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Analysis of the non-productive land use in Lithuania

Vilma Šalkauskienė[a,*], Daiva Gudritienė[a], Edita Abalikštienė[b]

[a] Institute of Land Use Planning and Geomatics, Aleksandras Stulginskis University, Universiteto Str. 10, LT-53067, Akademija, Kaunas District, Lithuania
[b] Forestry and Environmental Engineering, University of Applied Sciences, Liepų Str. 1, LT 53101, Girionys, Kaunas District, Lithuania

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ABSTRACT

The preservation of high-quality agricultural land and its proper use is a relevant task on a global scale. A specific problem is raised by the fact that agricultural land is a limited and a practically non-renewable natural resource. The use of land differs throughout the territory of Lithuania. Some areas are favourable to agriculture, while others are not. Less favoured agricultural areas include territories where agricultural activities are unprofitable due to low soil fertility, areas where the density of the rural population is lower than the national average, and areas where the viability of rural communities is decreasing. When planning the use of land, a priority must be given to the public interest, which also includes preservation and improvement of the land used for agriculture and forestry. It is necessary to harmonize natural (ecological) and agricultural systems, and on that basis it is necessary to economically and legally regulate the growth of production. Human agricultural activity must be adapted to the real natural conditions. Thus the environment would suffer minimum changes.

The aim of the article is to conduct a systematic planning analysis of the non-productive land use in Lithuania and to develop a model suggesting the ways how to use the non-productive land.

1. Introduction

The aim of the article is to conduct a systematic planning analysis of non-productive land use in Lithuania and to develop a model encompassing the use non-productive land.

To achieve the aim through systematic analysis, the following objectives are raised: to conduct the analysis of agricultural land in municipalities prevailed by non-productive land; to develop a method suggesting the reasonable use of non-productive lands by applying the mathematical method of multi-criteria analysis.

The main element of scientific novelty in the article is the model encompassing the use of non-productive land based on the analytical hierarchical process of multi-criteria analysis. After mathematical processing of statistical data and the data received by the assessment of natural, organizational and economic factors performed by competitive specialists (experts), the model suggesting the ways for using non-productive land was developed, allowing one to plan the prospects for the use of specific land plots and land holdings in the territorial planning documents.

When analysing and assessing the best planning of non-productive land use, it is important to select a suitable mathematical method that would allow one to perform a comprehensive and detailed analysis and multi-criteria-based comparison. When the analysed alternatives of land use are defined by several criteria, the assessment methods must be applied in order to enable one to take into consideration their entirety. The methods of multi-criteria decision analysis are well suited for this particular case.

Member states of the European Union determine the criteria to classify land as non-productive. In most cases, the average amount of country's crop production is used to identify less favoured agricultural areas. Taking it into account, each state determines the percentage expression of grain crops fertility in less favoured agricultural areas in comparison with the national average (usually 80% apply). The use of agriculturally favoured areas in Europe was assessed by the research into the support of the European Union for reducing the abandonment of less favoured agricultural areas, the research of extensive agricultural potential, the practice of good agricultural condition, and the support for rural communities (Paracchini et al., 2006; Pelucha et al., 2013; Strelecek et al., 2008). In Scotland (Bouma et al., 2012) and in Hungary (Pásztor et al., 2010), less favoured agricultural areas are identified by assessing soil properties.

Less favoured agricultural areas in mountainous terrains were compared with other less favoured areas by Dax and other scholars (2005), who determined that there was three times less arable land than in the plains; in woodlands the amount of arable land exceeded that of the plains twice. It was determined that the decline of the population in

* Corresponding author.
E-mail address: vilma.sinkeviciute@asu.lt (V. Šalkauskienė).

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those areas was greater than in the plains. In Poland, the use of land in less favoured agricultural areas was analysed by Jankowska-Huflejt et al. (2011). It was determined that in a mountainous terrain, the productivity of agricultural plants was lower by 74% in comparison with the national average; meanwhile, in less favoured agricultural areas of the plains, it was 19–39% lower if compared with the national average. E. Hatna and M. Bakker examined the abandonment of arable land in Europe. The assumption that the arable land was abandoned in those areas where agricultural conditions were unfavourable was verified (Hatna and Bakker, 2011).

Scholars of the European Union member states pay much attention to the assessment of the agriculture efficiency by applying a variety of methods to analyse the farming data (Fandel, 2003; Alvarez and Arias, 2004; Gorton and Davidova, 2004; Latruffe et al., 2005; Boussemart et al., 2006). In Lithuania, the efficiency of farms has also been examined in various aspects by a number of scholars (Vitunskienė, 2003; Kuodys and Kučas, 2006; Kriščiukaitienė et al., 2006, 2009, 2010; Gapšys and Mieliauskaitė, 2006; Skulskis et al., 2006; Poviliūnas, 2008). However, most authors analyse the efficiency of individual factors of production disregarding their mutual interaction and rational combination. Sojkova and other scholars (2008) examined technical efficiency in Slovak farms comparing less favoured agricultural areas with more favoured ones. Models describing both types of areas were developed predicting the efficiency of land use.

The issues of land use planning are relevant in neighbouring countries, namely, Poland (Banski and Mazur, 2016), Latvia (Abolina, Luzadis, 2015) and other European countries (van der Sluis et al., 2016; Lasanta et al., 2017). In addition, the issues related to the topic were analysed in works of Russian (Prishchepov et al., 2013) and Ukrainian (Smaliychuk et al., 2016) scientists.

R. B. Zhong states that people who grow agricultural products should enhance their knowledge of farming to expand capital in order to increase the competitiveness of their farms (Zhong, 2007). Liu Xu and Wang Xiudong emphasize that it is necessary to improve the existing systems and mechanisms (Xu and Wang, 2007).

As defined by M. Gehlhar, A. Regmi and other authors, the economic competitiveness of rural areas is the ability of economic entities acting in a specific area to create value for sustainable economic growth. Economic entities must be able to manage processes influencing the growth and productivity of their activities. The economic competitiveness of a country or a region is determined by the land, location, natural resources, labour force and the size of population (Gehlhar et al., 2006).

The assessment of economic parameters showed that the competitiveness of farms increased in less favoured agricultural areas of Estonia. Since 2001, the average size of a farm has increased from 16 to 48 ha, and stock-breeding has expanded in non-productive lands. Natural meadows and pastures have increased the biodiversity index, and the task has been raised to retain and enhance the natural grassland areas in non-productive lands (Köster et al., 2011).

Following theoretical research, Jian Qiang Li developed an econometric regression model to quantitatively determine the factors that affect agricultural innovation in Sichuan province. He claimed that the main factor impeding innovation is people's attitude (Jian, 2012).

Changes in non-productive and abandoned lands can be observed by remote methods using satellite-based information (de Beurs and Ioffe, 2011). CORINE maps of land cover and agriculturally less favoured areas analysed in the Mediterranean region. It is advisable to use the obtained spatial results to administer the rural development (Weissteiner et al., 2011).

Figuiera et al. (2005), Ginevičius and Podvezko (2001, 2004, 2007a,b,c), Ginevičius and Podvezko (2008), Hwang and Yoon (1981), Saaty (2008), and Tarrasón et al. (2007) conducted research applying multi-criteria methods for solving a variety of tasks. The literature describes numerous methods of multi-criteria decision analysis with different features, and different authors provide a diverse classification of methods in different literature sources (Triantaphyllou et al., 1998). However, one of the most commonly used classification methods is the classification by the type of data used. Then methods are divided into three groups: deterministic, stochastic (probabilistic) and contingent sets. The scientific literature (Fülöp, 2005; Caterino et al., 2009) claim that there is no universal method suitable to assess all problems of multi-criteria decision analysis; each method has its own advantages and disadvantages.

Agriculture-related decisions usually include several criteria, some of which are subjective. The analysis of these criteria by conventional methods is complicated. Multi-criteria methods may be used for the assessment of agricultural pollution (Fealy et al., 2010), the environmental assessment (Bello-Dambatta et al., 2009) and the assessment of the sustainability conception of the land-use (Munda, 2005).

The method of the analytical hierarchical process (AHP) is used for hierarchical structuring of the task, which allows one to decompose a relevant problem into smaller and clearer parts and thus the analysis is applied to assess agricultural decisions, taking into account a variety of factors. The AHP method was introduced by T. Saaty in 1980; therefore, it is often referred to by the name of T. Saaty. It is a popular and broadly applied method. It is most commonly used in the fields where the hierarchical structure of selection processes is clear enough. The method of analytical hierarchy is a closed logical structure that is realized by simple rules and designed for the analysis of complicated problems and the determination of the best solution (Podvezko, 2009). This method is widely applied in works of other scientists on the topic of land use planning (Mosadeghi et al., 2015).

Considering a variety of multidimensional sustainable development processes, methods of multi-criteria assessment may be successfully applied. These methods may be helpful in performing the tasks of selection, sorting, ranking and description (Baležentis et al., 2011).

Taking this into account, for the research objectives, it was decided to select those municipalities where the average productivity of land was assessed to be at least 37 (i.e., the economic value of soil is the same as that of sand and gravel soils or eroded soils). Out of 52 rural municipalities of the state, the land in 18 municipalities scored less than 37. In addition, the land of such productivity is also found in 48 elderships of 18 other municipalities. In the Republic of Lithuania, the average score of land productivity is approximately 41.80; however, in individual municipalities, it varies from 30.50 to 55.10. The scores also influence the intensity of agricultural land use and different measures of the state support. In non-productive areas, it is important to determine the best method of land use, taking into account economic, social, environmental and technological factors.

2. Material and methods

When analysing and assessing the best use of non-productive land, it is important to select a suitable mathematical method that would allow one to perform a comprehensive and detailed analysis and multi-criteria comparison.

Following the peculiarity of the problem the methodology concerning reasonable use of non-productive land was developed (Fig. 1).

Situation analysis is conducted and the main problem is identified, i.e. analyzing properties of non-productive land seeking optimal land use; forming a group of experts. Having conducted the analysis of multi-criteria land use models designed by foreign authors and evaluating natural, social, technological and economic conditions in Lithuania as well as having conducted the analysis of legal acts, the following alternatives for non-productive agricultural land use can be suggested:

I Crop production – prevailing production of market crop (grains, rapeseed, potatoes, etc.);
II Animal husbandry – growing herbaceous plants for forage of cattle and/or sheep, production of market milk and meat (beef);
III Natural farming – agricultural production only for private needs of a