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Research article

Land-use evaluation for sustainable construction in a protected area: A case of Sara mountain national park

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ABSTRACT

The process of making decisions on sustainable development and construction begins in spatial and urban planning when defining the suitability of using land for sustainable construction in a protected area (PA) and its immediate and regional surroundings. The aim of this research is to propose and assess a model for evaluating land-use suitability for sustainable construction in a PA and its surroundings. The methodological approach of *Multi-Criteria Decision Analysis* was used in the formation of this model and adapted for the research; it was combined with the adapted *Analytical hierarchy process* and the *Delphi process*, and supported by a geographical information system (GIS) within the framework of *ESRI ArcGIS software – Spatial analyst*. The model is applied to the case study of Sara mountain National Park in Kosovo. The result of the model is a "map of integrated assessment of land-use suitability for sustainable construction in a PA for the natural factor".

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1. Introduction

Protected areas can not achieve their full potential if they become isolated fragments of an ecosystem surrounded by incompatible or conflicting land use (Sandwith and Lockwood, 2006). This fragmentation can be caused by rapid population growth, urban development and tourism and intensive land use around many PAs in the world (Hansen and De Fries, 2007). As a result, ecological networks and the zoning approach have an increasingly important role in the protection of natural heritage and natural resources, and complementary land use. Protected areas and ecological networks consist of several basic types of natural heritage protection zones and sustainable-use zones: core areas, corridors, buffer zones (buffer and transitional) and sustainable-use areas (Bennett and Mulongoy, 2006; Geneletti and van Duren, 2008). In transitional zones and sustainable-use areas, sustainable use and construction are planned and carried out (Bennett and Mulongoy, 2006). Maksin et al. (2014) suggests that a twofold functional networking of space can be spoken of in PAs and ecological networks, the primary function of which is to protect and connect biodiversity, PAs and the landscape. Second and almost equally significant is the connection between PAs and ecological networks with residents, tourists and other users of the space, and the provision of environmental services to meet their needs. This means that some zones in the area of the ecological network can form a network of zones of sustainable development and construction of settlements, tourism, and other complementary activities. The integrated zoning of protected areas (PAs) – natural heritage protection zoning and land-use zoning – is being used more and more as an instrument to satisfy the often conflicting demands to strengthen the protection of natural heritage and natural resources on the one hand, and improve the quality of life of the local residents in the PA and its surroundings on the other (Naughton-Treves et al., 2005). The process of making decisions on sustainable development begins in spatial and urban planning when defining the suitability of using land for different purposes, in particular for sustainable construction in a PA and its immediate and regional surroundings. Therefore, the relationships and connections between natural heritage protection zones and land-use zones at the level of a PA or ecological network can be efficiently assessed and integrated through the process of spatial planning.

A review of relevant literature and available research concluded that there are no research results dealing with the topic of

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evaluating and selecting land for sustainable construction in protected or other areas. The spatial planning process is faced with many conflicting objectives and interests in the use of land. According to De la Barra (1995), establishing an environmentally, economically and socially sustainable model that will check whether certain purposes are justified includes prior evaluation, and then the establishment of criteria and indicators for defining the parameters of suitability for the land or location. Assessment of the suitability of using land for different purposes is one of the basic inputs for the process of spatial and urban planning. Progress in information technologies and scientific disciplines, including Geographic Information Systems (GIS) and the development of MCDA (*Multi-Criteria Decision Analysis)* methods for use in spatial and urban planning, provides adequate support to solving complex planning problems (Joerin et al., 2001). According to the same author, estimating the suitability of land use is similar to selecting an appropriate location for a particular purpose/activity, but it differs in that its goal is not to select the best alternative, but to determine and map the index of suitability for a whole area. MCDA methods have been used for the problem of *land-use suitability assessment* since the 1980s (Antoine et al., 1997; Collins et al., 2001; Kiker et al., 2005; Kunwar et al., 2010; Sharifi et al., 2006; and others). Visualization and the possibility of adequate mathematical calculations in order to obtain valid evaluation results for the suitability of land by means of a suitability map is achieved by integrating the MCDA and GIS methods. A combination of these methods is promoted for solving complex problems in urban planning and assessment (Phua and Minowa, 2005), like in the study of land use in urban planning based on MCDA and GIS applied in Lanzhou (Dai et al., 2001). Senes and Toccolini (1998) combine the *Ultimate Environmental Threshold* method with overlaying maps (GIS layers) for evaluating the suitability of land for development. Hall et al. (1992) and Wang (1994) use MCDA methods and overlaying maps in a GIS to define homogeneous land-use zones and the level of suitability of agricultural land in each zone. Another approach uses a combination of AHP methods and GIS for determining the suitability of land for agriculture and afforestation and for evaluating multiple scenarios of land use for these two purposes (Nyeko, 2012). A similar approach was used to determine the discontinuous zone of forest and agricultural land around the protected area of El Yunque National Forest (rainforest in Puerto Rico) for its protection from urban expansion (Lopez-Marrero et al., 2011). By combining MCDA methods and GIS, Eastman et al. (1993) mapped the land suitability for industry in Kathmandu. Other authors valorize the suitability of a habitat for endangered species (Pereira and Duckstein, 1993) or combine the methods with environmental modeling (Jankowski, 1995; Laaribi et al., 1996). A combination of these methods is also increasingly used for assessing the integration of planning options into a landscape (Domingo-Santos et al., 2011; Hernández et al., 2004; Tassinari and Torreggiani, 2006). Many researchers have used a combination of the above methods to determine the suitability of sites for landfills (Cheng et al., 2003; Kontos et al., 2005; Nenković-Riznić, 2011a, 2011b; Zamorano and Molero, 2008; and others). Joerin et al. (2001) shows the possibility of combining the MCDA and GIS methods for producing suitability land-use maps for housing, based on complex criteria and the evaluation of options by the stakeholders. Jeong et al. (2013) combines the Analytical hierarchy process (AHP) and Social additive weighting (SAW) with a GIS for the valorization and mapping of the suitability of land for constructing rural buildings and integrating them into the peripheral zone of Hervas, a town in Extremadura, Spain. Comino et al. (2016) combine MCDA with the Ordered Weighted Average method, stakeholder analysis and a GIS to support the ecological and environmental planning for the Pellice river basin in North West Italy. Geneletti and van Duren (2008) combine spatial MCDA and multiobjective evaluation with a GIS to optimize zoning of the Paneveggio-Pale di S. Martino Natural Park in the Trentino region of Italy.

The aim of this research is to propose and assess a model for evaluating the suitability of land for sustainable construction in a PA and its surroundings. The model should be designed to support the development, evaluation and selection of planning options and support planning decisions in the process of spatial and urban planning, as well as sectoral planning – planning the management of protected areas and the sustainable development of tourism, where appropriate, and other forms of sectoral planning. In this study, the evaluation includes only the set of natural factors, which is the starting point for evaluating anthropogenic and social factors. The methodological approach of *Multi-Criteria Decision Analysis – MCDA* was used in the formation of this model and adapted for the research; it was combined with the adapted *Analytical hierarchy process – AHP* and the *Delphi process – DP*, and supported by a geographical information system (GIS) within the framework of *ArcGIS software – Spatial analyst*. The model was applied to the case study of Sara Mountain National Park and tourism destination in Kosovo. The result of the model was a *map of the integrated assessment of land-use suitability for sustainable construction in a PA for the natural factor.*

2. Materials and methods

2.1. Case study and materials

Because of its unique natural heritage, Sara Mountain National Park, Kosovo ranks among the most attractive national parks in the Balkans (Map 1a). It is one of six European centers and one of 153 centers of world biodiversity. Sara Mountain is one of the richest European areas for its fauna. It is on the Emerald List of areas in the European ecological network, as well as the List of internationally important areas for plants – IPA areas (Stevanović, 2005), the List of internationally important areas for birds – IBA areas (Puzović et al., 2009), and the List of selected areas for butterflies – PBA (Jakšić, 2008). It is on the Preliminary List of World Natural and Cultural Heritage (UNESCO), the Preliminary List of Biosphere Reserves (MAB, UNESCO) and the Preliminary List of Ramsar sites (Standing Committee of the Ramsar Convention, UNESCO). This high central Balkan massif, with about 70 peaks over 2000 MASL and 30 peaks over 2500 MASL, belongs to the Shar Pindus mountain system and is the natural border between Kosovo, Macedonia and parts of Albania.

For the protection and sustainable development of Sara Mountain National Park (from now on: Sara NP) a key role needs to be played by the sustainable development of tourism in the protected area and its immediate surroundings. The first research into the tourist capacity of the former Yugoslavia was carried out in the "Analysis of the possibilities and problems of developing winter tourism in Yugoslavia" (Iten and Rey, 1968). The most important high mountain areas with the potential for developing all-year-round tourism are Prokletije Mountain and Sara Mountain. In the early 70s, the first sectoral and spatial plans for the tourism region of Sara Mountain were produced, and with interruptions, this continues today. Over the past years, tourist resorts (Brezovica) and the (unplanned) weekend settlement in Sara NP have only developed in the municipality of Štrpce. A new impetus for developing tourism will come from the new Priština-Prizren-Tirana motorway, which has significantly improved the transport accessibility of the area. Because of the potential for developing all-year-round tourism in this mountain massif it could represent a significant transboundary development area.

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