43%)

A3b, with a predominance of deciduous forest habitats (3%)

A3c, with a predominance of riparian habitats, wetland and alder (2%).

Group B. Natural and cultural landscapes, formed as a result of the joint action of natural processes and the conscious modification of land cover and spatial structures by man. It constitutes 47% of the commune.

Landscape type: B6. rural (agricultural) 47%.

B6b, predominantly longitudinal structures of arable fields, meadows and pastures (30%)

B6c, predominantly mosaic spread of small-sized agricultural lands (6%)

B6d, predominantly mosaic spread of average-sized agricultural lands (8%)

B6e, predominantly large-scale fields and/or meadows and pastures (3%).

3.2. Identification of areas of high natural values

The municipality contains several forms of nature protection, as referred to by the Act on Protection of Nature from 16 April 2004 (2013 Journal of Laws, item 627). These areas of protection include Stobrawski Landscape Park, Natura 2000 sites (Special Protection Area Grądy Odrzańskie PLB020002, Łąki w okolicach Karłowic and Stobrawą PLH160012), and several ecological areas: “Geśi Staw” (3.14 ha area, established in 1997) and “Puchacz” (6.55 ha area, set up in 2004). A Natura 2000 site and the Stobrawa Landscape Park within the town of Popielów are located wholly within the network of ecological corridors ECONET-POLSKA, which reinforces the importance of the ecosystem. Within the area of ecological corridors, the following towns are found: Stobrawa, Stare Kolnie, Kuźnica Katowska, Kaniów, Rybna, Popielowska Kolonia, Kurznie, Karłowice, and Lubienia. Outside of the area of ecological corridors lie the following towns: Popielów, Nowe Siołkowice, and Stare Siołkowice. The following towns have legal nature protection and are included in the network of ecological corridors: Stobrawa, Stare Kolnie, Kuźnica Katowska, Kaniów, Rybna, and Popielowska Kolonia (Fig. 3).

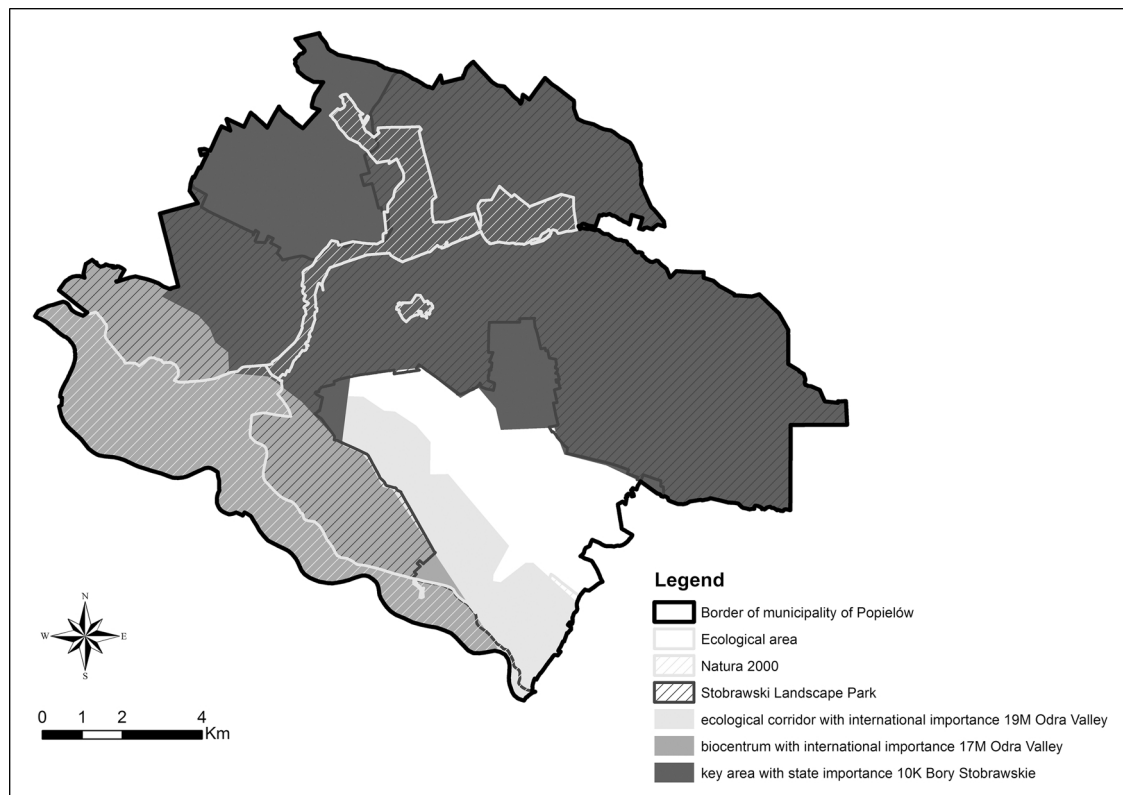


Fig. 3. Natural protected areas and ecological corridors in the Municipality of Popielów (study based on data from General Directorate of Environmental Protection and Liro).

3.3. Identification of areas of high cultural values

Legally protected cultural areas are located in the following villages: Kurznie, Karłowice, Lubienia, Popielów, Nowe Siołkowice and Stare Siołkowice. The village of Kurznie is under strict conservation protection, within a so-called designated zone “A,” as required under the Act of Protection of Monuments and Care of Monuments from 23 July 2003 (2003 Journal of Laws, item. 1568). Other villages (including Stare Siołkowice, Popielów, Popielowska Kolonia, Rybna, Stare Kolnie, Stobrawa, Kurznie, Lubienia and Kaniów) are designated “B” zones of conservation protection (a total of thirteen zones within the study area). The designation of conservation protection zones in these towns was formed because of rural systems with historic buildings from the Middle Ages. This involved the preservation of the following rural structures: historic building complexes, castles and the surrounding landscape (in the village of Karłowice).

3.4. Landscapes representative of the community

Landscape units were analysed in terms of the number of units of a

given type and total area (in km² and % of total area). On the basis of this analysis, the following landscapes representative of the community were identified: forest landscape with a predominance of coniferous forest habitats (A3a) and rural (agricultural) with a predominance of longitudinal structures of arable fields, meadows and pastures (B6b) (Table 5).

Based on the previously described criteria, each unit was assessed on a 1–3 point scale. The top-scoring units were classified as priority landscapes (Fig. 4).

3.5. Land policy and landscape character

To identify threats to priority landscapes and determine the coherence between landscape types and spatial policy, we have illustrated a map of spatial conflicts. After determining the relationship between the directions of development of the municipality (based on a map of development – Annex graphic to Local Development Framework for the municipality of Popielów, 2015) and the landscape sub-types, a characterization of potential conflicts is presented and described (Fig. 5, Table 6). We interpret spatial conflict as a land-use conflict that occurs

Table 5
Representativeness of landscape sub-types.

Landscape sub-types	Number of units within sub-type	Area of landscape units within sub-type [km ²]	Area of landscape units [%]
A2a including extensively used wetland meadows dominated by <i>Cnidion dubii</i>	2	8,97	5
A3a with a predominance of coniferous forest habitats	3	59,73	34
A3b with a predominance of forest habitats	4	5,44	3
A3c with a predominance of riparian habitats, wetland and alder	1	3,05	2
B6b predominantly longitudinal structures of arable fields, meadows and pastures	5	53,48	30
B6c predominantly a mosaic spread of small-sized agricultural lands	1	10,50	6
B6d predominantly a mosaic spread of average-sized agricultural lands	2	13,63	8
B6e predominantly large-scale fields and/or meadows and pastures	3	20,77	12

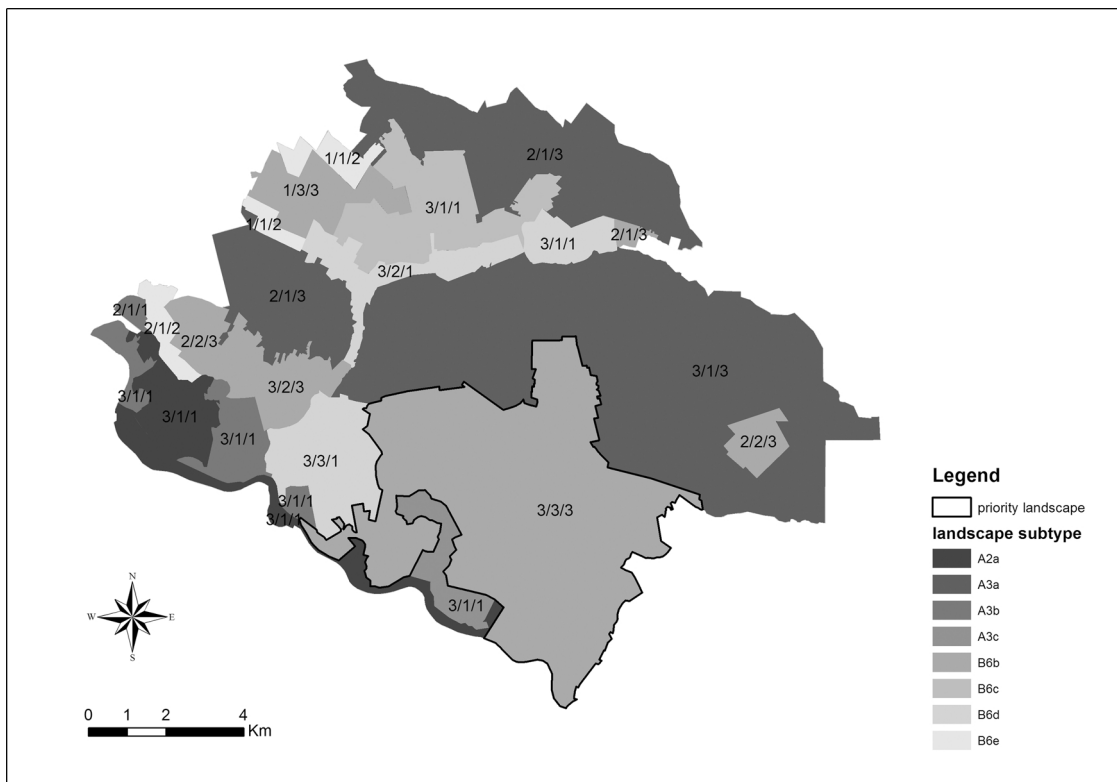


Fig. 4. Identified landscape sub-types and partial scores in each criterion (natural value/cultural value/representativeness) in the municipality of Popielów (own study).

whenever land-use stakeholders have incompatible interests related to certain land-use units (Von Der Drunk et al., 2011). For example, the location of the exploitation of raw materials, service buildings, production facilities or warehouses in areas of high natural and cultural

value with a character representative of the municipality is considered a land-use conflict. We outline the following conflict types: reduction of agricultural production, negative visual impact and nature conservation (changes in natural environment, disturbance of habitat, loss of

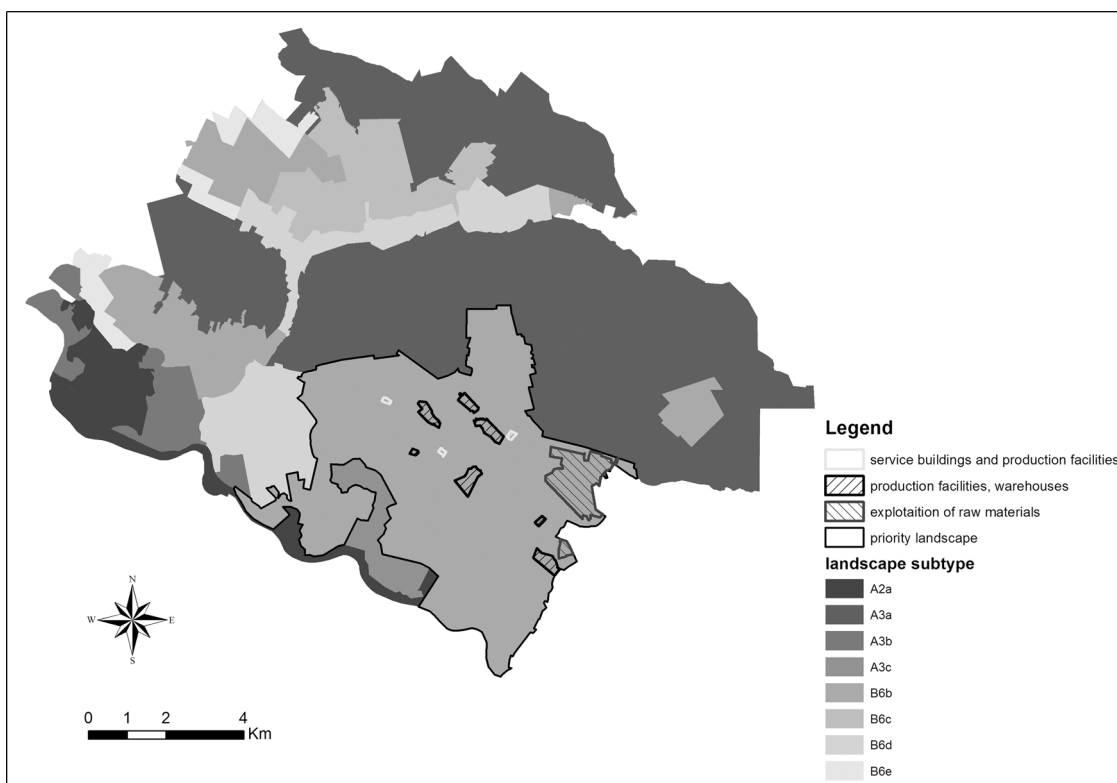


Fig. 5. Map of spatial conflicts between development maps and priority landscape units, presented alongside landscape typology.

Table 6
Results and possible counteraction of spatial conflicts.

Landscape sub-type	Change in land use	Result	Counteraction
B6b predominantly longitudinal structures of arable fields, meadows and pastures	From farmland to exploitation of raw materials	Changes in the ecosystem; changes in the physiognomy of the landscape; the emergence of new dominant surfaces, which could lead to a change in landscape type.	Creation of woods in adjacent areas in order to reduce any negative impact on the ecosystem from the potential land use changes and to reduce the impact on landscape physiognomy.
	From farmland to service buildings and production facilities; production services	Growing number of buildings due to service development and an increase in production facilities on the outskirts of built-up areas; the lack of an obvious service-production centre.	Adaptation of service development to meet the characteristic types of residential development in the region, combining residential and service functions; creating a centre of production in order to focus this type of development in one area and minimize its impact on the physiognomy of the landscape.
	From farmland and service to production facilities, warehouses	Changes in the physiognomy of the landscape (the dominant surface); scattered locations of buildings; change in nature of buildings; change in character of the landscape.	Creating a production centre in a suitable location (suitable for communication and connection purposes), which would have less impact on the landscape than dispersed production buildings; location of warehouses and storage facilities to be found in one area.

retention capabilities) (Von Der Drunk et al., 2011).

After a theoretical analysis of the urban planning adopted by the Municipality of Popielów, the following changes have been interpreted as having a neutral impact on the landscape.

- Planned new residential, service and production features in small villages (Popielowska Kolonia, Rybna, Stare Kolnie, Stobrawa, Kurznie, Karłowice, Kuźnica Katowska, Kaniów, Lubienia and Nowe Siołkowice) that should not alter the landscape character of individual landscape units. The greatest landscape changes are noted in satellite villages around large cities and along new transition roads (Bański and Wesołowska, 2010). As the municipality of Popielów is not directly connected to any large city or transition roads, new residential, service and production features will not have a negative influence on landscapes if they meet certain conditions. We must be aware of the appropriate regulations for new buildings because development may pose a threat to the rural landscape, particularly in the following towns: Popielowska Kolonia, Rybna, Stare Kolnie, Stobrawa, Kurznie, Lubienia, Kaniów and Karłowice. It must be noted that these are within conservation zones A and B as well as being part of a complex, historic and rural system of cultural value.
- Planned new tourism services near water (Stobrawa) that should not alter the structure of the landscape but should consider that this area lies within the Stobrawski Landscape Park. Tourism can have negative (Rico-Amoros et al., 2009) as well as positive (Gulinck et al., 2001) impacts on the landscape. We assess this land use change as positive. The size and location of tourism services should not change the landscape character and should meet the challenges of ecotourism. It is worth noting that the main centres of residential services, mining and manufacturing have been planned outside protected areas (Natura, 2000, Stobrawski Landscape Park).

The following has been rated as a positive change:

- Planned integration of forest areas, which will change the course of

the agro-forestry border and change the proportion of the agricultural landscape of the forest. Such a change is not interpreted as negative, especially as it contributes to an increase in forest cover and forest fragmentation is related to the deforestation or loss of forest cover (Nagendra et al., 2004).

4. Discussion and conclusions

The integration of natural and cultural qualities, together with the concept of representative landscapes, offers a basis for landscape value assessment for sustainable land use. Because landscape character is undergoing constant change, landscape value assessments need to be completed at periodic intervals, such as every five years. To adopt this methodology for wider use, the pros and cons should be considered (Table 7). The determination of landscape units at the local level is the first step to achieving sustainable landscape management (Richling, 2013). Studies such as this one are part of the current ongoing research on European landscapes (LANMAP, 2010) at the national level (Peil et al., 2004; Kolejka and Lipský, 2014; Kozová et al., 2009; Chmielewski et al., 2015), the province level (Kistowski, 2007) and within a local context (ECOVAST Landscape Identification, 2012).

Numerous examples from the literature show that landscape value assessment can be used as a tool for sustainable land use. One of them is the combination of socio-economic and landscape quality valuation used for prioritization of conservation activities and identification of opportunities for sustainable landscape development. The method was tested in the province of Spain with the use of different tools such as social preferences, contingent valuation and GIS (Molina et al., 2016). To identify how residents value their local environment in Ogasawara Islands, Japan 14 landscape values were assessed with the use of questionnaires, interviews and mapping (Havas et al., 2016). The results show which values need further improvement and the research is considered by the authors as having much to offer in terms of informing local policy-making. Gómez-Sal et al. (2003) uses landscape metrics to assess ecological, economic and productive value for each municipality in the region of Madrid, Spain. This model allows to examine how

Table 7
An evaluation of the method of priority landscape assessment at a local level.

Pros	Cons
<ul style="list-style-type: none"> - Able to assess landscape changes and their reasons - Direct implications for local land use policy, development plans and protection plans for areas of environmental protection - Easy to identify spatial conflicts - Direct diagnosis of landscape character 	<ul style="list-style-type: none"> - Needs to be conducted at periodic intervals due to rapid change - For other municipalities, topography of the land should be considered - Does not consider social and aesthetic landscape value

analysed cases are fitting to the reference scenarios established by planners and decision makers. Assessment of landscape aesthetics and landscape perception is also used for guiding future development. Frank et al. (2013) finds a correlation between the landscape metrics-based assessment with the visual assessment results of the photographs based on lay-people preferences and suggests that qualitative approach can find its application niche in regional planning process. Similar approach is presented by Vouligny et al. (2009) that compares the ability of an expert-based approach and of a lay people-based approach to assess the most the value of ordinary landscapes and concludes that in the planning process the combination of those two approaches is necessary. Public preferences are used to assess the value of rocky habitats of the city of Tokat, Turkey (Acar et al., 2013) that might be used for urban development and nature protection guidelines. Kalivoda et al. (2014) comparing landscape visual quality assessment with perception-based investigation discovered that people better find consensus for positively perceived landscapes and points out that this finding provides a cogent argument for legal protection of valuable landscape scenes. Another way for preserving landscape values is including the visibility in the landscape as one of the factors in the model for concerning the location of wind turbines (Kazak et al., 2017).

Poland has very little experience in the delimitation and management of landscapes at the local scale, and further studies should be conducted. The division of landscape units and the landscape itself allows for more integrated landscape management and thus ensures both the protection of land and the most effective management. The discussion involved in this research is an attempt to determine appropriate landscape units. The developed method should be the basis for more detailed research on landscape unit character assessments, the diagnosis of current situations, identifying historic changes in the landscape and the reasons for these changes, and establishing guidelines for its development. Adapting methods to the scale of the landscape research is a concern noted by scientists (Warnock and Griffiths, 2015) that should be further explored. The determination of priority landscapes should be developed as a model of multi-criteria analyses used in science to optimize and objectify decisions regarding spatial policy (Meyer and Grabaum, 2008) and social preferences should be included.

These conclusions can be used to assess cohesion between spatial policies of the municipality and the character of the landscape. The tested method presented in this paper has been adapted to the municipality of Popielów, the lay of the land of which had no impact on the boundaries of landscape units. If this method is used for other municipalities, however, differing terrain should be taken into account. Due to the very small sample area, this survey should be considered a pilot or preliminary study. To develop a method for determining landscape units at the municipal level, this study should be expanded to a larger area. In particular, adjacent municipalities should be investigated, and the consistency of spatial policies on border communities should be determined. Because the spatial structure and space management occur at the commune level within Poland and not by administration over the functional structure, management of the landscape should be conducted at the local level with particular emphasis on the politics of neighbouring municipalities and landscape units that occur between municipalities.

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