



# Planning of rural housings in reservoir areas under (mass) tourism based on a fuzzy DEMATEL-GIS/MCDA hybrid and participatory method for Alange, Spain



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## ABSTRACT

Rural housings' development in reservoir areas of (mass) tourism is a complex process since the areas are under increasing construction sprawls with ecological consequences. This paper presents a new planning approach to develop a reliable model identifying suitable to unsuitable sites for rural housing planning in Alange reservoir areas, Badajoz, Spain. The hybrid model presented herein is the combined application of the geographic information systems (GIS) and the multi-criteria decision analysis (MCDA) with the fuzzy DEMATEL method in order to make rural housings' suitability map. The sixteen criteria were clustered into four groups, namely physical, natural, environmental and socio-economic group. The FDEMATEL participatory method was applied for groups/criteria weight coefficients calculation regarding with their influence and sensitivity on rural housings' development in reservoir areas under (mass) tourism. Total 146 respondents participated in the weighting process. With the aid of the weighted linear combination (WLC), the final rural housings' suitability map is evaluated for the study area reported on grading scale of 0–1, from least suitable areas to most suitable area. Here, it shows that 17.30% of Alange municipality has a most suitable area for rural housings' development after considering groups with stable sensitive analysis. The proposed methodology and the results, therefore, can be used for sustainable and resilient planning policy at all government levels in the decision-making process due to its flexible character. Thus, this approach could support to verify suitable housings' sites in areas with similar geographical situations and conditions.

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## 1. Introduction

In Spain, a large number of reservoirs, namely artificial water bodies' system, can be configured in nearly two per 1000 km<sup>2</sup> (Ministerio de Medio Ambiente (Ministry of Environment), 1998). The reservoir areas, particularly close to the rural and urban core, are suffering by increasing construction and human movements with ecological consequences of (mass) tourism (Eduful & Shively, 2015; Sánchez-Ríos, 2008; Van der Wulp, 2009; Weaver, 2001).

These movements and consequences have affected to unsustainable rural development including illegal housings, which occurs disharmonious and discordant relations between housings and landscapes (Dwyer & Childs, 2004; Garcia, Hernandez, & Ayuga, 2006; Gallent & Tewdwr-Jones, 2000; Jeong, García-Moruno, & Hernández-Blanco, 2013). The sustainable housing planning is necessary to satisfy various interconnected elements, which affect to housing itself and its environment, minimizing negative impacts on the conflict between forbidden construction increase and reservoir maintenance urgently addressed (Chen et al., 2014; De Vriesa, de Grootb, & Boersb, 2012; Jeong, Montero-Parejo, García-Moruno, & Hernández-Blanco, 2015; Tewdwr-Jones, Gallent, & Mace, 2002; Tassinari, Torreggiani, & Benni, 2013). However, current rural housing planning has not yet evolved to handle with these new changes in rural reservoir areas (Bramley & Watkins, 2016; Jeong, García-Moruno, Hernández-Blanco, & Jaraíz-

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Cabanillas, 2014b). Therefore, choosing the suitable rural housings' sites following and meeting certain criteria can mitigate the negative influences on reservoir environments under (mass) tourism (García et al., 2006; Sánchez-Ríos, 2008).

In an assessment of the literature in rural housing planning, it identified an important gap currently has; particularly, there was a need to recognize more about housing's significance in rural areas (Awuah & Hammond, 2014; Hall, 1974; Milbourne, 2006). However, the literature of rural housing planning has a tendency to analyze rural housings' policy dimensions with an intuitional perspective that have been concerned predominately with the formal processes and actors of rural policy deployment and development (Hall, 1974; Hoggart & Henderson, 2005; Newby, 1979). For instance, many researchers found that its planning in Europe had developed to understand the rural had been constructed according to rural housing policy based on things used in urban (Liu, van Oort, Geertman, & Lin, 2014; Milbourne, 2006; Sturzaker & Shucksmith, 2011; Tewdwr-Jones, Gallent, & Shucksmith, 2003; Zhou, Li, Li, Zhang, & Liu, 2016). In the same vein of its characteristics, rural housing planning is related with the numerous man-made elements and various other factors that affect to the housing itself and the rural environment (De Vriesa et al., 2012; Jeong, García-Moruno, & Hernández-Blanco, 2012). Therefore, how rural is presented in the context of rural housings can be considered as a representation of post-productive countryside, which is a common trend occurred (Gallent & Tewdwr-Jones, 2000; Gkartzios & Scott, 2013). This popular discourse is now tightly interweaved with rural surroundings considering rural housings' activities and livings (Gallent & Tewdwr-Jones, 2000; Jeong et al., 2013). There, however, still remains a lack of engagement in the literature of rural housing planning in the areas of operational rural housing planning linking place and tourism vulnerability with different analytical tools.

Along with this rural housing planning, tourism as a powerful topic has become one of the fastest growing industry acting an important economic role of a country (Almeida-García, Peláez-Fernández, Balbuena-Vázquez, & Cortés-Macia, 2016; Boo, 1990; Loperz & Monteros, 2002; Weaver & Lawton, 2007). The increase of rapid (mass) tourism development, especially in reservoirs areas, has been dangerous for environmental conservation and residents' quality of life (Eagles, McCool, & Haynes, 2002; Such Climent, 2003). Thus, in many reservoir places, these incautious developments became a serious social concern due to inadequate practical and environmental evaluations (Chen et al., 2014; Jeong et al., 2014b). Regarding with recent tourism development activities, it has diverted from (mass) tourism to integrated and sustainable tourism, which extensively considers the subsequent impact of tourism on the environment (Eagles et al., 2002; Jeong et al., 2014b). The integrated and sustainable tourism can protect physical environments, can satisfy the tourists' and residents' needs and can improve economic growth through its development and conservation coexistence (Ars & Bohanec, 2010; Bunruamkaew & Murayama, 2012; Jaraíz, Mora, Gutiérrez, & Jeong, 2013). Together with this, it is necessary to decide proper criteria such as physical features, natural resources, environment characteristics and social identifications, which match with the fundamental properties of the study area with participatory decision-making process (Blaschke, 2006; Bo et al., 2012).

From its operational term, the geographic information systems (GIS) has been applied to assess rural housing development potentials with a wide range of techniques (Thomas and Hardin, 2000; Jeong et al., 2014b; Li, Long, Liu, & Tu, 2015). As an analytical tool, the GIS allows to analyze a large volume of spatial data that is the geographical expression to ecological, cultural, social and economic extent of a society (Ahmadi, Asgari, & Ghanavati, 2015; Böhme & Schön, 2006; Hermann & Osinski, 1999). The

combination of the multi-criteria decision analysis (MCDA) with the GIS is the most often applied model to rural housing planning in reservoir areas under (mass) tourism. In the hybrid GIS/MCDA model, the fuzzy DEMATEL (FDEMATEL) participatory method is employed to establish the network framework between the criteria and their weights (Pamučar & Ćirović, 2015). The benefits of FDEMATEL-GIS/MCDA hybrid and participatory model is flexibility and comparability and combination of network criteria in the GIS, adding a new value to the evaluation of problems related to rural housings planning in reservoir areas under (mass) tourism (Büyükoçkan and Çifçi, 2011; Jeong et al., 2012; Pamučar & Ćirović, 2015). Particularly, hybrid approach allows to use individual benefits and also to make a more holistic view within certain decision-making process (García-Moruno & Jeong, 2016; Uhde, Hahn, Griess, & Knoke, 2015). Then, the participatory approach is the treatment of group decisions, which will gain credence among decision-makers, since the model proposed considers the criteria evaluation by a large number of decision-makers (Cooke & Kothari, 2001; Jeong, García-Moruno, & Hernández-Blanco, 2014a; Ribot & Larson, 2005). The proposed hybrid and participatory model is further used for getting the final map for rural housings planning in reservoir areas under (mass) tourism.

The present paper describes an integrated planning approach for identifying rural housings' suitable sites in reservoir areas under (mass) tourism based on the hybrid GIS/MCDA model with the fuzzy DEMATEL participatory method. A case study area applying the method is Alange reservoir areas (Badajoz, Spain), which is experiencing considerable illegal construction increase and sprawl with ecological consequences of (mass) tourism. The sixteen criteria clustered into four groups were decided after evaluating a multitude of interrelated variables with a help of decision-makers' discussion. Using the online survey participation of criteria weightings, the FDEMATEL method generates the groups/criteria weight coefficients calculation. The final map for rural housings planning in reservoir areas under (mass) tourism was presented, unsuitable to suitable areas (on grading scale of 0–1), by the use of the weighted liner combination (WLC) and the sensitivity analysis with five different scenarios. This study provided to identify a unique decision-support method for rural housings planning behind the participation intention and influence filling a niche of multi-criteria techniques, spatial analyses and (mass) tourism management in reservoir areas. The suggested approach is organized first describing a brief description of a case study area. Then, the "Methodological background" section presents the FDEMATEL-GIS/MCDA model, which is particularly tested in the proposed case study area. In the "Results and discussion" section discuss the results from the method application. In the last section, the "Conclusions" summaries considerations obtained from this approach and describes suggestions for future research.

## 2. Case study area

This paper was designed to advance suitable rural housings' planning in reservoir areas under (mass) tourism based on natural, biological, scenic, cultural, historical and recreational values of Alange municipality, Badajoz, Spain. Alange municipality is geographical region located in the southwest of Spain. It occupies the space between 38°47' 0" N and 6°14' 0" W, covering the area of 160.32 km<sup>2</sup> (see Fig. 1). The case study area has a reservoir existence (of Alange, the area of 35.64 km<sup>2</sup>) near the urban core, which is the most important geographical feature. It is also very close to A-66 and E-90 highway considered as the main road network and other transport infrastructures in this municipality. Although Alange has a favorable geographic region position and values for tourism, (mass) tourism does not represent a significant income source and

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