Urban and Regional Planning
2016; 1(4): 69-76
http://www.sciencepublishinggroup.com/j/urp
doi: 10.11648/j.urp.20160104.11

A Spatial Regional Planning Assessment for Green Development Towards Ecotourism with Use of MCDA/SAW Method (Case Study: Spanish Rural Housings)

Jin Su Jeong

Department of Graphic Expression, University of Extremadura, Merida, Spain

Email address:
jin@unex.es

To cite this article:
Jin Su Jeong. A Spatial Regional Planning Assessment for Green Development Towards Ecotourism with Use of MCDA/SAW Method (Case Study: Spanish Rural Housings). *Urban and Regional Planning.* Vol. 1, No. 4, 2016, pp. 69-76. doi: 10.11648/j.urp.20160104.11

Received: October 13, 2016; **Accepted:** October 31, 2016; **Published:** November 19, 2016

Abstract: In the late 20th century, Spanish rural areas are under increasing pressure of illegal construction sprawls and human movements: the areas are also affecting to its ecological consequences. Particularly, the conflict in ecotourism areas between rapid urban development and environmental conservation urgently needs to be addressed due to their regional geographical characteristics. This paper presents a spatial and sustainable planning approach, identifying rural housings' suitability maps in a case study area, La Vera, Spain. Evaluation criteria determine a spatial data management with a grading system, based on constraints, tourism resource, environmental and social-economic criteria that are supporting economic opportunities, environmental conservation, local municipal benefits and efficient management of ecotourism. The method presented herein is an integrated application using the multi-criteria decision analysis (MCDA) based on the understanding of all possible aspects and implications, applied for weight coefficients calculation of the criteria according to their impact and sensitivity. Six constraints and twelve criteria were assessed in the process of computation, categorized into four groups. Then, with the assistance of the simple additive weighting (SAW), the final housings' suitability map is assessed for the case study area on grading scale of 0 to 255. Here, it displays that 7.99% of La Vera has a most suitable area for sustainable and resilient housings planning after considering their stable sensitive analysis. Therefore, the proposed planning method and the results measuring regional geographical characteristics can be used for policy and decision making process of sustainable and resilient housing planning towards ecotourism at all government levels and private sectors. Moreover, this approach can extend to similar geographical conditions and situations for verifying suitable housings planning suitability.

Keywords: Sustainable Development, Spatial Planning, Regional Geographical Character, Hybrid GIS/MCDA, Fuzzy Logic, Ecotourism, Sustainability and Resilience

1. Introduction

The sustainable and resilient planning of housing into the landscapes is a challenging job, as most of the times many controversial parameters have to be reflected [1, 2]. From current local planning and development modeling, the emphasis on the local municipal as to conserve local resources and to increase local benefits focuses the close association between ecotourism and decision-makers who are one of the essential stakeholders' groups [3, 4]. Here, decision-makers can devise more appropriate and efficient managing strategies and can handle possible conflicts between local resources conservation and economic developments [5, 6]. Respectively, considering with these facts, decision-makers can find the current situation of affairs and some ideas of future condition, ideally the possible consequences of the policies and plans under deliberation and participation who contributes a notable quality in ecotourism management [6, 7].

The planning of the housing with its landscapes normally depends more on the correct choice of location than on any other weighted aspects [8]. The geographic information system (GIS) imparts valuable tools to examine the location in depth when considering limitations, opportunities, visual characteristics and the overall landscape scene of spatial planning [8, 9]. The potential benefit of a GIS-based method

for housing planning arises from the point that it not only diminishes the time and cost of site selection but also offers a digital data bank for long-term monitoring of the site and location [10]. The sustainable and resilient planning of housings/constructions into their surroundings, however, is not a common deliberation in common practices yet [8, 11].

Thus, ecotourism in the context proposed is a significant issue, which has been acknowledged as a sustainable and resilience tourism form that contributes both to the economy in the tourism industry and environmental conservation, and therefore is dedicated like a sustainable means to improve regions with rich tourism resources [12, 13, 14, 15]. In tourism sector, sustainable planning and development has been comprehensively deliberated since such development can satisfy the demands of tourists, can protect physical locations, supplies opportunities to improve economic growth, and can improve the residents' life quality throughout the coexistence of environmental quality and tourism development [1, 11]. With increasing ecological interests and cultural heritages, the local environment quality improvements grow the visual attraction and also enhance the aesthetic and recreational values of its environments [13, 16].

Here, the employment of the multi-criteria decision analysis (MCDA) with the GIS is the most often used model for general housing planning [8, 17]. The GIS/MCDA model is applied to institute the framework network between criteria and their weights [18, 19]. The advantages of operational model are comparability and flexibility and network criteria combination in the GIS, including a new value to the evaluation of problems related to housings planning in Spanish rural region [18]. Precisely, this method enables to use distinctive benefits and also to build a more complete view within certain decision-making process [20, 21]. Then, the participatory method is the management of group decisions that will obtain credence amongst decision-makers, because the proposed model reflects the criteria evaluation by a large number of decision-makers [15]. Therefore, the proposed model is further used for gaining the final maps for housings planning under ecotourism in a specified area.

This article describes a new planning approach for verifying housings' suitable sites in a case study area under ecotourism of Spanish rural region based on the operational model. A case study area applying the model is La Vera (Caceres, Spain), which is experiencing significant construction sprawls with ecological consequences in the ecological and economic context. Here, the six constraints and twelve criteria gathered into four groups were determined after analyzing a multitude of inter-related variables with an aid of decision-makers' discussion. Then, the method creates the coefficients calculation and sensitivity analysis of criteria weight. The final map for Spanish rural housings planning under ecotourism in the area was presented, unsuitable to suitable areas (on grading scale of 0 to 255), by the use of the simple additive weighting (SAW) and the sensitivity analysis with various scenarios. This work furnished to clarify a sole decision-support method for sustainable and resilient housings planning, which filling a niche of multi-criteria techniques, spatial analyses and ecotourism management in the area proposed.

2. Materials and Methods

In order to determine the suitable location or locations for new rural housings concerned with ecotourism to their landscapes in the case study area, a substantial multi-disciplinary evaluation procedure with the multiple set of criteria is applied through the use of the spatial analysis tools provided by GIS with MCDA method enhanced fuzzy factor standardization, based on certain evaluation criteria such as tourism resource, environmental and socio-economic criteria. In this paper, SAW method is selected for the evaluation of the final suitability catalogue to resolve the multiple criteria problems. The research procedures are presented in the following sections.

2.1. Case Study Area Proposed

The case study area (see Figure 1), the county of La Vera with the area of 888 km2, is situated at the province of Caceres, Extremadura region of Spain. La Vera county consists of 19 municipalities: Aldeanueva de la Vera, Arroyomolinos de la Vera, Collado de la Vera, Cuacos de Yuste, Garganta la Olla, Garguera de la Vera, Guijo de Santa Barbara, Jaraiz de la Vera (the principal study area), Jarandilla de la Vera, Losar de la Vera, Madrigal de la Vera, Pasaron de la Vera, Robledillo de la Vera, Talaveruela de la Vera, Tejeda de Tietar, Torremenga, Valverde de la Vera, Viandar de la Vera, and Villanueva de la Vera. For the past two decades, these municipalities have experienced vast holiday residences' growth and subsequent service facilities. Precisely, its closeness to Madrid has turned into the region for the place increasingly destined for weekend housing. The countryside housings thus are an integral part of the historical and contemporary rural recreational countryside [22]. This growth has encouraged main changes in land use patterns, leading to widespread, which cause their consequent impacts.

2.2. Evaluation Criteria Identification

A suitable rural housing siting process under ecotourism measuring regional geographical characteristics requires consideration of extensive criteria and evaluation steps to identify the best available location and/or locations and to eliminate subsequent impacts and adverse long term effects (see Figure 2). The evaluation criteria are classified into four main categories: first, constraints; second, tourism resource; third, environmental; and fourth, social-economic criteria, based on the relevant literatures, experts' panel discussion and consultation, regional polices and European Union (EU) directives. Decision-makers' participation in ecotourism management can occur on different stages offering input for ecotourism planning and management and partaking in decision-makings on the organization committee.

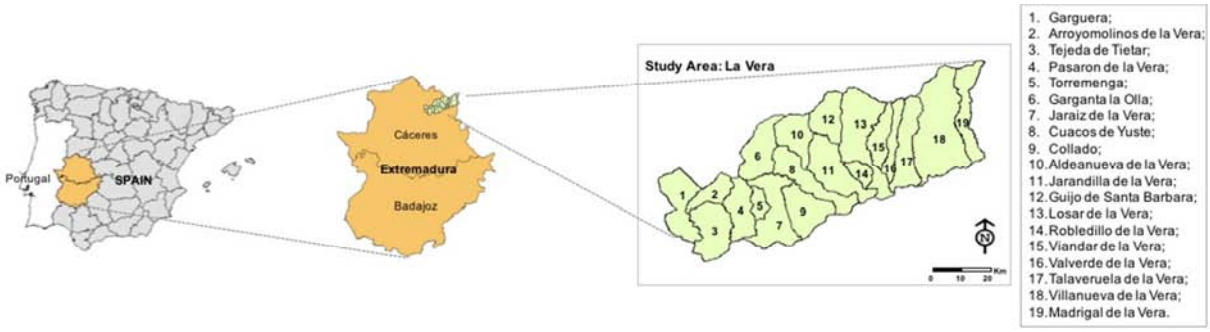

Figure 1. *The case study area (La Vera, Spain), which the light green area depicts the extent of study area with 19 municipalities: (1) Garguera; (2) Arroyomolinos de la Vera; (3) Tejeda de Tietar; (4) Pasaron de la Vera; (5) Torremenga; (6) Garganta la Olla; (7) Jaraiz de la Vera; (8) Cuacos de Yuste; (9) Collado; (10) Aldeanueva de la Vera; (11) Jarandilla de la Vera; (12) Guijo de Santa Barbara; (13) Losar de la Vera; (14) Robledillo de la Vera; (15) Viandar de la Vera; (16) Valverde de la Vera; (17) Talaveruela de la Vera; (18) Villanueva de la Vera; (19) Madrigal de la Vera.*

2.2.1. Exclusionary Criteria

The first group includes six constraining criteria that limit the analysis to the particular geographic areas.

Sensitive ecosystems are the areas environmentally protected by the European commission legislation and regulation for biodiversity & nature policies, NATURA 2000.

Local building ordinances are the areas prohibited for constructing buildings, which can degrade natural environments or areas by the local building ordinance legislation.

Important aquifers are the areas in ground water wells and/or springs with high groundwater pollution risk.

Surface water bodies are the areas with minimum distance from main and secondary stream to avoid water surface pollution monitored by EU Water Framework Directive (Directive 2000/60/EC) legislations and obligations.

Specific vegetation and land use types are the areas with dense vegetation formation using the normalized difference vegetation index (NDVI) following the Landsat satellite images of the digital elevation model (DEM).

Highways and railways are the areas measured by legal limits for minimum distance from highways and railways.

2.2.2. Tourism Resource Criteria

The second group includes criteria related to tourism resource parameters.

Vegetation types are the areas including an evaluation based on the ecological uniqueness of the deforested vegetation and spatial coverage of these natural formations based on the NDVI (assigned weight is 0.57).

Proximities of surface water are the areas calculated using Euclidean distance functions, which are the radial distance from surface water resources, lakes and/or rivers with continuous water flows (assigned weight is 0.25).

Proximities of water bodies are the areas calculated using Euclidean distance functions, a straight distance from water bodies, springs and/or wells (assigned weight is 0.12).

Visibilities from roads and railroads are the areas aiming to the aesthetic protection using the radial and visible distances from site accessing points such as roads (highways and local roads) and railroads (assigned weight is 0.06).

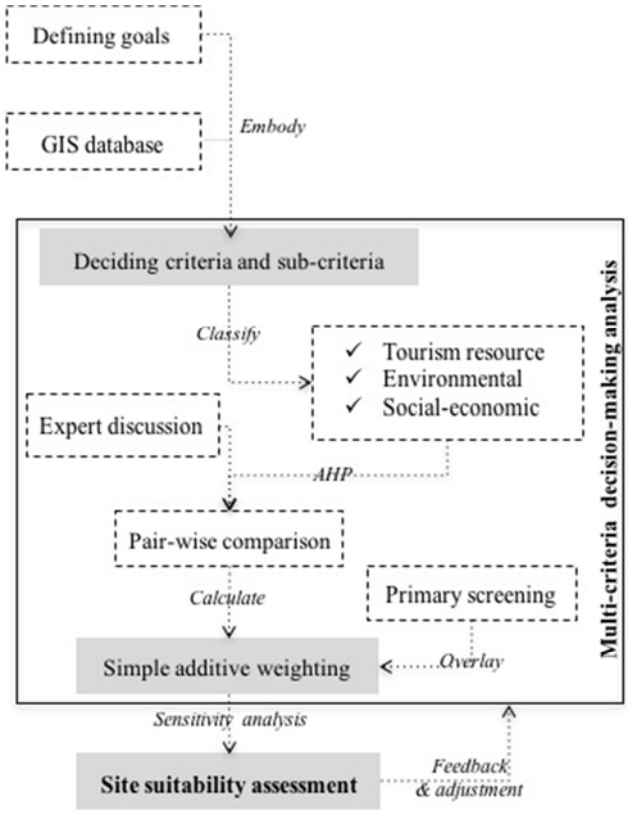

Figure 2. *The flowchart of the operational method for this study proposed.*

2.2.3. Environmental Criteria

The third group considers with criteria related with environmental parameters

Proximities of sensitive ecosystem are the areas calculated using Euclidean distance functions which are the radial distance of sensitive ecosystem based on the European commission regulation of nature & biodiversity policy, the NATURA 2000 (assigned weight is 0.56).

Land use and cover type are the areas aiming economic development covering different land use and cover types (LESOTEX) (assigned weight is 0.25).

Slopes of the land surfaces are the areas showing environmental attributes' derivation and landscape processes

of land surface flow, expressed in degrees (assigned weight is 0.07).

Elevations are the areas showing the basic parameter of land surface and atmospheric process for environmental attributes' derivation (assigned weight is 0.12).

Table 1. *Relative importance of pair-wise comparison and their numerical rate.*

More important intensity	Definition	Less important intensity
1	Equal importance or preference	1
2	More or less equal to moderate importance or preference	1/2
3	More or less moderate importance or preference	1/3
4	More or less moderate to strong importance or preference	1/4
5	More or less strong importance or preference	1/5
6	More or less strong to very strong importance or preference	1/6
7	More or less very strong importance or preference	1/7
8	More or less very to extremely strong importance or preference	1/8
9	More or less extreme importance or preference	1/9

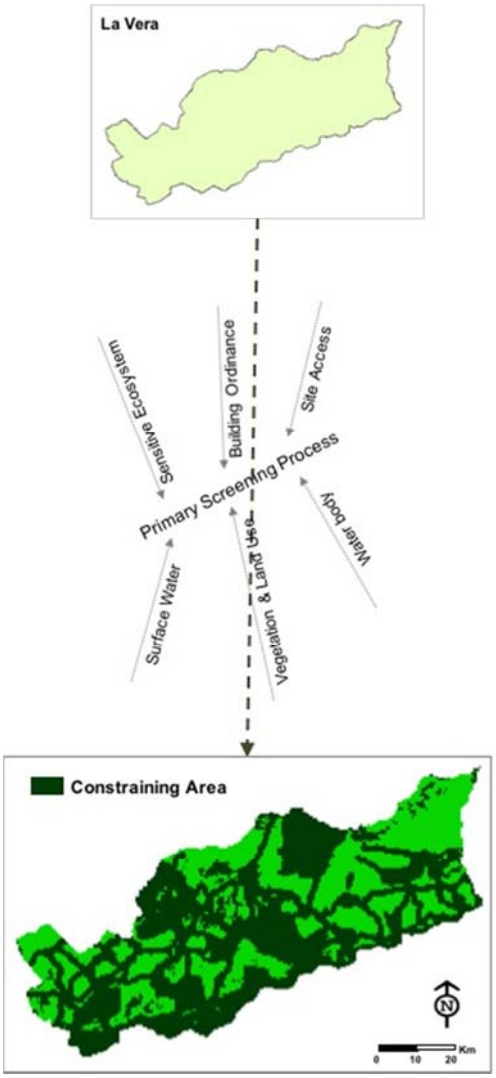

Figure 3. *Resulted areas after extracting six constraints assessment.*

2.2.4. Social-economic Criteria

The fourth group includes criteria relevant to social-economic parameters.

Proximities to residential areas are the areas calculated using Euclidean distance functions, the radial distance from towns and villages representing a high concentration of human activities (assigned weight is 0.13).

Proximities to urban areas are the areas calculated using Euclidean distance functions, the direct distance from urban areas based on land use and cover type (assigned weight is 0.26).

Site accesses are the areas calculated using Euclidean distance functions, the direct distance from the sources of site access infrastructure such as local roads, highways, and train railways (assigned weight is 0.56).

Population densities are the areas showing the influence zone around town, city, and human settlement related with economic distance based on the national statistical institute (NSI) of Spain (assigned weight is 0.05).

2.3. Evaluation of Suitability on Rural Housing Planning

In this section, the methodologies were used to associate the evaluation criteria controlling the site suitability for new rural housings concerned with spatial planning and sustainable development towards ecotourism. Starting with the AHP, we got the relative importance weight with the PCM and the grading values as judging and examining the current conditions under each criterion. Then, the SAW method was utilized for the suitability index calculations.

The AHP as the MCDA technique was utilized to excerpt the relative importance weights of criteria and was applied for formulate the assessment system in a specified decision-making problems [23]. This method based on the PCM is to identify the hierarchical structure, to regulate the relative importance weights of the criteria and sub-criteria, and to allocate preferred weights of each alternative and control the final score. The PCM organized by the decision-makers is liable on the observed importance of criteria based on certain prearranged points of scale as shown in Table 1.

The method, the application of the SAW, as the last step was used a 9 points scale to excerpt information, which is a score given to each indicator by comparing the current status of the indicator related to some desired conditions. Then, it is to compute the final grading values in multiple-criteria problems followed by the grading scale used in this work for the suitability index is 0–255, which is, correspondingly, from the least to the most suitable zones as shown in Eq. (1) [24, 25, 26, 27].

$$V_i = \sum_{j=1}^{n} w_j v_{ij} \quad (1)$$

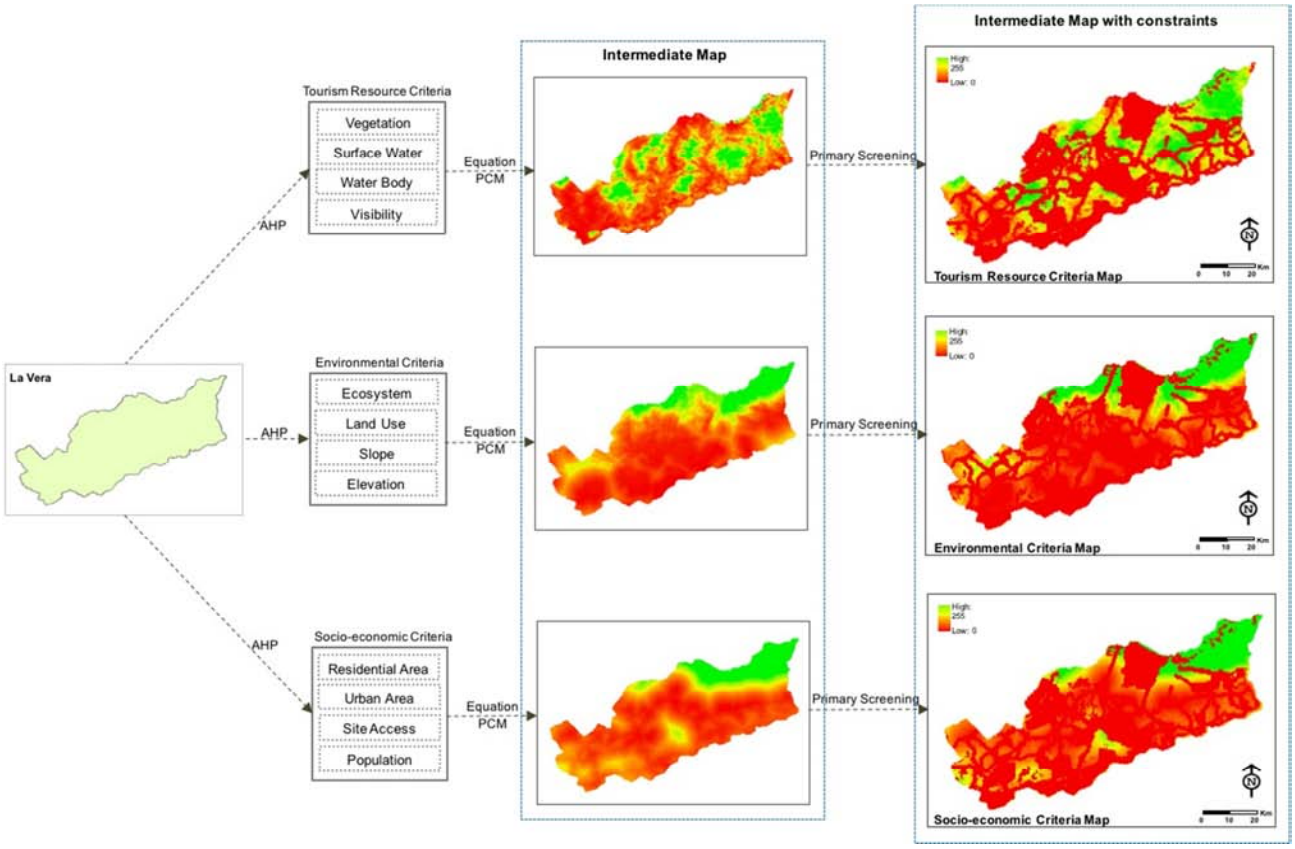

Figure 4. *Intermediate suitability maps resulted from the three previously examined groups and from applied the exclusionary criteria.*

3. Results and Discussion

Several methods have been presented for rural housing planning and development using the GIS and the MCDA in the recent studies [6, 9, 11, 28]. In the study presented, however, besides proposing all the benefits of the techniques above-mentioned, a vital contribution has been achieved through the application of the sensitivity analysis, which offers weight coefficients calculation of the criteria according to their impact and sensitivity. Moreover, the distinction of the parameters was involved in the siting process into four groups, i.e., constraints which are not included in the weighting process, tourism resource, environmental and social-economic criteria.

Regarding the final suitability map for housings planning and development in Spanish rural region, from the suitable to unsuitable areas, they were identified as the suitability index 0–255, that is, the higher the score, the more suitable the area. The SAW method was applied to resolve the criteria problem of housings placement in Spanish rural region towards ecotourism. The maps in following figures present the process to decide the land priority to gratify the research objective. Therefore, the final suitability maps are created by gathering, using the same practice based on the intermediate results. Particularly, constraints (exclusionary criteria) always remain as Boolean masks and they are not related in any weight assignment manner as shown in Figure 3.

The intermediate suitability maps that result from the three previously assessed groups, were used as the weighting functions of 0.667 (2/3) and 0.750 (3/4) as shown in Figure 4. Here, first, tourism resource criteria which already excluded constraints were calculated and aggregated. Second, environmental criteria which already excluded constraints were weighted and aggregated. Third and last, social-economic criteria which already excluded constraints were calculated and aggregated. The four different weights were assigned as the same way of the intermediate results: 1st rank is 0.5000, 2nd rank is 0.3330 and 3rd rank is 0.1670 (2/3); 1st rank is 0.0514, 2nd rank is 0.3050 and 3rd rank is 0.1810 (2/3); 1st rank is 0.6110, 2nd rank is 0.2780 and 3rd rank is 0.1110 (3/4); 1st rank is 0.6160, 2nd rank is 0.2680 and 3rd rank is 0.1160 (3/4). The assigned weights display a low level of risk in this process. This aggregation is skewed towards the criteria with the highest suitability score. The possible grouping scenarios were illustrated as using three major criteria which were combined with 12 sub-criteria and 6 constraint criteria.

The methods of the SAW were chosen as the correct way to dissolve the multiple criteria problems of the rural housing siting planning and sustainable development towards ecotourism considering regional geographic characteristics. The final suitability map is produced by aggregating, using the same procedure, the intermediate results as shown in Figure 5. For example, as a sensitivity analysis, alternative (a) employs 2/3; alternative (b) applies 3/4 in the order of tourism resource,

environmental and social-economic criteria. It displays the categorized percentage areas of the case study area: the best area in alternative (a) is 7.00% with high membership scores of 200 to 255 from total area; alternative (b) allocates the most suitable areas of 7.99% with high membership scores of 200 to 255 from the total area. In the framework of municipalities, the results present how much percentage area was assigned to each area as shown in Figure 5. Among the nineteen municipalities in the case study area (La Vera), Villanueva de la Vera in the Figure 1 aforementioned has the highest suitability area percentage for both alternatives' valuation.

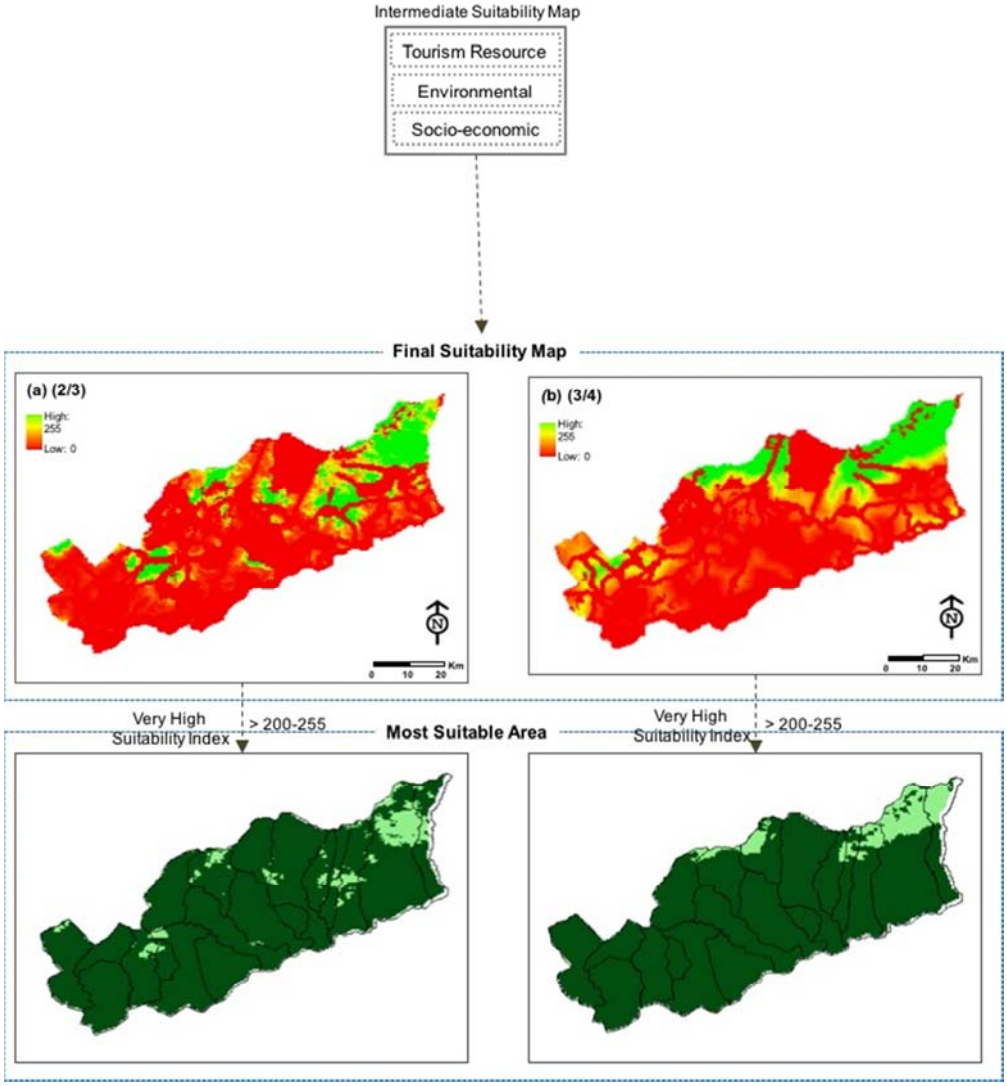

Figure 5. *Possible composite suitability map and each highest suitability map presenting each municipalities based on 2/3 and 3/4 sensitivity analysis derived by three criteria groups.*

The results of the combination process are noteworthy to point out that various spatial patterns, produced by the weights allocated to the criteria, the tourism resource, environmental and social-economic objectives excepted six constraints and to indicate that the presented methodology is able to reveal the most suitable areas for new rural housings into its landscape towards ecotourism, as well as to give an initial ranking of the suitable areas. Thus, it is fairly simple to search different spatial planning scenarios, as far as an ecotourism approach is anticipated, or a more sensitive environmental alternative is intended. Based on the estimated study area of 888 km2, suitable location and/or locations must be at least the study area size using a post combination constraint if only one rural housing is to serve the entire study area.

This needs to be designated in a fixed amount of top-ranked locations, which fits to the fifth suitability category (200 to 255), corresponding to the required area. Consequently, integrated multi-criteria spatial decision model based on the methodology presented in this work with the developments can be very useful in the final decision. Hence, the planning method proposed and the results measuring regional geographical characteristics can be used for policy and decision making process of sustainable and resilient housing planning towards ecotourism at all government levels and private sectors. Besides, this approach can extend to similar geographical conditions and situations for verifying suitable housings planning suitability.

4. Conclusions

This paper presents the spatial and sustainable operational method, in order to identify suitable areas for rural housings planning in Spanish region under ecotourism, measuring regional geographical characteristics. The main advantages of this approach are to selecting criteria and to weighting them by decision-makers. This has flexibility and ability to integrate with the GIS framework, the six constraints and twelve criteria clustered into four groups, namely tourism resource, environmental and social-economic group. Three intermediate suitability maps were created, which were aggregated to make the composite suitability map. The AHP was used and was offered a quite objective weights assignment process. The method proposed was used to choose the coefficients of criteria weight, or importance of each criteria, and the SAW with the sensitivity analysis were applied to summarize the criteria weight and the final suitability sites classification for rural housings planning of the case study area. The final analysis results present that the proposed model has high suitability and reliability. The application of operational model for sustainable and resilient housings planning potentials evaluation has identified as positive and justified based on the criteria adopted. Also, it positively differentiated the parts of space highly suitable for sustainable and resilient housings planning. Sensitivity analysis by altering the group weight coefficients revealed a high degree stability of the model. Therefore, the proposed planning and development method and the results can be used for policy and decision making procedure of sustainable and resilient housing planning at all government levels and also private sectors. Moreover, this approach can extend to similar geographical conditions and situations for verifying suitable housings planning suitability.

Since new rural housings planning and development depend on public opinion forces and regional planning policies in accordance with scientific and logical analysis, we postulate that this methodology holds important potential to encourage the complexity of decision-making in real world applications. Hence, the presented methodology and analyses here can be customized to other regions and countries requiring more integrated and efficient planning and development for the management of sustainable and resilient works towards ecotourism. The evaluation results also deliver a new empirical approach to assessing existing environment and infrastructure and to forecasting their future improvements. Precisely, this model analysis suggests a method to the sustainable and resilient assessment management considered regional geographical characteristics with the main aim of rising the life quality and satisfaction for residents, visitors and tourists.

References

[1] Eagles, P. F. J., McCool, S. F., Haynes, C. F. Sustainable tourism in protected areas: guidelines for planning and management, International Union for the Conservation of Nature Gland, Switzerland, 2002.

[2] Jeong, J. S., García-Moruno, L., Hernández-Blanco, J., Sánchez-Ríos, A., Planning of rural housings in reservoir areas under (mass) tourism based on a fuzzy DEMATEL-GIS/MCDA hybrid and participatory method for Alange, Spain, Habitat International, Vol. 57, 2016, pp. 143-153.

[3] Byrd, E. T., Cardenas, D. A., Dregalla, S. E., Differences in stakeholder attitudes of tourism development and the natural environment. e-Review of Tourism Research, Vol. 7, No. 2, 2009, pp. 39-51.

[4] Ryan, C., Equity, management, power sharing and sustainability disuses of the 'new tourism', Tourism Management, Vol. 23, No. 1, 2002, pp. 17-26.

[5] Lai, P. H., Nepal, S. K., Local perspectives of ecotourism development in Tawushan Nature Reserve, Taiwan, Tourism Management, Vol. 27, No. 6, 2006, pp. 1117-1129.

[6] Jeong, J. S., García-Moruno, L., Hernández-Blanco, J., Integrating buildings into a rural landscape using a multi-criteria spatial decision analysis in GIS-enabled web environment, Biosystems Engineering, Vol. 112, No. 2, 2012, pp. 82-92.

[7] Blaschke, T., The role of the spatial dimension within the framework of sustainable landscapes and natural capital, Landscape and Urban Planning, Vol. 75, 2006, pp. 198-226.

[8] Jeong, J. S., García-Moruno, L., Hernández-Blanco, J., A site planning approach for rural buildings into a landscape using a spatial multi-criteria decision analysis methodology, Land Use Policy, Vol. 32, 2013, pp. 108-118.

[9] Hernández, J., García, l., Ayuga, F., Integration methodologies for visual impact assessment of rural building by geographic information system, Biosystems Engineering, Vol. 88, No. 2, 2004, pp. 255-263.

[10] Moeinaddini, M., Khorasani, N., Danehkar, A., Darvishsefat, A., Zienalyan, M., Siting MSW landfill using weighted linear combination and analytical hierarchy process (AHP) methodology in GIS environment (case study: Karaj), Waste Management, Vol. 30, 2010, pp. 912-920.

[11] Tassinari, P., Carfagna, E., Benni, S., Torreggiani, D., Wide-area spatial analysis: A first methodological contribution for the study of changes in the rural built environment, Biosystems Engineering, Vol. 100, 2008, pp. 435-447.

[12] Ross, S., Wall, G., Evaluating ecotourism: the case of North Sulawasi, Indonesia, Tourism Management, Vol. 20, No. 6, 1999, pp. 673-682.

[13] Jaraíz, F. J., Mora, J., Gutiérrez, J. A., Jeong, J. S., Comparison of regional planning strategies: countywide general plans in USA and territorial plans in Spain, Land Use Policy, Vol. 30, No. 1, 2013, pp. 758-773.

[14] Weaver, D. B., Lawton, L. J., Twenty years on: the state of contemporary ecotourism research, Tourism Management, Vol. 28, No. 5, 2007, pp. 1168-1179.

[15] Jeong, J. S., Montero-Parejo, M. S., García-Moruno, L., Hernández-Blanco, J., The visual evaluation of rural areas: a methodological approach for the spatial planning and color design of scattered second homes with an example in Hervás, Western Spain, Land Use Policy, Vol. 46, 2015, pp. 330-340.

[16] Zhang H., Lei, S. L., A structural model of residents' intention to participate in ecotourism: the case of a wetland community, Tourism Management, Vol. 33, 2012, p. 916-925.

[17] Jeong, J. S., Hernández-Blanco, J., García-Moruno, L., Approaches to validating a mutual participatory web-planning interface in rural Extremadura (Spain), Land Use Policy, Vol. 39, 2014, pp. 211-223.

[18] Pamučar, D., Ćirović, G., The selection of transport and handling resources in logistics centers using multi-attributive border approximation area comparison, Expert Systems with Applications, Vol. 42, No. 6, 2015, pp. 3016-3028.

[19] García-Moruno, L., Jeong, J. S., The study of building integration into the surrounding rural landscape: Focus on implementation of a Web-based MC-SDSS and its validation by two-way participation, Land Use Policy, Vol. 57, 2016, pp. 719-729.

[20] Uhde, B., Hahn, W. A., Griess, V. C., Knoke, T., Hybrid MCDA methods to integrate multiple ecosystem services in forest management planning: a critical review, Environmental Management, Vol. 56, 2015, pp. 373-388.

[21] González-Gómez, D., Jeong, J. S., Airado Rodríguez, D., Cañada-Cañada, F., Performance and perception in the flipped learning model: an initial approach to evaluate the effectiveness of a new teaching methodology in a general science classroom, Journal of Science Education and Technology, Vol. 25, 2016, pp. 450-459.

[22] Vepsäläinen, M., Pitkänen, K., Second home countryside. Representations of the rural in Finnish popular discourses, Journal of Rural Studies, Vol. 26, 2010, pp. 194-204.

[23] Saaty, T. L., A scaling method for priorities in hierarchical structures, Journal of Mathematical Psychology, Vol. 15, 1977, pp. 234-281.

[24] Hwang, C. L., Lin, M. J., Group decision making under multiple criteria: lecture notes in economics and mathematical system, Springer-Verag, New York, 1986.

[25] Hwang, C. L., Yoon, K. L., Multiple attribute decision making: methods and applications, Springer-Verlag, New York, 1981.

[26] Jeong, J. S., González-Gómez, D., Cañada-Cañada, F., Students' perceptions and emotions toward learning in a flipped general science classroom, Journal of Science Education and Technology, Vol. 25, 2016, pp. 747-758.

[27] González-Gómez, D., Airado Rodríguez, D., Cañada-Cañada, F., Jeong, J. S., A comprehensive application to assist in acid−base titration self-learning: an approach for high school and undergraduate students, Journal of Chemical Education, Vol. 92, 2015, pp. 855-863.

[28] Jeong, J. S., García-Moruno, L., Hernández-Blanco, J., Un modelo web para la asistencia en la toma de decisiones en la integración de las construcciones rurales mediante planificación espacial multi-criterio (A decision-supporting web model for integrating rural buildings with multi-criteria spatial planning), Informes de la Construcción, Vol. 66, No. 533, 2014, e004.