Gis Supporting Landscape Issues In Land Consolidation Works In Poland

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Keywords: land consolidation, landscape planning

SUMMARY

The present approach to consolidation works is considered in a broad context concerning post-consolidation development of the area.
The paper presents a proposal of supporting the decision making process in the course of designing the landscape issues in the general project of land consolidation with GIS-related data originating from two sources in Poland: the Topographic Database and the Land-and-Buildings Cadastre. The use of GIS-related analysis is presented.

Introductory remarks

The agricultural structure, existing in Poland, has contributed to development of at least two problems, which must be overcome in rural areas: firstly, high scattering of agricultural parcels creates difficulties in income generation for farms when other, alternative sources of incomes do not exist, and, secondly, distribution of land resources in particular farms results in the situation, when almost 50% of farms are not involved in market production; this means that significant part of agricultural production is not related to the market in the existing agricultural structure.
The instrument which allows for temporary solution of those problems is land consolidation process, which has been performed for many years.
It has been estimated that about 3 million hectares of arable lands in Poland require consolidation. The highest demands for land consolidation works exist in the south-eastern and in the central part of the country.
As a result of activities performed within the land consolidation process, which were related to reduction of the number of land parcels in farms as well as with modification of their shapes, improvement of effectiveness of farming through decrease of costs of transport and facilitation of mechanisation of farming is achieved. In contemporary land consolidation works rules of sustainable development are considered. Following those rules, new non-agricultural functions are introduced in the rural space. A concept of post-consolidation area management is developed within the land consolidation project; this concept includes:

- Protection of the natural environment (preservation of natural, valuable components of the agricultural environment, creation of physical conditions for the needs of aforestation processes),
- Management of rural landscapes (consideration of the local landscape values, support for landscape protection functions, increase of tourist attractiveness of rural areas),

- Delineation of lands to be used for the needs of technical and social infrastructure (reduction of differences between the level of life in rural and urban areas, development of infrastructure for the needs of agro-tourism),
- Water management (flood protection, water retention for the needs of recreation).

Usually, land consolidation projects are developed by the Polish geodetic service for the area of one village – one cadastral unit. Together with developing computerisation of land and buildings cadastre in Poland, as well as with growing access to digital spatial data, the GIS technology is applied for the needs of land consolidation projects; this technology supports decision making processes. The paper presents an attempt to use spatial data, which originates from the Topographic Database (which is in the phase of development), in order to amend cadastral data with the content, which does not appear in the cadastre and which might be useful for development of land consolidation projects.

Research aims and data sources

The aim of the project is to support the decision making process related to land consolidation works, with selected spatial data (originating from two sources: from the Topographic Database (TBD) and from the Land and Buildings Cadastre (EGiB)).
The possibility to amend the cadastral map with the terrain relief, as well as with permanent man-made and natural features, has been examined. The cadastral map, produced within the discussed project, amended with the content from the TBD, would become the background for the land consolidation project performed with the use of spatial analysis, which support the decision making processes.
Geometric and descriptive data, originating from the Topographic Database (TBD) and from the Land and Buildings Cadastre (EGiB) have been applied. Data from those two sources are adapted to the specifics of the project: accuracy of classification and recording of data corresponds to the scale of the project – the local scale. The land consolidation process is usually performed for the area of one village, therefore the project presented in the paper, has been developed for a selected cadastral unit.
Data required for the general land consolidation project are register data concerning lands located within the area of the land consolidation project:

1) data concerning the cadastral unit,
   - Name of the unit and its number, being the element of the unit identifier,
   - Digital description of borders of the district, which considers borders of the units of the basic, three-level division of the country,
2) data concerning register parcels included within the district,
   - Number of a parcel being the component of the parcel identifier,
   - Digital description of borders of parcels,
   - Size of a parcel,
   - Information, which specifies sizes of land use type units and soil classes within a parcel,
   - Number of the register unit of lands, to which the land parcel is assigned,
   - Specification of documents, which specify rights to the parcel.
3) data concerning buildings, which are the elements of real property,
4) data on location of buildings, which are the separate property,
5) data concerning land use units and soil classes,

- Digital description of borders of those land use type units and classes,
- Specification of land use type units and soil classes within the borders of particular land use type units and numbers of those units.

Data from the Land and Buildings Cadastre (EGiB) are sources of geometric register data used for the needs of the project. They are available as *shape* format files for two layers:

- A layer of cadastral parcels,
- A layer of soil classification borders.

Auxiliary data which amend the cadastral data in the project are data originating from the Topographic Database (TBD). The following components constitute the Topographic Database (TBD):

- ORTO database – the database of digital orthoimages;
- NMT database – the Digital Terrain Model database;
- TOPO database – contains data on location and features of topographic (field) objects; data included in this component contain complete terrain information – starting from land use/land cover types, through roads or buildings classified according to their types, telecommunication lines, power supply lines, to location of individual trees, wells or wayside chapels and crosses; data are grouped in thematic layers, which contain data from particular groups, (e.g. the layer of trees, the layer of telecommunication networks etc.) in vector format.
- KARTO database – data stored in the TOPO Database, presented in the form of a topographic map,
- meta database – a set of information which describe data stored in the TBD database.

The following data sources concerning the terrain relief, have been used:

- the digital terrain model in the „TIN" structure in ASCII format.

As a source of information concerning permanent, man-made features (such as: surface technical infrastructure (location of installations, chapels, crosses, wells) and natural, permanent features (as rows of trees along roads, individual trees and bushes, fences, rocks, erratic boulders) the following data sets have been used:

- Data files of the vector Topographic Database in the GML format, for vector and descriptive data (from the vector TOPO topographic database),
- A digital orthophotomap in the GeoTIFF format (from the ORTOFOTO base).

Methodology

The task performed within the discussed project consisted of generation of the cadastral map, amended with the content, which concerned the terrain relief and permanent natural, and man-made features, originating from the Topographic Database (TBD).

Works have been performed with the use of ESRI ArcGIS software, version 9.1. The list of layers used for the needs of the discussed task, includes:

From the EGiB database:

The graphical part of EGiB – the cadastral map in the form of *shape* format files for two layers:

- layers of parcels,
- layers of classification units.

From the TBD:

- a digital orthophotomap in the GeoTIFF format,

- NMT („TIN" structure in ASCII format),
- Selected layers from the vector database, TOPO level 3 (GML format).

The conceptual model of the vector topographic database has been developed in such a way, that it allows to prepare comprehensive description of the terrain with the accuracy similar to the description ensured by the topographic map at the scale of 1: 10 000. In the case of the vector topographic database the terrain has been presented at three different levels of generalisation with three levels of classification of objects have been distinguished. Data from the third level, which corresponds to the scale of 1:10 000 have been used for the needs of the project.

Layers selected from the vector TOPO database, from the third level, which were required for the discussed task, were the data listed below. Only such layers of the third level, which occur within the area of investigations, are included in the presented set of data; they are:

- The "cadastral unit" layer PT PE 01,
- The "reservation" layer TC RE 01,
- The "banks and dykes" layer BB ZM 01,
- The "embankments" layer BB ZM 02,
- The "power supply lines" lines SU EN,
- The "telecommunication line" layer SU EN 03,
- The "tree" layer OI PR 05,
- The "chapel, cross" layer OI OR 02,
- The "wells" layer OI OR 06.

Conclusive remarks

The objective of presented works was to amend a cadastral map with elements which do not occur on this type of map, but which are required for development of a land consolidation project.

Data presented above and originated from various sources, which are required to meet that objective, have been integrated in one geo-database.

Utilisation of TBD allows to limit, or even eliminate, the necessity of field visits and surveys, which are usually required in order to amend the cadastral map, before the land consolidation project is implemented.

Comparison of the tree layer (OI PR 05), which originates from the TOPO, vector database of level 3, used as information about permanent landscape features, which occur within the area of investigations, from the orthophotomap, justifies the need to perform the field inspection.

The orthophotomap may be used for inspection of the real land use, as well as for discovering discrepancies between legal and physical (real) borders. Thus, those areas, which require field inspection before the land consolidation project is started, may be delineated.

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BIOGRAPHICAL NOTES

Adrianna Pulecka graduated from the Faculty of Landscape Architecture at the Agricultural University in Warsaw. She competed her doctor thesis on management and protection of the rural landscape in the course of transformation of spatial structure of rural areas in Poland. At present, she works at the Warsaw University of Technology Faculty of Geodesy and Cartography.

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