

Cultural Landscape Management: Aspects of Transformation in Agricultural Production Space That Shape the Deagrarisation Process and Biodiversity*

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Abstract

The research was carried out in 2024 in southern part of Poland, and concerned analysis of changes related to deagrarisation process, while focusing on selected transitional areas, called ecotones. These were grasslands, with estimated potential for ruminant grazing. The aim of the study was to assess some indicators and stimulants characterizing agricultural production space, in the aspect of cultural landscape management. The analysed stimulants were the average length and width of the ecotone zones, size of the fields immediately surrounding such zones, types of crops cultivated, and intensity of these crops. For the rational management of cultural landscape, there have been also considered factors such as the extent of abandonment of agricultural land use around the ecotone, and presence of not-native species, especially invasive ones. Research results show that fields of small sizes were beneficial from the point of view of the agricultural production space's condition, as they averagely promoted the increase of the local biodiversity. In terms of the diversity of cultivated crop species, the presence of a larger number of such plant species has both environmental and cultural landscape values. For the both analysed municipalities, the transformation in agricultural production space and its impact on the biodiversity was assessed as average.

Keywords: deagrarisation, ecotones, potential for grazing, management of cultural landscape

Introduction

A landscape is an area, which character is the result of actions and interactions of both natural or human factors. Landscape protection encompasses actions to preserve and maintain its important or distinctive features in order to guide and harmonize changes, resulting from social, economic, and environmental processes. Landscape management in turn, includes actions important from the perspective of a sustainable development, ensuring its regular maintenance (Myczkowski, 2003). According to Plit (2016), a cultural landscape is formed at the interface of two systems: nature and culture. Nature is an extremely, perhaps even infinitely complex system of interconnected elements of the abiotic and biotic spheres. The cultural landscapes of Poland, formed by the local communities of people living in a given area, have been created and evolved over many centuries, and still are undergoing various changes (Myga-Piątek and Jankowski, 2009). The broadly understood concept of cultural landscape also reflects the complex relationships between humans and the natural environment (Mitka, 2000). Different processes, such as agricultural intensification, rural abandonment, but also the urban sprawl, are nowadays threatening cultural landscapes worldwide (Schmitz and Herrero-Jáuregui, 2021). Therefore, according

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to that authors, there is a growing need for developing new approaches, that are focused on management strategies for preserving cultural landscape and natural heritage, which is dependent on that.

The unsustainable land management is considered to be one of the main factors of land degradation, resulting from the lack of incentives to invest in such land. This manifests itself in a progress in deagrarianisation process in the agricultural production space, resulting from the discontinuation of agricultural use. At the advanced level that leads to the biodiversity reduction, both in arable lands and grasslands. Thus, scientists see conservation agriculture as an effective and sustainable practice for agricultural production (Daujanov et al., 2016). In Poland productive deagrarianisation, which means that the land is no longer farmed, is the most often observed in the case of low-quality soils, and difficult and technologically challenging land. Besides, more and more farms cease to breed ruminants, which makes some of the grasslands useless from the agricultural point of view. These processes cause changes in the ecosystems shaped through farming, which include the expansion of not-native species, especially invasive, resulting in reduction of the local biodiversity (Musiał and Musiał, 2018). Yet, maintaining the biodiversity in a given area is exactly that part of cultural landscape's protection, and agricultural landscape management, which should be of the special importance.

It is well known that humans due to their ability to manipulate nature have had a profound impact on environmental transformations. Rapid population growth and increased consumption, particularly since the Industrial Revolution, have led to significant exploitation of the most of natural resources. Consequently, animal and plant species are on an increasingly larger scale becoming extinct, and ecosystems are undergoing changes on an unprecedented scale (Henle et al., 2012). In the 20th. century, nature conservation became a mandatory part of the work of individual governments. Each country went through various stages of this often lengthy process, which in fact began in the first half of the 19th. century. Then there was observed gradual strengthening of public opinion, and a significant shift in the perception of nature. It was also when the first suggestions emerged concerning the need to protect natural landscape as an important national heritage (Haila, 2012). In the second half of the 20th., but especially in the 21st. century, environmental awareness grew even more, due to the rapid further loss of many habitats. In the western European countries, serious attempts have been made to restore the biodiversity of different plant communities related to the cultural landscape. In this respect some attention began to be paid to the use of various grasslands communities, especially meadows and pastures, but also xerothermic vegetation (Hopkins et al., 1995).

Many plant species occurring in grasslands are dependent on traditional land-use regime. As changes in agricultural systems have led to widespread abandonment and colonization of various habitats by shrubs and trees, the role of agricultural production space has changed into serving as the reservoirs of biodiversity (Prévosto et al., 2011). Moreover, if we take a closer look at the individual elements of cultural landscape, we can see that it is built by many different habitats, that are both natural, semi-natural, but also artificially created monocultures of cultivated fields. We can also notice the occurrence of some changes in physical environment, for example a sharp boundary, as in the interface between areas of forest and the cleared land. Elsewhere a more gradually blended transitional area will be found, where species from different plant communities can occur together with the local, unique ones. Plants when being in competition tend to extend they reach, as far as their abilities allow. The zone where two or more different plant communities meet is called ecotone (Figure 1). It can contain some number of highly adaptable species, that tend to colonize such transitional areas. In practice that means that in such places of different width and length, various plant communities meet and integrate with one another. It seems important in that kind of considerations, also because the flora, and plant communities determine the most crucial cultural landscape components (Musiał, 2018).

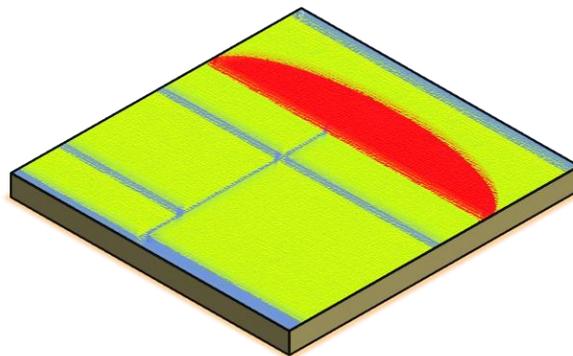
Subregion called the Jędrzejów Plateau, which is located in the southern Poland, is largely a fertile agricultural land, where limestone soils can be found. In this area especially floristically diversified are small cultivated fields (being artificially created monocultures), that are often situated in the close vicinity to xerothermic vegetation (of a semi-natural origin). It is also quite common situation, that the ecotone zones arise between these two types of vegetation. There has been also observed in that areas, some manifestations of abandonment of agricultural production. This phenomenon called deagrarianisation, results there mainly from the slowdown of structural and production changes. This proces includes the extensification of production, to the point of limiting them to the level of merely maintaining the sustainability of farms, which can be described as a state of decline. Such recessive processes may be intensified by the fragmentation of agricultural land and the extreme extensification of its use. They concern the methods of agricultural land management and its potential deproductivisation. The aim of the study was to assess some indicators and stimulants characterizing agricultural production space, in the aspect of the cultural landscape management.

Materials and Methods

The research was carried out in 2024 in a part of Nida Basin macroregion, which is called the Jedrzejow Plateau subregion. Studied area was located in its southern part, covering the municipalities of Sędziszów (I), and Słupia (II), situated about 70-90 km north from Krakow. According to Kondracki (2009), the Nida Basin is a part of the bigger unit, called the Lesser Poland Upland. This region is distinguished by its wealth of both natural landscape, and cultural values (Mirek et al., 2006; Dembek, 2012). In fact, as far as altitudes are concerned, it is rather a lowland, with the elevations from about 310 to 330 m a.s.l. They are built by some mesozoic sediments, on which evolve very specific soils, called rendzinas (Bednarek et al., 2009). They are rare in the territory of Poland, occupying an area of just 1,6% of the agricultural production space (Smreczak et al., 2018). That type of calcareous soils are shallow and stony, which is why the plant communities that grow on such a substrate are quite distinctive. As there has been presented by Chmielewski and Kułak (2016), the term ecotone was introduced into scientific literature at the beginning of the 20th. century by F. Clements, meaning the visible boundary between adjacent plant communities. Since the mid-20th. century, it has been widely used in general ecology, where it denotes the interface between adjacent ecosystems. Then, since the 1980s, it has also become a popular term among landscape ecologists, applied to various types of landscape boundaries, encompassing abiotic, biotic, and anthropogenic components (Odum, 1982; Forman, 1995). Centuries of field cultivation in Poland, have allowed for the development of characteristic weed communities, called also segetal plant communities, that accompany various crops. They have created regionally distinctive habitats in Poland (Matuszkiewicz, 2002). Also, they may be especially interesting, when they occur in some transitional areas, for example with xerothermic vegetation (Figure 2).

The valuation of changes or threats related to deagrarisation process, focused on selected ecotone zones. These were grasslands, with estimated potential for ruminant grazing. The analyses attempted to determine the state of organization, so also management of the agricultural production space adjacent to such enclaves, in terms of using following stimulants (scoring 1-5 points: from 1 - low values, to 5 - high values of a given indicator):

- the average length (A) and width (B) of the ecotone zones;
- the size of the fields immediately surrounding the zones (C);
- the type of crops cultivated – number of plant species (D);
- the intensity of these crops (E);
- the extent of abandonment of agricultural land use around the ecotone, i.e., field fallowing (F);
- the presence of not-native species, especially invasive (G).



**Figure 1. Diagram depicting an ecotone, as a visible boundary between adjacent plant communities
(in red colour)**

Source: Own study (2025), based on: Chmielewski and Kułak (2016).

In total there have been carried out 50 vegetation surveys, in such transitional zones, which have been formed between the segetal weeds communities and xerothermic vegetation (Figure 2). As nowadays in Poland all plant communities are subject to changes caused by the human impact, the particular plant species were assigned to historical-geographical groups, according to the method proposed by: Tokarska-Guzik (2005), Zając (1979), and

Zajac and Zajac (1992), that classify the synanthropic species. It is especially interesting, as in the Central Europe, plant vegetation has been significantly altered by humans. Therefore, alien species (which means not native) - anthropophytes, are a permanent component of many plant communities, and *de facto* influence the local biodiversity. They also tend to occur in the habitats which have been subjected to the pressure of deagrarisation processes, and therefore abandonment of agricultural use.

Synanthropic species are divided into several groups:

*Anthropophytes – not native, divided into 2 groups based on the time of their arrival on the territory of Poland:

- archaeophytes (Arch) - species that were introduced by humans before the 15th. century;
- kenophytes (K) - species that were introduced after the 15th. century.

*Apophytes (A) – native, but occurring in habitats modified by humans.

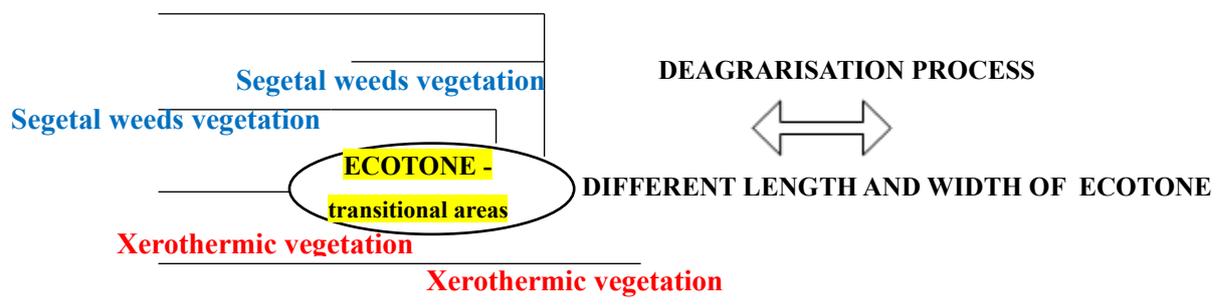


Figure 2. Ecotone as a transitional area, or a zone where two or more plant communities meet and integrate

Source: Own study (2025).

Results and Discussion

The ecotone zones were built by grasslands, with some potential for ruminant grazing. The analysis of changes in selected ecotones related to deagrarisation process, showed that the average number of vascular plant species given for 25 vegetation surveys in separately Sędziszów (I), and Słupia municipalities (II), was higher in the first one (213). The assessment included also fields directly adjacent to that transitional areas. For Sędziszów municipality area average width of such zone was from 10-20 m, and length of approximately 300-400 m. For Słupia municipality these average values were as follows: 5-10 m (width), and 150-200 m concerning the average length (Table 1). The research results show that fields of small sizes (indicator C) were beneficial from the point of view of the condition of agricultural production space, as they averagely promoted the increase of local biodiversity. If small fields, of approximately 0.5-1 ha, received the highest score (5 points), while fields larger than 10 ha, the lowest (0 points), in the area (I), the averages field sizes, located near ecotone zones had acreage of about 0.5-1 ha. On the other hand in (II), the average field area was approximately 1-2 ha, which gives 4 points for this indicator. In terms of the diversity of cultivated crop species (indicator D), the presence of a larger number of such plant species had both environmental and cultural landscape values, and indicated the provision of ecosystem services and public goods by agriculture (Wilkin, 2010). When 8-10 crop species occur in the vicinity of the ecotone, diversity is assessed as high (5 points), while when just 1-2 species occur, it is assessed as low (1 point). In the studied area of Sędziszów municipality, the average number of species was 6, which was equivalent to 4 points, and for Słupia municipality it was 4 species (3 points).

There was also analysed the intensity of cropping (indicator E), and therefore crop production around such ecotones. For that stimulant, the highest score (5 points) was assigned to just sustaining agricultural land use, which means extensive production, while 1 point was assigned to very intensive cropping. In the area of Sędziszów municipality (I) the average crops around analysed ecotones where extensive (5 points), and for Słupia (II), they

were assessed as being moderately intensive crops (3 points). The state and management of cultural landscape in the aspect of the local biodiversity was also influenced by the degree of abandonment of agricultural use of the fields surrounding ecotones. In order to quantify the share of agricultural land that has not been used, there was presented the stimulant F. If this level of land abandonment was insignificant (approximately 5% in the visual assessment), the score for this index was a maximum (5 points), indicating a high degree of biodiversity maintenance. However, if the traditional land-use regime was disturbed at over 80%, the score was 0 points. The higher share of land abandonment was estimated for Sędziszów (I), from 15-20%, and for Słupia municipality (II) it was on average 5-10%. This phenomenon and the degree of deagrarisation process is a consequence, but at the same time an actual reason of complexity and multifunctionality of rural areas. In relation to the essence of gradual abandonment observed for the agriculture, this is also a kind of response to the impossibility of maintaining socio-economic development of a given region, basing only on the income obtained from the agricultural production (Kłodziński, 2012; Musiał, 2024). In turn, the G indicator measures the degree of occurrence of non-native species, defined as invasive (herbaceous plants, shrubs, and trees). The presence of sparse herbaceous plants and tree seedlings, gives a score of 5-4 points, while a high participation of invasive species in the coverage of ecotones of approximately 40-70% gives a score of 1-0 and indicates low biodiversity. In the study area, the share of invasive species was higher in the municipality of Słupia (2 p.), than in Sędziszów (4p.). For the both analysed municipalities the transformation in agricultural production space and its impact on the biodiversity was assessed as average.

Table 1. Assessment of ecotones and development of agricultural production space, that surrounds such zones

Stimulants (A-G)		I.	Data from 25 vegetation surveys	II.	Data from 25 vegetation surveys
Total number of species from 50 vegetation surveys		245			
Total number of botanical families		37			
Number of species in each municipality		213		185	
A.	Average length of zones	4	- average length approximately 300 -400 m; - average width approximately 10-20 m; - field area approximately 0,5 - 1 ha; - average 6 species; - extensive crops; - share of abandoned land approximately 15-20%; - herbaceous, shrubby, and non-native tree species;	3	- average length approximately 150-200 m; - average width approximately 5-10 m; - field area approximately 1-2 ha; - average 4 species; - moderately intensive crops; - share of abandoned land approximately 5-10%; - numerous herbaceous, shrubby, and non-native tree species;
B.	Average width of zones	5		4	
C.	Average field area size	3		4	
D.	Diversity of cultivated species	4		3	
E.	Crop intensity	5		3	
F.	Degree of abandonment of agricultural land use	4		5	
G.	Occurrence of invasive species	4		2	
Transformation in agricultural production space and its impact on the biodiversity		Total value = 29 (average values)			Total value = 24 (average values)

Source: Own study, (2025).

Explanations to the table: the area of municipalities: (I) Sędziszów, (II) Słupia. Stimulants A.-G.: from 1 - low values to 5 - high values of a given indicator.

In the studied area in zones between segetal weeds and xerothermic communities, there have been noticed over 245 vascular plant species, that belong to 37 botanical families (Figure 3). The most numerous were species belonging to *Fabaceae* family (15,5%), but also to: *Asteraceae* (12,3%), *Poaceae* (10,96%) and *Rosaceae* (6,85%). However, the most botanical families were represented by only one species, which in fact indicates the high local biodiversity. Among them there have been noticed also protected species and those put on the red lists

presented by Zarzycki and Szelaĝ (2006), which mean they are especially vulnerable or endangered. Such a great abundance of plant species was determined by specific soil conditions, but also maintaining the extensive plant production, which also results there from different stages of deagrarisation process. High floristic diversity, means also that, in studied area there can be found plant species, which are assigned to different types of grassland. It is important, as they are the main biodiversity hotspots in Poland, covering over 45 types of plant communities.

In the ecotones dominated species classified into different historical-geographical groups (Figure 4). The most numerous were apophytes (67,58%), which are native, but occur in habitats changed by humans. Apophytes are plants with exceptionally sophisticated abilities to colonize new habitats (Marciniuk, 2009). In the transitional areas there were also found species classified as archaeophytes, which are very interesting group of so called „newcomers from the pre-modern period”. They often arrived in the territory of today's Poland with cereal grains, and in that way agricultural development contributed to their evolutionary success (Zajac, 1979). In the studied area they constitute less than one-third of all synanthropic species found in ecotone communities (30,59%). This is a high rate, especially since representatives of this group are often rare and endangered vascular plant species, that can be found on the Polish red lists. Their abundance was determined by the specific type of limestone soil, called rendzina, which forms the habitats for various representatives of archaeophytes. On the other hand, kenophytes were not so common in the ecotones, as they do not tend to occur very often in neither segetal nor xerothermic vegetation. They constituted only less than 2% of all species recorded in these communities. The most common kenophytes in the study area originate from the American continent. The climatic similarities between their homeland and Central Europe, allowing for relatively easy acclimatization, mean that they are common throughout the country, including the grassland communities (Tokarska-Guzik, 2005). However, the kenophytes are often invasive plants in Poland, as show the example *Solidago canadensis* in most of the semi-natural habitats.

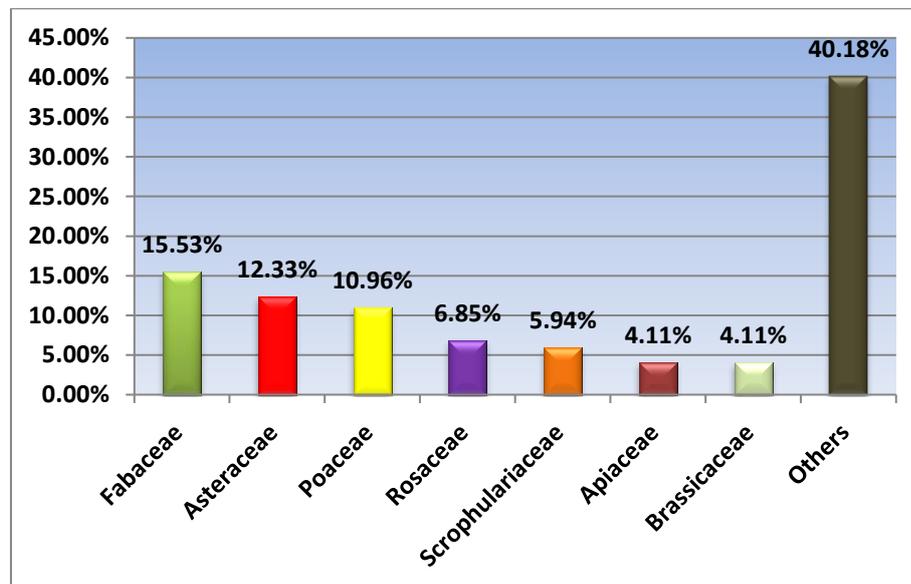


Figure 3. Botanical families of species occurring in the ecotones of the studied area

Source: Own study (2025).

In addition to anthropophytes, also apophytes, which are native plants with a limited geographic range, can also be invasive species (Zajac and Zajac, 2009). They usually migrate from their natural habitats, making them even more difficult to maintain their original status. Apophytes, as plants that tend to occupy places changed by humans, have shaped the ability to successfully invade new habitats (Medwecka-Kornaś, 2006). In the study area they constituted over two-thirds of all the species recorded in ecotone communities. Also, they represented various types of plant classes typical for the Polish flora, as they originate from different habitats. In the studied area they were represented by several such groups, and the most numerous have been species from the meadow-pasture

class, called the *Molinio-Arrhenathereta* (Matuszkiewicz, 2002), which constituted to almost 38% of all vascular plant species noted in that area.

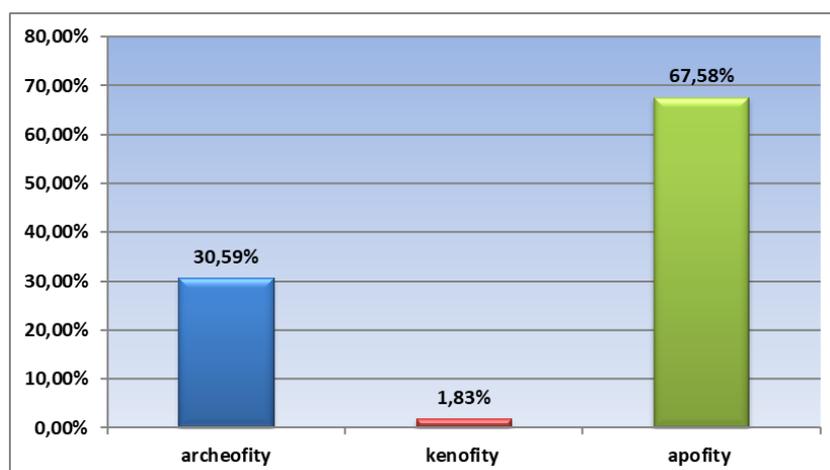


Figure 4. Affiliation to different historical-geographical groups

Source: Own study (2025), based on: Tokarska-Guzik (2005), Zajac (1979), Zajac and Zajac (1992).

Summary

In the studied area, several factors were analyzed to indicate which direction of agricultural production space development has a positive impact on the preservation of biodiversity in the cultural landscape. The research results show that that proper management of cultural landscape, in order to maintain the diversity of vascular plant species is related to the following management strategies regarding the agricultural production space: preservation of small sizes of fields, sustaining the diversity of cultivated species, low crop intensity and just a slight abandonment of agricultural land use. For the both analysed municipalities, the transformation in agricultural production space and its impact on the biodiversity was assessed as average.

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