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Possibilities of optimal land use as a consequence of lessons learned from land consolidation projects (Slovakia)

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ABSTRACT

This paper acquaints readers with outputs produced from thematic maps and analytical testing in a land consolidation project which is being conducted in Slovakia at the Žitava River basin (1.628-square-kilometres total watershed). New options and strategies are presented for the use of a land consolidation database for projects in any planning, optimizing and development activity to be performed by any expert who enters the model area with her/his own opinions. We highlight problems currently limiting rural development (the area's low ecological stability, frequent floods, ever greater soil erosion, etc.) and also describe measures which could protect the area against natural disasters (e.g. ongoing water erosion, silt accumulating and choking streams and water expanses). The paper introduces methodical procedures that enable a functional organization of the area to be designed (calculating ecological stability, determining critical points and a methodology for determining the degree of erosion in endangered areas, etc.). It also analyses conditions in relation to protecting and developing the rural region, highlighting the chief problems in water management, access to roads and environmental protection, while graphically presenting basic thematic layers crucial for assessment. Based on this data set, a broad portfolio of combinations can be utilized for evaluating the quality of the proposed measures. We suggest a new combination of methods to let system users determine what measures should be recommended for cadastral plots. Examples are presented of changes affecting the structure of the landscape, the threat of erosion, elimination of flood conditions and the quality of life in the model area.

1. Introduction

Nowadays, many researchers in Slovakia (e.g. Vanek, 2006; Hudecová, 2010; Muchová and Petrovič, 2010), in the Czech Republic where history has developed similarly (e.g. Dumbrovský et al., 2014; Sklenička et al., 2014) and from outside these countries (e.g. Hartvigsen, 2014; Pašakarnis et al., 2013; Vitikainen, 2004; Lisec et al., 2014; Van Dijk, 2007) believe land consolidation (LC) projects have had the most positive influence in agricultural countries on how landscapes are arranged and protected. Land consolidation (LC) is among the key tools many countries in the European Union (EU) are using for rural development. This has spurred the EU to approve measures in the 2014–20 Agricultural and Rural Development Operational Programme titled "Land Consolidation" (http://enrd.ec.europa.eu/). LC activities are closely related to fulfilment of the Village Restoration Programme, which encourages residents to harmoniously develop an environmentally friendly community, conserve municipalities' natural and cultural values and develop a green economy either through their own efforts or with their municipal governments.

Authors such as Lisec et al. (2014), Korthals and Bong (2011), Pražan and Dumbrovský (2010) agree that the importance of LC can be specified from different perspectives. The Land Consolidation Project brings plot owners and stakeholders different benefits. In some cases, LC projects are negatively perceived because they simplify the land property market, opening it up to foreign investors interested in buying up soil (Kokolová, 2013). This negative view of LC can likewise be seen in disgruntled owners more inclined towards the "old socialist order" (Vašek, 2014) because about half a million hectares of land in Slovakia are still registered under the name of unknown owners. Thomas (2006), Vitikainen (2004) and Jürgenson et al. (2010) see LC as important to landowners because it offers them the opportunity of consolidating their scattered plots to improve business and farming.

Owners expect land prices to increase in the market, but also to see opportunities arise to start using their land or signing new

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leases on exactly measured plots (Niroula and Thapa, 2005). In other words, Slovak owners expect LC especially to bring order to the current chaos of land ownership, a result of it not having been recorded in land registries and title deeds after 1951. About 50% of Slovakia's plots have not been ever legally registered. Currently, plots are being re-registered nationwide, Muchová and Antal (2013).

The discrepancies in ownership, mentioned earlier (not only) in Slovakia, are causing a lack of interest among owners and an overall negative impact on the landscape. The land is either sold (especially for development) or leased to companies whose commercial activities degrade rather than protect the land. This situation has been noticed in different variations among many post-socialist countries. Müller and Munroe (2008), Kuemmerle et al. (2009) and Lisec et al. (2013), in addition to others, see current rural development trends leading to disruption of the cultural landscapes that characterize these regions (as experienced in Albania, Slovenia). The high level of fragmentation experienced in many parts of Poland, according to Kupidura et al. (2014), prevents the creation of legal and spatial conditions that allow rural areas to develop into multifunctional units. The Hungarian experience (Vranken and Swinnen, 2006) shows the domination of corporate farms in some regions restricting access by households to land and becoming a weight on rural development. Research providing a better understanding of the consequences from post-socialist changing land use change on ecosystems and biodiversity can be found also in Kuemmerle et al. (2009) and Skokanová et al. (2012).

LC can boost rural development especially through optimal, environmentally-friendly use together with measured human interventions. Construction of country lanes and forest roads within approved consolidated lands can also be beneficial. Improvements can be also seen in the abolition of agricultural vehicle routes through the centre of towns and villages (Sorensen et al., 2004), in addressing harmful surface water drainage and in protecting rural areas from flooding through erosion control and water management (Dumbrovský and Korsuň, 2012), in increasing ecological stability and biodiversity and in sustainable rural development (Lisec and Pintar, 2005; Pašakarnis and Maliene, 2010; Krnáčová et al., 2013; Špulerová et al., 2011) as well as simplified and easily managed land use planning by municipalities, arranging plots so they are accessible for (agricultural) use even after the construction of community bypasses in addition to road and rail corridors (Korthals and Bong, 2011). The proposed structure of land use changes in LC projects should correspond to the environmental conditions expressed in case studies (Druga and Falt'an, 2014; Munteanu et al., 2014).

Land consolidation projects in Slovakia are being processed comprehensively and aimed at addressing ownership fragmentation and the optimizing of proposed rural development in detail. There is already enough technical and legal background available from all stages of the LC project. Fig. 1 presents a simplified LC simplified scheme for Slovakia. The resulting project phases (obtained by direct or indirect methods) are shown in bold, a more detailed characterization is provided by e.g. Muchová and Antal (2013).

The last 25 years have seen a number of LC projects suffer fundamental defects caused by failure to comply with mandatory steps. Project designers often enough lack the necessary landscape engineering qualifications. Unsatisfactory and defective outputs from projects seem to be chaotic and their usefulness is questionable. In many cases, we have detected that a proper drafting of general principles in functional rural organization (spatial land reorganization) could, for instance, address flooding and reserve land for suggested measures and facilities, providing the opportunity for action to be taken. Unless something like this is done, additional solutions, defining measures to be taken and facilities to be built after the LC projects are documented in land registries will be difficult or even impossible. The projects tend to ignore important problems, such as negligence of water issues. An assessment that is too shallow or just plain incorrect of the causes can cause flooding and erosion. Unfortunately, projects with serious deficiencies are being approved and verified by engineers without the necessary knowledge, leading to projects that have been formally completed, but with almost no easy way to resolve problematic issues.

Land consolidation is a specific matter each country must address. Authors of methodological procedures unanimously agree that LC is a tool to resolve defects/conflicts in countries where the land is intensely used for agriculture. Demetriou et al. (2012b) writes in particular that a new LC planning support system is needed in Cyprus because projects are taking too long with high operational costs and conflicts erupting between the stakeholders. Cay et al. (2010) also present optimization studies for reallocation of consolidated land. Trubins (2013), among others, believes all transitions between land-use categories and changes within existing categories should be considered for a better understanding of the transformation of the land-use system. These important land-use changes have barely been studied empirically beyond net changes of land-use categories. Decision support systems for rural consolidation and related planning processes are mentioned by Demetriou et al. (2012a). These integrate artificial intelligence technologies and multi-criteria decision methods with a geographical information system. Optimizations studies for reallocation of land using statistical methods are also presented by Cay and Iscan (2011).

The authors of this paper provide strategies and highlight new opportunities for planning, optimizing and development activities based on available data from a model area, accompanied by the corresponding context (overview of LC foundations in Slovakia, thematic maps, etc.).

2. Material and methods

The basic analysis for drafting an optimization process is elaborated in a model area comprising the basin of the Žitava River (Fig. 2). 125 cadastral districts with a total area of 1.628 square kilometres are located in the watershed, comprising two regions and five districts. Almost a third of the Žitava basin is covered by forests (both the north and eastern edge), while the remaining river area is covered by arable land intensively exploited for agriculture, where mainly cereal crops are cultivated. The climate of the river basin can characterized, mainly in the lowlands where the productive part of the arable land is located, as dry and marked by very warm or warm temperatures. The soil is regarded to be high quality and deep with either no soil skeleton or one at a very low level. The maximum elevation measured at the north part of river basin is 882 m above sea level and the minimum elevation measured at the south part of river basin is 120 m above sea level.

The main input data are outputs obtained from LC projects and also excerpted resources (materials), geo-referenced to the Uniform Trigonometric Cadastral Network (S-JTSK Krovak East North – the Slovak Republic's binding coordinate system) and Baltic Elevation System after adjustment. The entire thematic map catalogue is based on the Infrastructure for Spatial Information in the European Community (INSPIRE) and can be divided into four themes: initial themes, initial analytical themes, derived analytical themes and designing themes.

Basic thematic materials are divided into registers: REVIEWS, RASTER, SOIL, ECOLOGY, LAND USE, DEM and WATER. Registers contain the fields for the various LC project stages as well as materials entering the project as the foundation for the development stages.

REVIEWS (Fig. 3) contains information about completed projects that have been incorporated into the river basin model and