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Transformations of cultural landscapes – combing old maps and modern technologies (Sudety Mts case study, SW Poland)

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INTRODUCTION

Sudety Mts in SW Poland were subject **to long-term transformations of cultural landscapes** of various trends:

- a constant increase in human impact since medieval times until the end of the 19th century – an increase in population and economic activities (mining, glass making, weaving and textile industry, hydrotechnical constructions, urbanization etc.)
- trend of depopulation and land abandonment since the last 100–150 years due to various political, economic, social and environmental reasons

development and decline of anthropogenic landforms and features
large-scale changes in land use/land cover

AIMS AND METHODS

- to **detect the type and scale of long-term human impact** on the cultural landscape in selected areas of the Sudety Mts.
- to **evaluate the possibilities to reconstruct** the human-induced **transformations of landscape** and their persistence based on diverse cartographic, aerial and LiDAR data from various time periods by the use of GIS.
- to **critically asses the source materials** and problems rising from the comparative **analysis of historical and modern maps and data** of various resolution and the level of data detail.

THEMES IN CULTURAL LANDSCAPE TRANSFORMATIONS

There are several **main types of changes** in cultural landscapes which **can be detected and analyzed** in the Sudety Mountains **based on available historical and modern data**. The main trends of transformations are presented below, along with the methodological problems specific for each group.

Source materials included:

- Regler's maps (1764–1779, ca. 1:24,000),
- topographic maps Mestischblatts (1875–1930s, 1:25,000),
- current topographic maps (1:10,000) from the offical state Database of Topographic Objects (BDOT10k),
- ortophotomaps, LiDAR data.

TYPE OF LANDSCAPE CHANGES — EXAMPLES — METHODOLOGICAL PROBLEMS

SETTLEMENT NETWORK

- Constant increase in built-up areas, especially around cities and town (Fig.1.).
- Disappearance of settlements due to (a) depopulation and shrinking of built-up areas, (b) inclusion into larger settlements, i.e. into towns (Fig.2.).
- Recent increase in areas with scattered settlements (second homes, tourist functions, suburbanization) (Fig.1., 2.).
- The modes of development or decline of settlements are highly influenced by the local topography and other environmental contraints (Fig.1., 2.).

Fig.1. Spatial development of built-up areas in Lwówek Śląski town is strictly related to topographic constraints.

1. Different scales and resolutions of historic maps and current databases.

2. Changes in administrative borders between settlements.

3. Lack and/or inconsistency of statistical data from different periods, which is crucial for calculating population changes.

LAND USE/LAND COVER

- Constant decline of arable lands since the 1880s (due to depopulation and land abandonment) was compensated by an increase in forests and grasslands (Fig.2.).
- Spatial shifts in built-up areas although their total surface stays roughly at a constant level (Fig.2.).
- Long-term persistence of landforms related to agriculture (terraces, stone piles and walls), even under current forest cover (especially well visible on LiDAR) (Fig.3.).

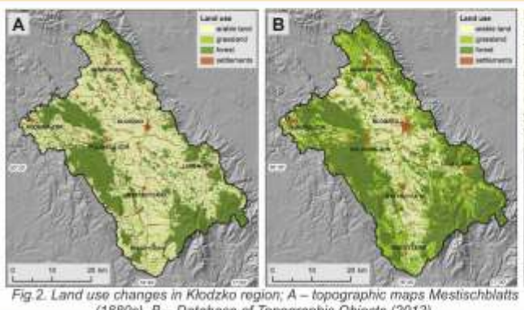

Fig.2. Land use changes in Kłodzko region; A – topographic maps Mestischblatts (1880s), B – Database of Topographic Objects (2013).

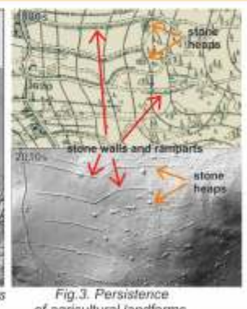

Fig.3. Persistence of agricultural landforms.

1. Inconsistency of map scales and resolution of data, i.e. very detailed classification of land use categories in current BDOT needs an aggregation of data in order to compare it with Messtischblatts.
2. Incompatibility of coordinate/metric systems in different maps needs additional transformations, which can impact the results of comparative analysis.
3. Lack of metric system in the oldest available topographic maps (Reglers).
4. Only the largest anthropic landforms (terraces, stone piles and walls) are marked on the historic maps, therefore these features cannot be compared in a longer time-scale with much more detailed LiDAR data.

"INDUSTRIAL" ASPECTS OF LANDSCAPE

- Large-scale transformation of production modes and their visual appearance in the landscape (gradual disappearance of wind- and water-mills, shifts in location of lime kilns, abandonment of old mining sites, etc.) (Fig.4-6.).
- Increase in industrial areas since the end of the 18th century and decline of most of them in the second half of the 20th century.
- Long-term persistence of traces of former mining sites and quarries (visible on LiDAR) (Fig.6.).

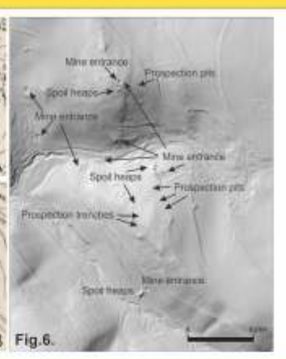

Fig. 4. Wind- (red circle) and water (yellow circle) mills visible on Regler's maps (1770s) do not exist in the contemporary cultural landscape.

Fig.5. The highest level of industrialization can be recognized on the maps from the turn of the 20th century; examples of: A - lime quarries and kilns (Kalkofen); B - brickyard (Zgl.). Most of the exploitation or industrial sites are not in use any longer.

Fig.6. Landforms related to former mining are very well visible on the LiDAR data in spite of the cease of their exploitation for at least 70 years.

1. Various scales of historic and present cartographic sources make the comparative analysis on development of mining or industrial sites very imprecise.
2. Various types of maps present diffrent details about industry and other economic activities or do not present them at all.

HUMAN-INDUCED CHANGES IN HYDROGRAPHY

- Widespread channel regulations, i.e. straightening, especially in the 19th century.
- Construction of diverse hydrotechnical objects of various scales (water mills, weirs and large dams with reservoirs).
- Large-scale, gradual decline in number and area of fishing ponds (Fig.7.).
- Persistence of traces of former channels and hydrotechnical constructions in the landscape (especially well visible on LiDAR) (Fig.7.).

Fig.7. While the fishing ponds have vanished for more than 100 years ago their traces (dikes) are visible on DEM data.

1. Some apparent changes in river channels can be the result of inconsistency of map scales and resolution of data or adaptive transformations of coordinate systems.
2. Changes in hydrography, such as they can be detected from the cartographic sources, can be the result of both natural and human-induced processes; therefore cartographic materials must be supplemented by historic sources to interpret correctly the changes in fluvial system.

CONCLUSIONS

- The possibility to investigate **the long-term transformations** of cultural landscapes **depends highly on the available source materials** and their properties therefore they are regionally very diverse and **no universal procedure can be adopted** for such analysis for larger areas.
- While **some** of the landscape **transformations can be traced on a long-term and highly detailed scale**, the **other** can be detected **only for selected sites and shorter periods**, and should be treated rather **as estimates** in both qualitative and quantitative analysis.
- In spite of diverse constraints in comparative analysis of cartographic sources from various time periods, **the general trends in transformation** of cultural landscapes in the Sudetes **can be detected**, related to both the initial increase and further decline of human impact in the study area.