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How has the landscape changed? Landscape transformation analysis of Ogrodzieniec-Podzamcze (POLAND) using landgraphy and landscape stratigraphy methods

Abstract

This article presents a combination of landscape biography and stratigraphy as a method for the visualisation of historical landscape change. The main goal was to analyse the evolution of the cultural landscape of part of the Ogrodzieniec municipality – Podzamcze (Częstochowa Upland, Poland). The evolution of the landscape was reconstructed based on cartographic materials (topographic maps from the last 200 years) and scholarly literature. The results show the dominance of the agricultural landscape in all studied periods. The forest and settlement landscapes expanded significantly within the studied period. The fortified landscape is clearly visible as a core running through all the years. The results indicate changes of an evolutionary type and heterogenous (genetically), heterotonic (in terms of land cover) form. The method can be used in well-documented areas to visualise the past and contemporary landscapes and to forecast future ones, so it can be useful in landscape planning.

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1 Introduction

The permanent process of evolution in nature leads to a diversification of the globe's landscapes. Contemporary factors driving this process can have both a natural and an anthropogenic character. Depending on the anthropopressure gradient, varied types of landscape can be distinguished: primary, natural and cultural (Bogdanowski et al., 1979); natural, natural-cultural and cultural (Chmielewski et al., 2016); or natural (primary, semi-natural, quasicultural) and cultural (among others: pastoral, agricultural, settlement, forest management, industrial, tourist) (Myga-Piątek, 2012). Natural landscapes have gradually been marginalised and replaced with cultural landscapes created by humans as a result of different kinds of management, e.g., forestry, agriculture, settlement (rural and urban) and mining (Antrop, 2004). Cultural landscapes can be defined as historically formed fragments of geographical space created as a result of a combination of environmental and cultural factors forming a specific structure and reflected by regional distinctiveness perceived as a specific physiognomy (Myga-Piątek, 2012). Assuming a gradual increase in anthropogenic factors and an accompanying increase in the density of cultural elements in the geosystem, it is possible to distinguish several evolutionary types which have gradually been replaced by others and historically assigned to a given period of societal development.

In this paper, the authors analyse the transformation of the landscape of Ogrodzieniec-Podzamcze and Częstochowa Upland using the landscape stratigraphy method (Myga-Piątek, 2012; Myga-Piątek, 2018; Żemła-Siesicka & Myga-Piątek, 2021b). The concept of landscape stratigraphy can be used to analyse and create a typology of cultural landscapes on a chronological basis by the interpretation of the different evolutionary stages of landscape development (Myga-Piątek, 2018; Aldred & Fairclough, 2003; Antrop, 2004; Fairclough, 2010). These stages usually reflect distinctly defined stages in a society's civilizational development. Since Neolithic times, natural and seminatural landscapes (typical of hunter-gatherers) have been progressively marginalised on a global scale and replaced by landscapes developed as a result of pastoralism, agriculture, water management, settlement (rural and urban), intensive forestry, mining, and later industry, transport and now also international trade, commerce, and services including tourism (Antrop, 2004; Myga-Piątek, 2012).

Differentiation and change in the landscape are usually evolutionary. However, they can also occur in a revolutionary way, leading to "landscape faults" (a sudden event associated with the impact of a strong factor, Myga-Piątek, 2018) and interruptions in cultural continuity, e.g., due to extreme natural events, wars, reforms, and social, political, and technological revolutions (Myga-Piątek, 2012). Landscape faults can lead to gaps, understood as the lack of a time-determined chronological chain in the evolutionary process of landscape formation (Myga-Piątek, 2012). In response to these changes, the landscape's historical profile may be continuous (laminar cultural overlaps) or discontinuous (gaps, faults). The land cover types that remain unchanged over a certain period (time depth) provide evidence of landscape permanence (Lieskovský & Bürgi, 2018). So far, stratigraphic models have been presented in the literature to reconstruct the evolution of natural landscapes of remote geological epochs (among others: Stratigraphic Landscape Analysis – SLA, Green et al., 2013). The model has also been implemented for the visualisation of changes in archaeological landscapes (Żemła-Siesicka, 2022).

The main objective of the paper was to analyse the evolution of the cultural landscape of Ogrodzieniec Podzamcze (at the landscape unit scale – microscale) and to point out the character of the changes using the landscape biography (to describe the periods before 19th century) and stratigraphy method (for more detailed analyse of the periods after 19th century and for visualising the landscape change). The choice of the area was based on its natural diversity, its long settlement history providing an extended period for analysis and its variety of land uses, as well as its current multi-directional development. Another important criterion for the selection of the test area was its well-documented history (in scholarly literature).

2 Material and methods

2.1 Study area

A part of the Podzamcze district in Ogrodzieniec with an area of 2.73km2 was selected for the analyses (Fig. 1). This area covers the landscape of Podzamcze, with the most significant landmark being the castle and its surroundings: settlement, agricultural fields and forests.

Most of the Ogrodzieniec municipality (area 86 km2), including Podzamcze, is located in the Czestochowa Upland mesoregion, and a smaller part is located in the Siewierz Basin (Solon et al., 2018). The Często-

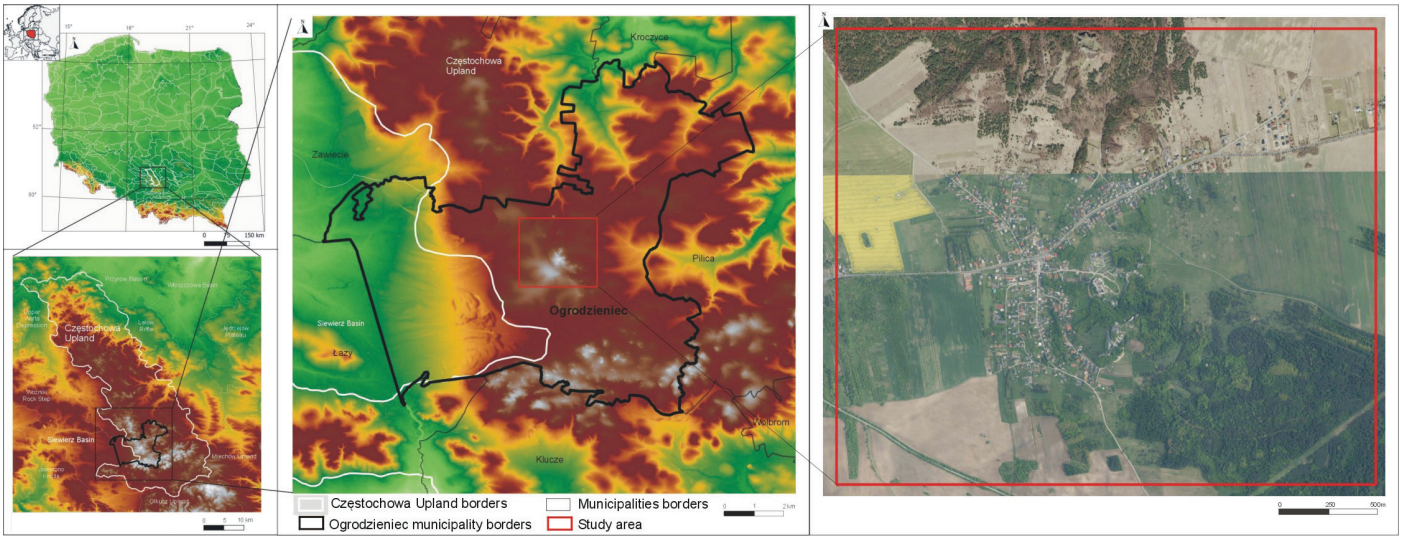

Figure 1. Location of the study area.

Figure 2. Study area – the Janowski Mountain with the ruin of the castle and Podzamcze district (photo taken from a balloon by author, 21.10.2022).

chowa Upland is a structural unit that stands out in terms of landscape. It consists of limestone from the Jurassic period. The diversity of the landscape results from long-lasting geological and geomorphological processes, followed by settlement processes which started in the prehistoric period. The characteristics of the local microclimate, the diversified water conditions and the mosaic lithological, morphological and soil system determine the high diversity of plant communities (Richling et al., 2021). This, in turn, determines the distinctive mosaic of the landscape, including the diversity of forest communities (Urbisz, 2008). Brown-earth soils and loess patches have been used for agricultural purposes for centuries. The characteristic communities of this area are psammophilous and xerothermic grasslands.

A characteristic element of the landscape of Podzamcze is the highest elevation of the Upland – Janowski Mountain (516m a.s.l.), with the ruins of the medieval castle and its neighbouring group of rocks (Fig. 2). It is included in a legally protected area: the Eagles' Nests Landscape Park. The qualities of the natural environment of the region were the basis for early settlement development, from prehistoric cave shelters, through the medieval village connected to the castle, to present urbanization and industrialization. Due to the diversity of landscape values and its visible attractiveness and (importantly) the proximity of a large agglomeration – Górny Śląsk – Zagłębie Metropolia, it is also intensively developed and strongly penetrated by tourism.

2.2 Stratigraphy model

The research is based on the stratigraphy model presented by Myga-Piątek (2012, 2018, Żemła-Siesicka & Myga-Piątek, 2021b). The method allows the transformation of the landscape to be presented and interpreted on a diagram (block scheme), where the height of the block (y axis) represents the time interval, and the "top" of the block presents the spatial location of the landscape elements (x and z axis). The block is constructed of the landscape layers, where the oldest layers are located at the bottom and are covered by younger landscapes. It is a transformational approach that considers the contribution and mutual proportions of natural and artificial elements in the structure of landscapes. In this case, the degree of transformation of the natural landscape and its saturation with anthropogenic elements is important (Antrop, 2004; Myga-Piątek, 2014). The differentiation of landscapes may be evolutionary or revolutionary, continuous (laminar cultural stratification) or discontinuous (extreme natural events, cultural faults and interruption of cultural continuity – gaps). The basis for distinguishing the main landscape types is the anthropopressure gradient. At the basic taxonomic level, groups of landscapes were adopted: primary, seminatural and cultural. The second level of separation of chronological "typological layers" is their genesis (absolute age / stratigraphic position – relative age). In terms of the different processes of transformation, Myga-Piątek (2012) distinguishes the main landscape types and subtypes in the stratigraphy model: homogeneous (formed at one time, usually as a result of similar natural or cultural processes) and homotonic (landscapes with a similar land use or land cover pattern), heterogeneous but homotonic and heterogeneous and heterotonic. The stratigraphic types are presented in Table 1 and in Figure 3.

Table 1. Stratigraphic landscape types

Type	Sub-type	Description
homogeneous and homotonic	-T1	cultural landscapes developed centuries ago on a natural land cover, Landscape similar to the original, without subsequent transformations; no subsequent cultural layers, so-called raw root
heterogeneous but homotonic	T2/A	complete and chronological landscape layer arrangement, not changed in a revolutionary manner but modelled in an evolutionary manner
	T2/B	incomplete profile with gaps, lack of a certain origins link
	T2/C	inversion profile - chronologically younger landscape developed on an older landscape
heterogeneous and heterotonic	T3/A	incomplete transformations, the possibility of older landscapes being surrounded by younger ones (landscape intrusions)
	T3/B	coexistence of cultural (or natural) landscape types, representing various styles of use, functions, origins and chronology

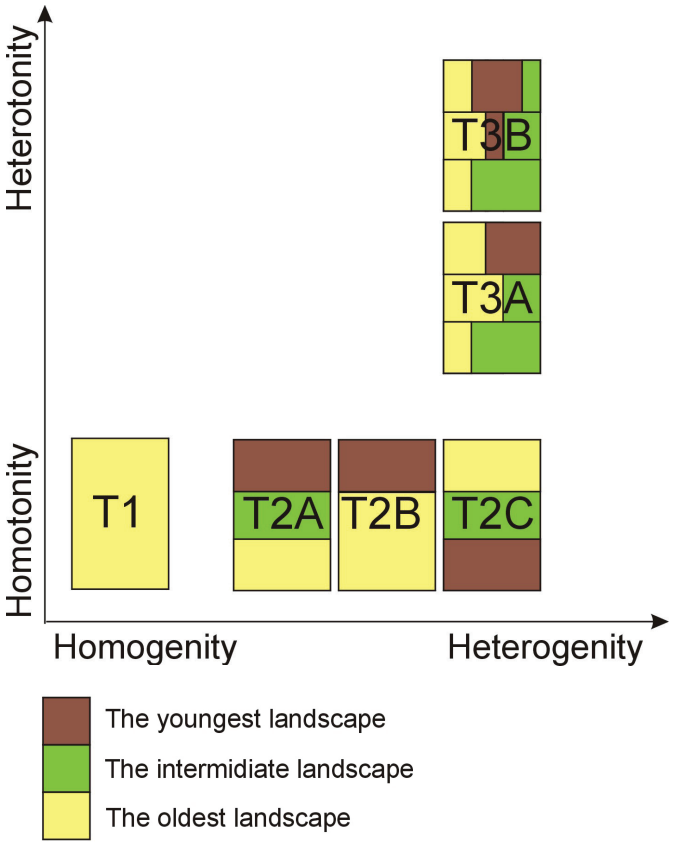

Figure 3. Diagram presenting the stratigraphic landscape types depending on the homo/heterotonity and homo/heterogenity.

A literature review was carried out to complete the analysis of the landscape changes throughout history, which enabled the preparation of a landscape biography. This term was introduced by archaeologists at the end of the 20th century to describe the transformations in landscapes from prehistory up to the present (Roymans et al., 2009). The authors propose the introduction of the term "landgraphy", which, by analogy with landscape biography (Raszeja, 2015), is understood as a description of an individual history of development of an area (cultural landscape) from its "birth" to the present (in this case the landscape is a regional (rather than typological) concept). The landscape evolution analysis was based on secondary sources – detailed research results published in specialist literature on the subject (geological, palaeobotanical, palaeoclimatic, archaeological, historical, etc.) – and primary sources – cartographic analyses covering the last 200 years – that were blended together. The level of detail here applies to the level of landscape units (understood as a spatial unit with defined boundaries and

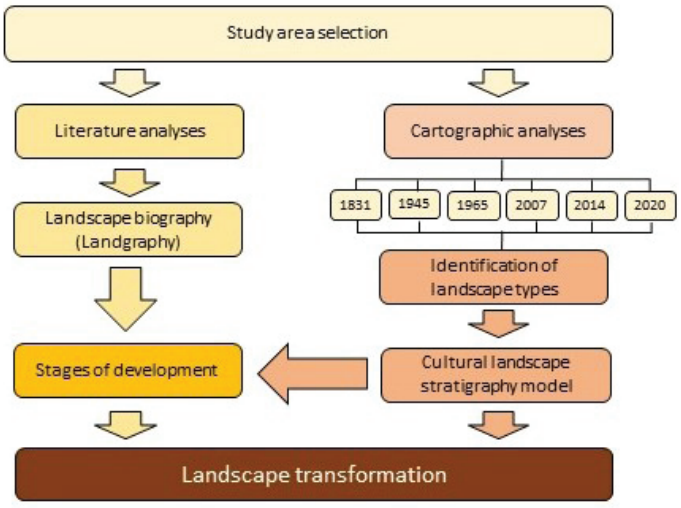

Figure 4. The research steps.

size, determined on the basis of the homogeneity of the landscape background, i.e., the uniformity of land cover, Chmielewski, 2012). Research based on cartographic sources can show the change in more detail than the literature analysis. The written sources, especially those concerning distant history, can be applied more easily to the region than to specific places (e.g., there are some archaeological findings of early cave shelters in the vicinity of the study area (e.g. Myszków, Zawada, Przewodziszwice; Ginter, 1966; Foltyn & Waga, 1992), so humans were probably also present in Podzamcze, but the literature does not point out this particular area). On the other hand, there are extensive sources of information concerning the castle and its changes (on the architectural and not landscape scale), but descriptions of its surroundings are very limited.

The materials used in the analyses of landscape changes were mostly cartographic (topographic maps). These analyses cover the last 200 years, as the oldest maps accessible are from 1831. The Database of Topographic Object (TBD) (2020) digital maps were used, as well as historical topographic maps, both digital and digitised. For cartographic analyses, Geographic Information System (GIS) software (Mapinfo Pro 17.0) was used. The next step of the research was the construction of the stratigraphy model. This process was performed using 3D modelling software (SketchUp Make 2017) and graphic software (Autodesk Sketchbook and CorelDraw 9). For the graphics, a graphic tablet was used.

The stratigraphy model incorporated cartographic analyses from the last 200 years (the period available on topographic maps). Construction of the stratigraphy model included:

- Collection of maps. Topographic maps from 1831 (Charter of the Kingdom of Poland, 1831, scale 1:126 000), 1944 (WIG topographic map of 1944, scale 1:100 000), 1965 (Topographic map of 1965 scale 1:50 000), 2007 (V Map Level 2 -2007, scale 1:50 000), 2014 (Database of Topographic Object 10k – 2014) and 2020 (Database of Topographic Object 10k - 2020) were used.
- Identification and classification of landscape types.
- Map overlay and construction of the stratigraphy model. The method adopted in this paper is the graphic imaging of the stratigraphic model proposed by (Żemła-Siesicka & Myga-Piątek, 2021b). A selected fragment of a map (a square containing the castle and its nearest surroundings, covering different types of landscape) from particular years was projected onto the profile, marking visible layers of landscape types on it, and finally, one profile containing the whole examined time interval was obtained.

3 Results

3.1 Cultural landscape landgraphy

The landgraphy of Ogrodzieniec-Podzamcze is based on the literature (Sulimierski et al., 1886; Poleski, 1919; Strzelecki, 1951; Górski, 1993; Muzolf, 1994; Partyka, 2004; Myga-Piątek, 2012; Kołodziej-Pawłowska, 2010; Cygankiewicz & Łaś, 2021) regarding Ogrodzieniec municipality and the history of the castle and its closest vicinity – Podzamcze (the Bailey). The castle played a significant role in the landscape development of Podzamcze. It was erected near the state border route, which was then one of the most important trade arteries in the region, connecting Cracow and Toruń (Strzelecki, 1951). The castle was a core of the area's spatial organisation, especially during the development of the settlement in the Middle Ages. Nowadays, the castle, as a tourist attraction, has totally different scope of spatial organisation. The development of the village of Ogrodzieniec was related to its location on the trade route but also to its iron forges (Partyka, 2004). In the 19th and 20th centuries, factories and cement plant played a role in the city's development. Stages of development which present the important time intervals in the life-history of the area can be distinguished in the transformation of the landscape. Based on the stages for the whole region – the Częstochowa Upland, presented by Myga-Piątek (2012) – ten intervals are presented and described in Table 2. The stages reflect changes in the landscape types, from primary and seminatural through the first cultural stages that started the evolution (agricultural, pastoral), to urban and industrial landscapes. The changes are related to environmental features determined by the historical period, development of the economy, technology and political shifts. Throughout its history, the natural landscape has undergone a threefold process of naturalisation after the disappearance of anthropogenic factors. These changes are indicated as three gaps of several hundred years. The most significant changes have taken place in the last 200 years.

3.2 Identification of landscape types

The Topographic maps from 1831, 1944, 1965, 2007, 2014 and 2020 were used for the identification of landscape types, understood as land cover classes, categorised into forest, agricultural and settlement landscapes. Due to the characteristics of the area, the fortified settlement landscape (which forms the core and oldest element of the study area) was also distinguished. The original topographic maps, as well as obtained landscape types are presented in Figure 5.

Based on topographic maps from the period 1831–2020, the succession of landscapes was determined and presented in the form of stratigraphic imaging (Fig. 5). The compiled profile allows for a biographical description of the landscape. The stratigraphic profile shows gradual changes and incomplete evolutionary replacement of individual landscape types. Thus, landscapes from different historical periods are shown. The fortified landscape (castle), with both historical-cultural and physiognomic significance, represents a particular cultural "intrusion". It is clearly visible as a core running through the

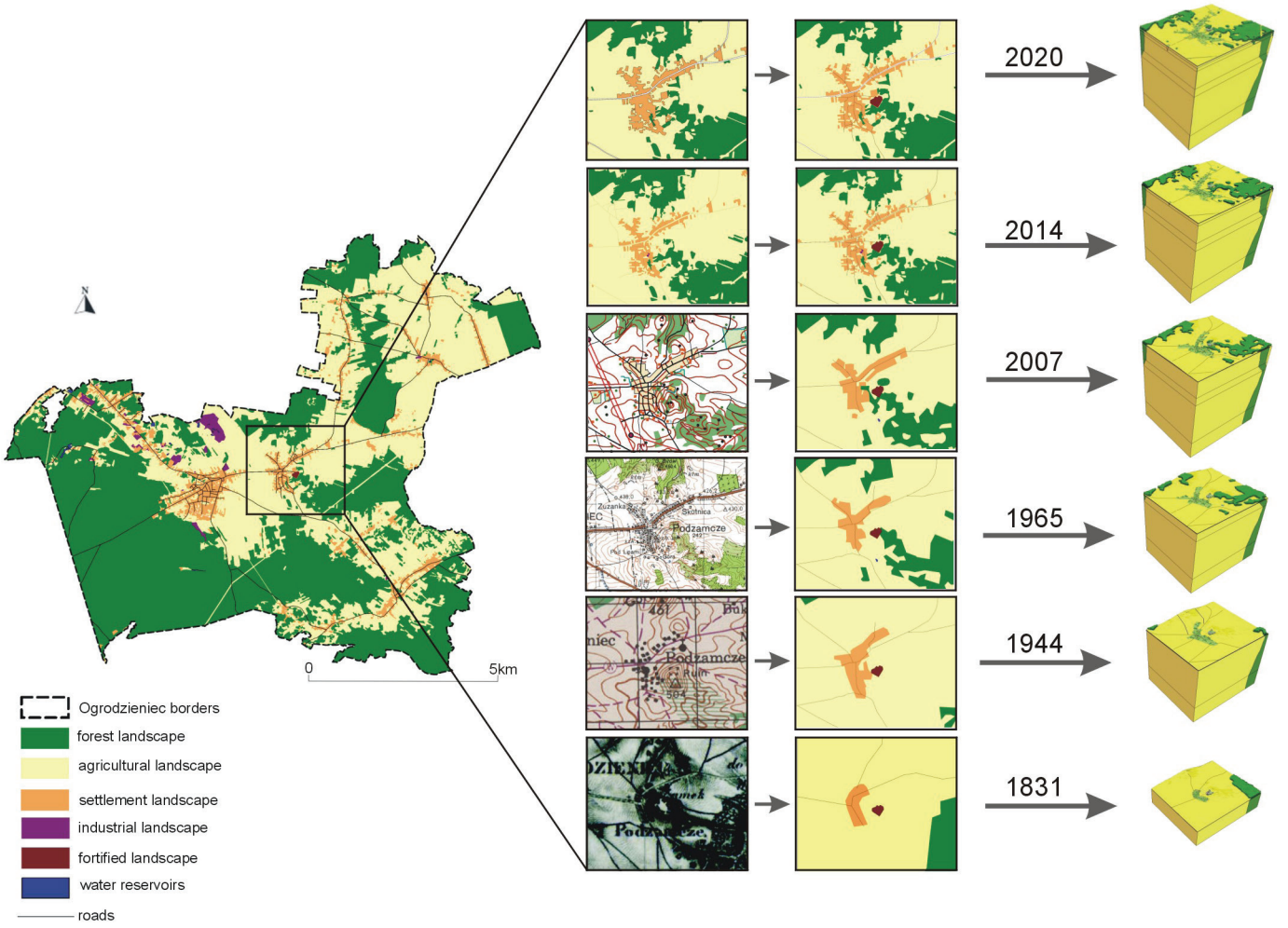

Figure 5. Stratigraphy model of Ogrodzieniec-Podzamcze.

years. The forest and settlement landscapes expanded significantly within the studied period, while the agricultural landscape decreased. The current landscape has retained elements of the former spatial organisation. The evolutionary, not revolutionary, character of the changes is evidenced by the maximum thickness of the landscape, which is presented by forest, agricultural and settlement landscapes, although the agricultural ones dominate the entire profile. The core of the settlement landscape is clearly visible next to the castle. A "thin" settlement landscape is present in areas more distant from the castle. The type of the stratigraphic profile indicates the degree of landscape persistence. The horizontal arrangement of landscapes in the profile shows a break in the continuity of land cover, while the vertical arrangement brings the area closer to a persistent landscape. In the case of Podzamcze, the vertical structure is visible, indicating a high degree of landscape persistence.

According to Myga-Piątek's (2012) stratigraphic genetic typology, the presented fragment of Podzamcze can thus be classified as a heterogeneous and heterotonic landscape.

3.3 Landscape transformation of Podzamcze against the Częstochowa Upland

The mosaic land cover with the medieval castle is a characteristic landscape of numerous areas of Częstochowa Upland. Research on such a small area of Podzamcze can be an excellent test of the method and its results, which were developed theoretically and tested initially for the mesoscale of Częstochowa Upland, for which the life-history of the landscape has been presented by Myga-Piątek (2012) and the stratigraphy model by Żemła-Siesicka & Myga-Piątek (2021b). Below, an interpretation of their study is presented to compare the results of the research on Podzamcze and of the whole region. This can reveal

Table 2. Stages of development of Częstochowa Upland (based on Myga-Piątek, 2012; Nita & Myga-Piątek, 2012), and Podzamcze, based on a literature review (Sulimierski et al., 1886; Poleski, 1919; Strzelecki, 1951; Błaszczyk 1965; Kruk, Przywara 1983; Godłowski, Kozłowski, 1985; Foltyn, Waga 1991; Górski, 1993; Muzolf, 1994; Godłowska et al., 1995; Rydzewski, 1995; Godłowski, 1995; Młodkowska-Przepiórowska, 1995; Partyka, 2004; Kołodziej-Pawłowska, 2010; Myga-Piątek, 2012; Cygankiewicz & Łaś, 2021,) and the author's own cartographic research

Stage	Date	Częstochowa Upland	Podzamcze
I	Before 8000 BC	Natural processes - primary landscape	
		prehistoric cave settlement	-
II	8000–4500 BC	Primary and seminatural landscape, landscape change related to the development of human skills and early functions (gathering, hunting, fishing)	
III	4500–1800 BC	Primary, seminatural and cultural (agricultural) landscape	
		landscape change related to stationary settlements and flint mining	- no detailed data
GAP	1800–1300 BC	Depopulation due to unfavourable climate under conditions of poor environmental productivity; primary and seminatural landscape reconstruction – first gap in the landscape profile	
IV	1300–500 BC	Seminatural and cultural landscape (agricultural and pastoral);	
		development of the settlement	- probable early settlement - no detailed data
GAP	500 BC–200 CE	Depopulation due to unfavourable climate under conditions of poor environmental productivity; seminatural landscape reconstruction - second gap in the landscape profile	
V	Przeworsk culture (200–500 CE)	Cultural landscape (agricultural and rural, settlement)	
		accelerated process of land development caused by the popularisation of iron tools	establishment of a settlement on Mount Birów in the immediate vicinity of the research area
GAP	500 CE–9th century	Depopulation due to unfavourable climate under conditions of poor environmental productivity; seminatural landscape reconstruction - third gap in the landscape profile	
VI	9th–15th centuries	Cultural landscape (agricultural, rural, fortified):	
		settlements concentrated in the river valleys, with water mills, metallurgical plants, iron works; defensive castles with a characteristic bailey (fortified landscape)	Development of the settlement related to the stronghold and, later, of the castle. Already in the 11th century, there was a settlement of tar makers, hunters and farmers. The settlement was developed at the turn of the 13th and 14th centuries, when the stronghold on Mount Birów in the immediate vicinity of the research area was established, but then it was burned down. The landscape changed significantly in the second half of the 14th century, with the construction of the castle and the establishment of the village of Ogrodzieniec (1346 – first mentions, 1350–1370 – construction of the castle, 1386 – establishment of the city under the rent law).
VII	16th–19th centuries	Cultural landscape (agriculture, rural, forest management, settlement, urban)	
		settlements moved to higher areas, dispersed; development of agriculture under the feudal system (serfdom)	In the 16th century the role of the castle was still significant. It was expanded in 1530, but then destroyed during the war, in 1702. After that, a slow deterioration of the castle began. The landscape was changing to an agricultural one under the feudal system. According to the map of 1831, in the first half of the 18th century, in the vicinity of the castle the agricultural landscape dominated, and the settlement was well developed, clustered on the west side of the castle.
VIII	mid-19th century–the end of the Second World War	Cultural landscape (agriculture, rural, craft, forest management, urbanisation): post-feudal management	
		Water and manorial management; beginnings of industralisation) importance of the rivers as economic axes, numerous breeding ponds; first landscape protection and tourist functions; development of existing settlements	In the second half of the 18th century, Ogrodzieniec formally ceased to be a city. Industrial plants, a brewery, a brickyard and lime kilns appeared in the landscape. At the turn of the 20th century, the essential layout of the settlement network was formed. The castle was deteriorating at a rapid pace. According to the map of 1944, the agricultural landscape expanded at the expense of the forests. The settlement of Podzamcze was still developing.
IX	After Second World War–1990	Cultural landscape: connected with the socialist economy.	
		Agricultural landscape: destruction of many palace and manor buildings, establishment of state farms. Industrial landscape: strong industrialisation of the region based on iron and rock mining (development of the metallurgy, cement and ceramics industries). Tourist landscape: intensive tourist penetration by the inhabitants of the surrounding agglomerations (Częstochowa and the Upper Silesian Industrial Region), first summer houses. Rural and urban landscape: modernisation of villages (new technologies and building materials; protected landscape and network of protected areas, e.g., Eagles' Nests Landscape Park and many nature reserves).	Cultural landscape: development under free market conditions; strong diversification of land use types; removal of a large areas of arable land from use; rapid process of natural forest succession; dispersal of previously compact settlements; change of proprietary status in villages (second homes development) and of the physiognomy of villages. Tourism is increasingly prevalent; tourist services and infrastructure continue to develop. The forests are still increasing at the expense of the arable fields (related to the spatial politics of afforestation). The settlement is expanding rapidly. Lack of traditional architectural style. The dynamic growth of the development was, and still is, caused by the accessibility of land suitable for construction in rural areas, and the cultural and visual attractiveness of the village.

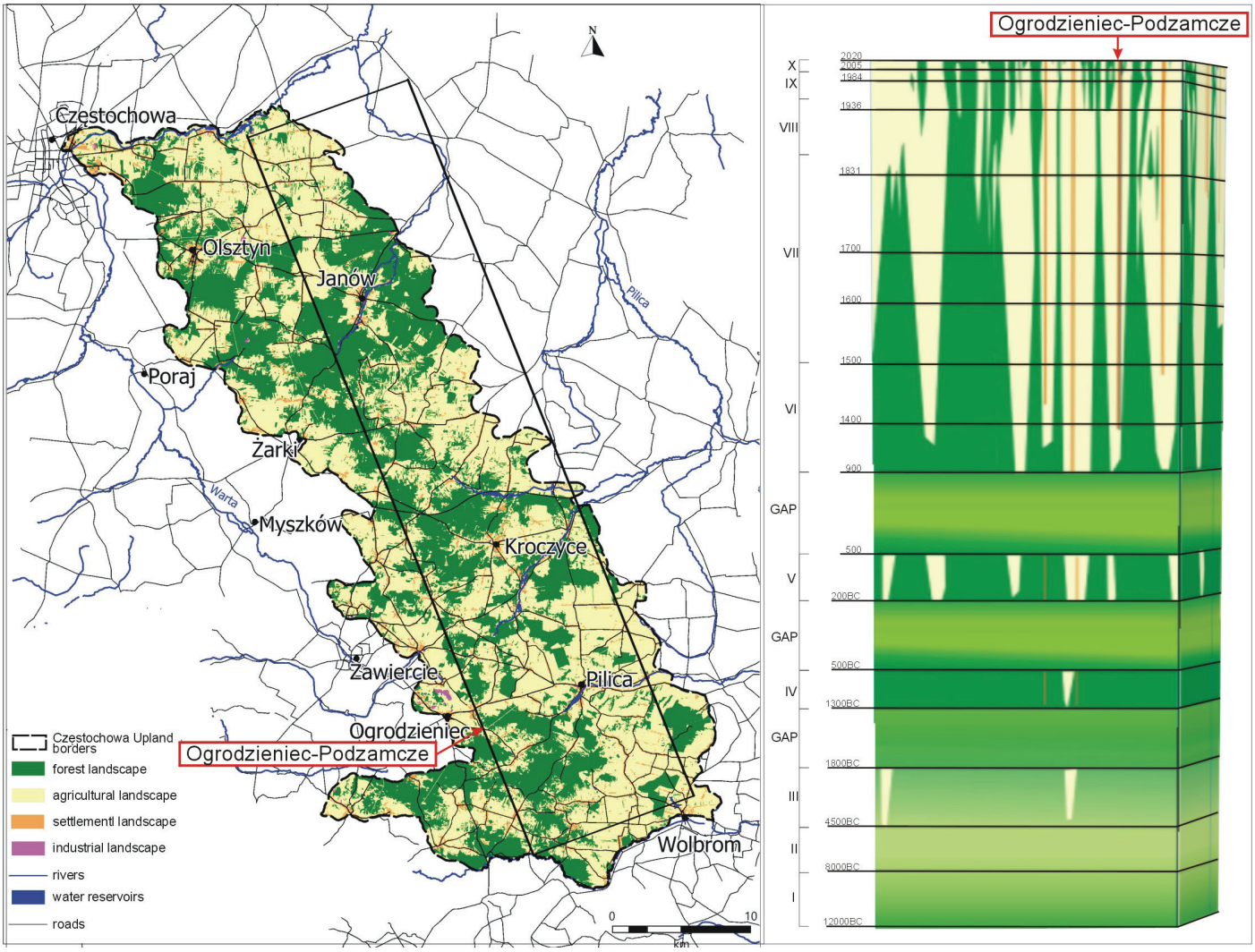

Figure 6. Stratigraphy model of Częstochowa Upland. On the left – current landscape types. On the right – the landscape stratigraphy model. Colours used, related to the land cover: green – forest landscape, yellow – agricultural landscape, orange – settlement landscape, brown – fortified landscape, blue – bodies of water.

similarities in the transformation and also opens up the possibility of comparing the applicability of the method at different scales (micro and mesoscale). In the landgraphy of Częstochowa Upland, Myga-Piątek (2012) distinguishes 10 stages of the development of the cultural landscape, from the late Palaeolithic (12,000–8,000 years BC) to the present day (Tab. 2). The comparison of the stages for the whole Upland and Podzamcze is presented in Table 2.

At present, the Częstochowa Upland area is dominated by agricultural landscapes (Żemła-Siesicka & Myga-Piątek, 2021a). Due to the migration of people to larger cities and the development of services, including tourism, cultivation is being abandoned (Myga-Piątek, 2012). Forest landscapes occupy a significant area. The landscape types map (Fig. 6) shows a mosaic of forest and agricultural landscapes in the northern and central parts of the area. The largest compact forest landscapes are present in the area of Olsztyn and Janów. Settlement landscapes occupy a small area (Żemła-Siesicka & Myga-Piątek, 2021a), although these areas are now increasing due to the development of services and tourism, including the construction of second homes and summer homes in particular.

The stratigraphy model illustrates the chronological replacement of landscapes. The changes in the Częstochowa Upland were evolutionary – the surface of the landscapes increased or decreased rather than being entirely replaced by other landscapes. According to Myga-Piątek's (2012) stratigraphic genetic typology, the presented landscape model, like the model of Podzamcze, can be classified as heterogeneous and heterotonic.

The stratigraphy models show landscape changes throughout the ages. The traditional rural landscape, including the valuable landscapes associated with the fortified castles and their surroundings, is constantly changing. In the Częstochowa Upland, the landscape has been transformed from forested to typically rural and is now partly returning to wooded landscapes, while built-up areas are increasing, especially in landscapes of high value. This process, together with the expansion of the settlement landscape, is a common feature of the whole Upland. The example of Olsztyn, one of the main towns in the Częstochowa Upland (Fig. 7), exemplifies this trend, as does Podzamcze, which has been studied in detail in this research.

In the landgraphy both of the Częstochowa Upland and Podzamcze, ten stages of landscape development were distinguished. The characteristic transformation at both scales involves the stages beginning from stage VI, when the cultural landscape, including the fortified landscape (the medieval castles) began to dominate. At the beginning of the 19th century (from this period, the cartographic research enables more detailed comparison), both in the whole region and in Podzamcze the decrease in the forested area and the dominance of arable fields are visible on the stratigraphic profiles. This trend was still present in the first half of the 20th century, but in both areas was reversed thereafter. The forested area increases, but so does the development of the settlements at the expanse of the arable fields. This development started in the second half of the 20th century but is still continuing today.

In Podzamcze, the transformation is related to the development of residential areas and tourism services, including tourism infrastructure. The location of a landscape park in close proximity to the Upper Silesia-Zagłębie metropolitan area and Częstochowa, as well as valuable views related to the castle surrounded by monadnocks, make the area of Ogrodzieniec, and especially Podzamcze, very attractive for single-family housing and hotels. However, the development is coming closer and closer to the castle, causing the degradation of the harmonious cultural landscape (Cygankiewicz, 2011). Particularly valuable views of the castle were the subject of research and development guidelines as early as the 1960s. At that time, it was specified that the silhouette of the castle should be opened up and allowed to dominate and that the extent of greenery should be restricted to the foot of the panorama only. According

Figure 7. Compilation of photographs of Olsztyn, view towards Biakło Mountain, on the left – a photo from the period 1914 (photo from the National Digital Archive collection), on the right – a photo from 2017 (author's own collection).

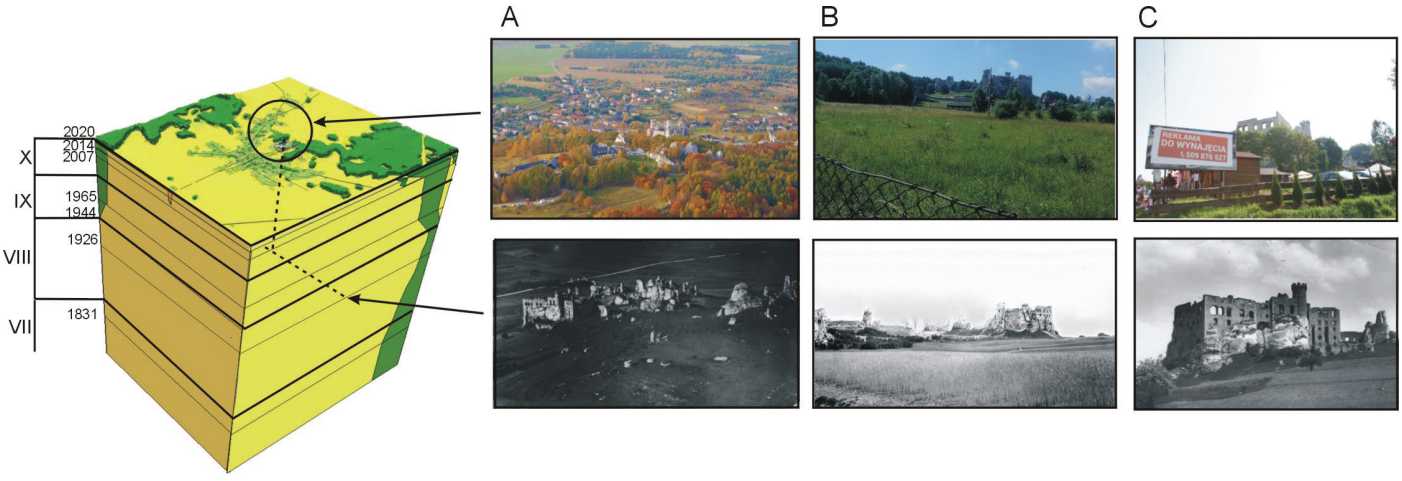

Figure 8. Spatial graphic drawing stratigraphy model with photovisualisation of the castle. Above – 2021 photo (source: author's own collection), below – photo from 1926 (source: National Digital Archive collection). A – bird's eye view, B – the castle with surroundings, C – the closest vicinity of the castle.

to stratigraphic analyses, at that time, the forested areas in close proximity to the castle were still considerably limited. Over the years, the forest landscapes of Podzamcze have spilt over, increasingly limiting the foreground of the scene. The landscape stratigraphy shows those changes in a graphical form; in the figure, the transformation is illustrated additionally with actual and archival photos (Fig. 8).

The profile shows the character of the changes. On the basis of the stratigraphic profile and the character of landscape transformations, the contemporary landscape of the Upland and Podzamcze can be defined as heterogeneous and heterotonic mixed subtype, which is a transitional type between heterogeneous homotonic landscapes and heterogeneous heterotonic vertical landscapes. This group is difficult to interpret, even though, at present they are the most common landscapes, especially in highly populated areas where the land has been used for many centuries. There are several varieties within this type, depending on the participation of (proportions between) different types of cultural landscapes dating to previous historical periods and the course of layer deposition (evolutionary or revolutionary).

In the Częstochowa Upland, a simple continuous replacement of one landscape type with another occurred only in the first stages of the transformation. From the beginning of stage VI various changes happened simultaneously and locally in a scattered process. Both in the case of the Upland and Podzamcze the changes from forest to agricultural and later to settlement landscape occurred in the form of a spatial mosaic, so the transformation was incomplete in terms of function, structure and physiognomy. It is also characteristic of both areas that in recent decades some of the arable fields (chronologically younger landscapes), have been replaced by older forest landscapes. This direction of the process is described for the heterogeneous and homotonic, the reversed stratigraphic subtype.

Various factors affecting the formation of the landscape co-occurred (e.g., development of the settlements and, later, urbanisation processes occurred simultaneously with the formation of arable fields or industrial areas), resulting in the co-existence of functions in a given area. The present structure of the cultural landscape of Częstochowa Upland retains elements from various historical periods and additional elements from "horizontal" landscapes. Structural elements of earlier types form landscape relicts or landscape "intrusions" that protrude into the topography. An example of such an intrusion is the fortified landscapes in Częstochowa Upland, including the castle in Podzamcze.

4 Discussion

The analysis of the landscape transformation of Podzamcze serves as an example for the use of the landgraphy and stratigraphy model. This test of the method on a microspatial scale opens up the discussion of its methodological context (the applicability, strengths and weaknesses of the method) but also allows us to interpret the landscape transformation itself.

4.1 Advantages and limitations of the method

The test of the theoretical method of stratigraphy at a local scale, and also the comparison with the mesospacial scale, enabled the identification of its advantages as well as some limitations. The differences in the areas at meso and microspatial scales necessitate an individual approach to the stratigraphic method, especially to stratigraphic imaging. The mesospatial scale, covering an expanded area of the mesoregion, allows for a spatial generalisation of changes. This scale shows landscape changes throughout history, with low imaging detail. The documentary sources for this area are numerous, which enables the preparation of a landgraphy. The landgraphy based on secondary sources (detailed research results that have been published in specialist literature on the subject – geological, palaeobotanical, palaeoclimatic, archaeological, historical, etc.) and primary sources (cartographic analyses covering the last 200 years) can be blended together. The description of landscape changes (landgraphy) at a microspatial scale, can be limited by the accessibility of the literature. The use of visualisation of historical changes requires good documentation of the area and will therefore be difficult to apply in regions that are poorly recognised and described in the literature. Cartographic research, on the other hand, can

be very detailed at a local scale but only for periods with a good archive map cover.

One unavoidable disadvantage of the stratigraphy method is the impossibility of visualisation of the "oldest" landscapes. The older the landscape layers, the less accurate and reliable the data, and in some periods, the information is not available at all. The availability of cartographic materials before the 19th century is very poor and even if the maps exist, they are too general to be used at the microscale. Another problem with cartographic sources is the variable accuracy and scale of the maps (raster and digital maps: V Map, BDOT). In the historic paper map, the land cover is more generalised, and in the contemporary digital maps, it is more precisely presented. The question of the usefulness of historical topographic maps has already been raised in the literature (e.g., Affek 2012; Kuna 2015; Sobala 2012). However, it should be noted that in the present research it is a peripheral issue. The analysis allows for a certain generalisation of landscape structure and does not require a detailed analysis of individual elements of the geographical space. The juxtaposition of maps from different periods illustrates the directions of land cover change. The differences in the detail of boundaries (fragmentation) of individual land cover types exert a limited influence on the visualisation of landscape transformation over the centuries.

4.2 Opportunities of the study

The presented method, as a method of imaging landscape persistence, may be helpful for planning and spatial management at the local level (municipalities) or on a regional scale. The landscape planning process cannot be detached from its past changes. As Marcucci (2000) noticed, the landscape has dynamic legacies and landscape planning is a temporal activity. This understanding of landscape is seen in the British application methods of Historic Landscape Characterisation (HLC) and Historic Land-use Assessment (HLA) but also in other similar methods used for landscape planning in other countries (e.g., Greece, Turkey, Spain; Turner, 2018). In Poland, the history of landscape changes was not included in the method for landscape assessment and planning, the so-called Landscape Audit (introduced by the Act of 24 April 2015 and amending some acts in connection with the strengthening of landscape protection tools, which is the result of the ratification by Poland of the European Landscape Convention). And yet, the assessment of the historic character of a landscape is crucial for its protection (Jaworek, 2012). Thus, the presented method may become complementary to landscape audit studies.

The stratigraphic model opens up the possibility of the reconstruction of the landscape in particular periods. Each stage of the development can be visualised and described by the landgraphy. The model allows past changes and processes to be analysed and moments of radical transformation (like the construction of the castle) or periods of slight changes (e.g., the long-term natural processes of reforestation, which can be observed in Ogrodzieniec) to be indicated. Very detailed recognition of the dynamics and trends of past changes could enable the model to be overridden by possible future processes. The scenarios of future change can be visualised and overlaid on the stratigraphic model. In this way, the trends can be corrected in a desirable direction. Stratigraphy as a tool for landscape forecasting requires separate analyses of dynamics and trends (including statistics) and, as such, opens up new possibilities for future studies.

5 Conclusions

In this paper the use of landscape stratigraphy for the analysis of landscape transformation was tested. The presented research proposes an interdisciplinary approach to the visualisation of change, incorporating elements of cartographic study (analysis of change based on historical maps) as well as historical research incorporating archival data, geography of settlement data, complex physical geography information, and archaeological, paleo-geographical, iconographical and architectural aspects (spatial construction of the model and graphics).

The following conclusions can be drawn:

- The developed landgraphy (on a general level, using secondary, multidisciplinary sources) and the landscape stratigraphy method (detailed primary studies, using original cartographic, iconographic,

and photographic sources, and also field research) illustrates the type and nature of changes occurring in the landscape of the study area.

- The stratigraphy model of Podzamcze shows the dominance of the agricultural landscape in all studied periods. The fortified landscape (castle) is clearly visible as a core running through all the years. The forest and settlement landscapes expanded significantly within the studied period. The results obtained and their comparison to Częstochowa Upland can be considered representative of the evolutionary processes characteristic of the entire mesoregion.
- Changes in the landscape of Podzamcze have taken place in an evolutionary way. The contemporary landscape of these areas has a heterogeneous, heterotonic form.
- The method can be very useful in landscape planning as a tool presenting the persistence of the landscape. The model shows the directions and dynamics of landscape transformation, allows future changes to be predicted and, through the planning system, permits landscape changes to be corrected in a desirable direction. The method presented in the case study shows that it is possible to create forecasts for landscape evolution with a very high degree of accuracy.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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