A GIS-MCDA Based Model for the Suitability Evaluation of Traditional Grape Varieties: The Case-Study of ‘Mantonico’ Grape (Calabria, Italy)

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ABSTRACT

Physical land suitability evaluation is crucial to rural spatial planning, as it directly contributes to designing successful and sustainable interventions. This paper deals with a physical land-suitability evaluation model for Mantonico, a historical and traditional grape variety of Southern Calabria (Italy), which is showing a considerable decline in its cultivation, owing to the abandonment of this cultivar in favor of others that are certainly more quantitatively productive, yet less valuable from a traditional and cultural point of view. The evaluation model developed was based on consolidated GIS-based MCDA (Multi-Criteria Decision Analysis) procedure and showed that the choice of the criteria (factors and constraints), which describe the physical land suitability for a niche product, is important and delicate. In fact, it is not always easy to establish how territorial characteristics may influence the development of the cultivation of an agricultural product. In this paper, the choice and, above all, the values associated to the factors, adequately represented real conditions and, as a consequence, the results of the model showed a clear coherence between suitability gradients and lands with similar cultivations. Results were validated by comparing the real geographical distribution of the current vine growing to the suitability value obtaining a very positive feedback on the robustness of the implemented model. The comparison between current vine-growing areas and the values obtained from the model clearly shows that the current vine-growing sites of the study area fall in suitable and very suitable classes (83.8%).

Keywords: Analytic Network Process (ANP), Calabria (Italy), GIS-Based MCDA (Multi-Criteria Decision Analysis), Mantonico Grape, Physical Land Suitability Evaluation

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1. INTRODUCTION

Current rural spatial-planning strategies are increasingly aimed at sustainability criteria and characterized by multi-temporal approaches which integrate the use of territorial resources by enhancing the complex and multifunctional character of rural areas (Barreca, Di Fazio, & Modica, 2004; Modica et al., 2012). The Land Suitability Evaluation (LSE) is a method for assessing the suitability of an area for a specific land use and is based on the explicit identification of constraints and opportunities for the conservation and future development of the territory (FAO, 1976, 1993; Steiner, 1983). The process to determine LSE begins by understanding the problem and defining the alternatives by means of a set of criteria. Today, in a LSE procedure the principles of sustainable development should explicitly be taken into account when choosing and weighting criteria and alternatives.

The LSE can be implemented through a process composed of two phases (Barreca et al., 2004; Fichera & Modica, 2007): 1) a physical LSE (suitability is an intrinsic characteristic of the examined area); 2) a subsequent usability evaluation (usability is the current possibility to use the present resources). As remarked by Steiner, McSherry, & Cohen (2000) suitability techniques are essential for informed decision-making. With specific reference to suitability evaluation analysis for viticulture, several researches have been recently carried out (Bonfante, Basile, Langella, Manna, & Terribile, 2011; Costantini & Barbetti, 2008; Hood, Cechet, Hossain, & Sheffield, 2006; Riccioli, El Asmar, El Asmar, & Fratini, 2013; Stanchi et al., 2013; Watkins, 1997).

Choosing an appropriate location for an activity as well as for a specific land use is normally related to decision support and Multi-Criteria Decision Analysis (MCDA). Scientific works on MCDA techniques, also referred as Multi-Criteria Evaluation (MCE), date to the mid of 1960s in the regional economic planning and decision-making research fields (Carver, 1991; Keeney & Raiffa, 1993; Nijkamp, Rietveld, & Voogd, 1990; Roy, 1968; Voogd, 1983).

One of the most common procedures in spatial planning and decision-making processes is still the GIS-based Multi-Criteria Decision Analysis (GIS-MCDA) (Carver, 1991; Joerin, Thériault, & Musy, 2001; Maleczewski, 1999, 2006) that represents a key element in implementing a Spatial Decision Support System (SDSS). MCDA techniques use geographical data, consider the user’s preferences (provided by experts and/or stakeholders), manipulate data, and set preferences according to specified decision rules (Maleczewski, 2004). Following what stated before, the most significant difference between spatial Multi-Criteria decision analysis and conventional Multi-Criteria techniques is the explicit presence of a spatial component. In turn, coupling GIS and MCDA increased the use of GIS and its based technology as the basis of a traditional DSS.

GIS-MCDA procedures prevail because they allow to consider, at the same time, the objectives of the analysis and the different criteria which influence land suitability in relation to a specific land use. In the model implementation phases, this characteristic simplifies the weighting of the criteria that concur to the final judgment, overcoming the excessive rigidity and the schematic structure of the original LSE (FAO, 1976, 2007) which is still the international reference procedure for territorial analysis and evaluation studies.

Over the last twenty years, Multi-Criteria evaluation models have played an increasingly important role, also thanks to their integration into GIS decision-making tools (Maleczewski, 1999, 2006; Pereira & Duckstein, 1993). As a matter of fact, the introduction of GIS tools in physical LSE, which was concomitant with the scientific and technological advance of such tools, has enabled to see the whole spatial planning approach from a new perspective (Maleczewski, 2006). Furthermore, their usefulness is even more increased with the evolution of user-friendly graphic interfaces and thanks to the possibility to employ already developed and suitable decision analysis systems that allow to...
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