Plausibility in the eco-design and eco-innovation of rural-housing: reason and confidence in a methodological approach for the sustainable development of reservoir environment under tourism

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Abstract: - The value of water resources and bodies has been acknowledged in terms of environmental, ecological, and landscape vision and sight because water itself is closely interrelated to the existence and expansion of humanity. The eco-design and eco-innovation of rural-housing in reservoir environment with sustainable tourism and mass-tourism development are under rising pressure of prohibited housings sprawls, human movement and entertaining and tourist consciousness starting from the end of the 21st century in Spain. In rapid urban/rural development and water resources and bodies maintenance, the conflict and struggle are required to be straightforwardly suggested in these such areas. This paper, therefore, describes a combined operational eco-design and eco-innovation plausibility of a participatory multi-criteria analysis (MCA) method for a rural-housing development in a case study reservoir area under tourism and mass-tourism. A case study executing this method was implemented in the Alange municipality with a reservoir of Badajoz region, Spain. Accordingly, this study explores priority criteria investigating the analytical hierarchy process (AHP) and supporting opportunities of environmental conservation and economic growth as well which strongly emphasize benefits to the local community and effective management of tourism and mass-tourism. To reach a consensus criteria weight, a web survey to local residents and group discussion with a panel of experts are conducted for an analytical procedure. Then, it evaluates the suitability of the study area in order to optimally eco-design and eco-innovation of rural-housing based on the criteria with the aid of simple additive weighting (SAW) operator functions. This work classifies the particular attention and comparison for public participants in the analyzed map and in the valuation of the water visibility. The results measured and analyzed propose an innovative empirical and valued management method to assess the contemporary environment and infrastructure, and to predict their future developments, which could be applied to other situations and destinations. Particularly, this model analysis suggests a reason and confidence in a methodological approach to enhance the participatory thoughts and attitudes of public participants in the sustainable assessment management in reservoir environment under tourism and mass-tourism. Hence, this tool plans an approach to eco-design and eco-innovation of rural-housing development with the main objective of rising the reservoir environment's quality of life for residents and the visitors' satisfaction.

Key-Words: - eco-design and eco-innovation; plausibility; rural-housing; reservoirs; participatory attitude; GIS/MCA; sustainability; sustainable tourism and mas-tourism

1 Introduction

The sustainable development of rural-housing is connected to several organized factors including counter-urbanization, economic growth, rural depopulation, and social, national and ecological sustainability [1-4]. The challenges and procedures of planning rural-housing have been reviewed by many academics and professionals previously, who have also drawn devotion and attention to new formulas of rural-housing [5-8]. The popular discussion and discourse on this theme is connected to the style of activities and livings and rural environments, which are practiced by their inhabitants and visitors [9-11]. Rural neighborhoods appreciate the complementary maintenance of the local and regional government in terms of overall economic assistance policies and pointed rural-housing assistance and support. Formerly, the issue of rural studies was considered as marginal at best and inconsequential at worst; nevertheless, we note

numerous serious contributions to the understanding of rural-housing subjects in the last few years [2,12]. A substantial part of recent man-made buildings, particularly, has happened in rural areas. This has caused in an upsurge in their entertaining potentiality and human relocation to these areas, which also equals the urban sprawl that can see in the 20th century in the Extremadura region of Spain [13-15]. Yet, planning and design for rural-housing has not advanced consistently to deal with these new transitions in rural areas. Therefore, cautious assortment of locations of rural-housing to meet certain criteria could moderate undesirable impacts on current rural environments [16,17].

The eco-design and eco-innovation as sustainable and resilient planning of rural-housing into the environments and landscapes is a challenging work, as most of the times many controversial factors and parameters have to be redirected [18]. From existing local and regional planning and development modeling, the emphasis on the local and regional municipal as to conserve local and regional resources and to increase local and regional benefits emphases on the very close involvement between tourism and mass-tourism and decision-makers who are one of the essential stakeholders' groups [19]. Here, decision-makers could envisage more effectual and appropriate management methods and could knob probable disagreements between local and regional resources conservation and economic developments [2,20]. Respectively, considering with these facts, decision-makers could find the current situation of affairs and some ideas of future condition, ideally the probable consequences of the plans and policies under discussion and contribution, who supplies a distinguished quality in tourism and mass-tourism management [21]. The eco-design and eco-innovation of rural-housing with its landscapes usually depends more on the correct assortment of location than on any other weighted features. The geographic information system (GIS) reveals a valuable tool to examine the site in depth when considering overall visual characteristics and landscape scene of spatial planning [11]. The apparent benefit of a GIS-based method for eco-design and eco-innovation of rural-housing arises from the point, which it not only regulates the cost and period of place selection but also recommends an arithmetical data bank for long-term observing of the site and location [22]. The eco-design and eco-innovation, sustainable and resilient planning, rural-housing into their surroundings, however, is not a mutual discussion in conjoint performs yet [11,15].

Water itself is intently related to the survival, growth and expansion of humankind. The confident response of people to the existence of water is revealed even today as the gratification of the sea, rivers, reservoirs, water parks, etc. for various reasons [23]. Thus, the worth of water forms and bodies has been renowned in terms of ecological, environmental, and landscape view [24,25]. Yet, in different seasons many displacements and movements of population with nature has been caused as often overlooking ecological conservation and development by man interactions [26]. In Spain, a large number of reservoirs (nearly 2 exist per 1000 km2) are existed that are artificial bodies of water, which configured as a system. Especially, reservoir areas in the Spanish rural–urban fringe are under increasing pressure from construction sprawls, human movement, and growing recreational and tourist awareness [27]. These ecological values can be deliberated by consigning a number of economic operatives; consumers indicate their favorites by how much money they are eager to pay for particular services [28,29]. Afterwards, local residents obtain benefits from their improved local environment, which donates to their quality and worth of life [30]. This notion also distinguishes the necessity of association and participation among numerous individuals and associations in the management of environmental quality and water resources [31,32]. Therefore, the disagreement between rapid urban sprawl and reservoirs' maintenance in such areas urgently needs to be addressed. In the late 20th century of Extremadura region, urban sprawl with especially illegal constructions and human movements has been being introduced to the areas of reservoir, which has impacted to the housing itself and the linking between rural-housing and the up-to-date environment [11,13].

From the feature of participatory spatial planning (PSP), combined approaches to planning are adding credibility among decision-makers; policy-setters, planners and the public as well [33]. In operational stations and views, participatory approaches in planning are distributed by the intentions and reasons of effectiveness and productivity, applicability and responsiveness and their assumed low cost [34]. Public participation should also encourage a logic of possession and commitment to plan completion and understanding of the attitude of

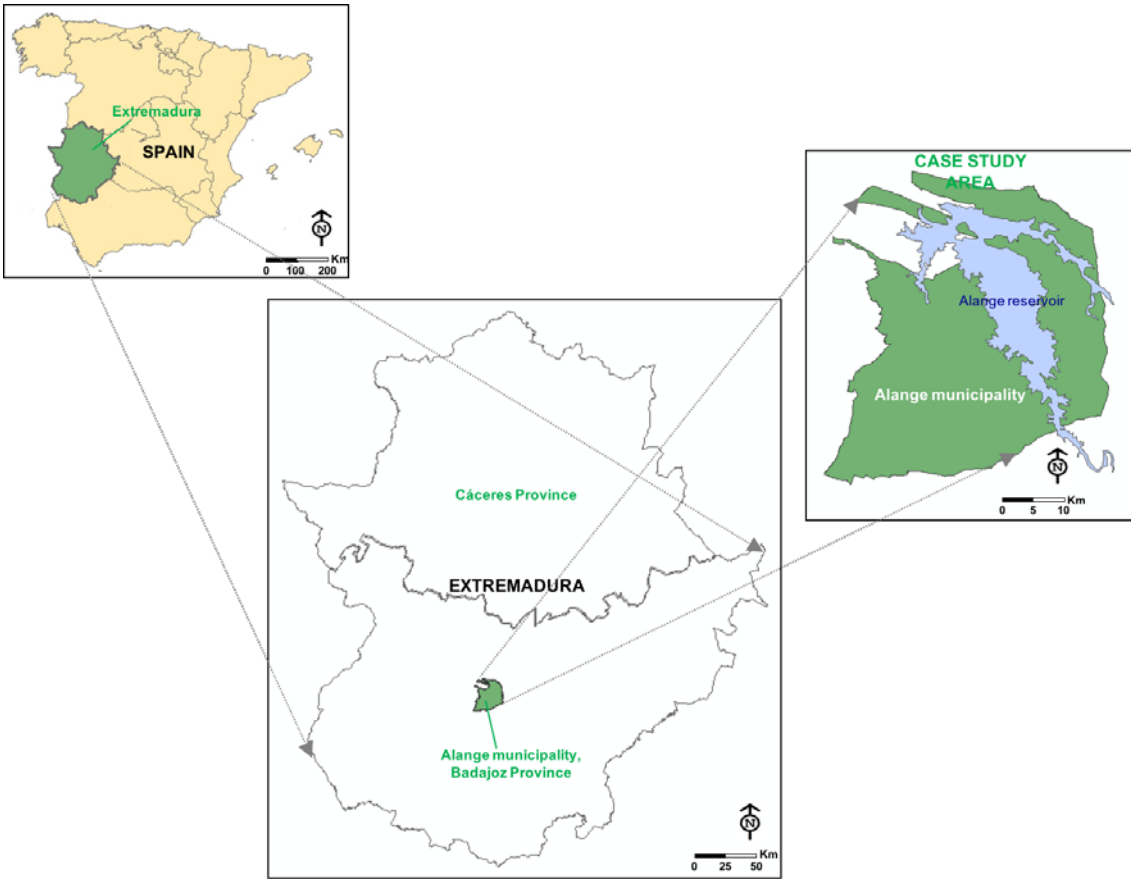

Fig. 1: Alange, Spain as the case study area experimented

the public towards the planning principles as well [35]. The attitude can encourage the decision-makers who generate more right and competent management strategies and treat with possible divergences between local and regional resources preservation and economic developments [20]. Though public participation in eco-design and eco-innovation of rural-housing planning takes time and patience to complete results, it increases the probability for government activities to better expose people's necessity. Exactly, it is also for the earnings to be more honestly allocated and preferably the potential consequences of the policies and plans [21,36]. The employment and application of the multi-criteria analysis (MCA) with the GIS setting is the most often used model for general housing eco-design and eco-innovation in planning [11,37]. The GIS/MCA tool is appreciated to activate the framework and outline between criteria weights. The benefits of integrated operational model are flexibility and comparability and network criteria mixture in the GIS, containing a new value to the assessment of problems together with housings eco-design and eco-innovation in planning of Spanish rural region [15,37]. Accurately, this method authorities to practice unique benefits and also to figure a more wide-ranging vision inside of certain the procedure and elaboration of decision-making [38,39]. Afterwards, the participatory method is the management of group decisions, which acquires credibility among decision-makers, because the proposed model produces the criteria evaluation by a large number of decision-makers [11]. Then, the proposed model is expended for adding the final maps for rural-housing's eco-design and eco-innovation in planning under tourism and mass-tourism in a specified area.

This paper outlines an integrated operational methodology for eco-design and eco-innovation of rural-housing development with participatory multi-criteria evaluation method as environment and sustainable development in Spanish reservoir area under tourism and mass-tourism. The criteria were attained by the interrelated variables to realize the priority areas of rural-housing in a case study area proposed. A case study executing this method was

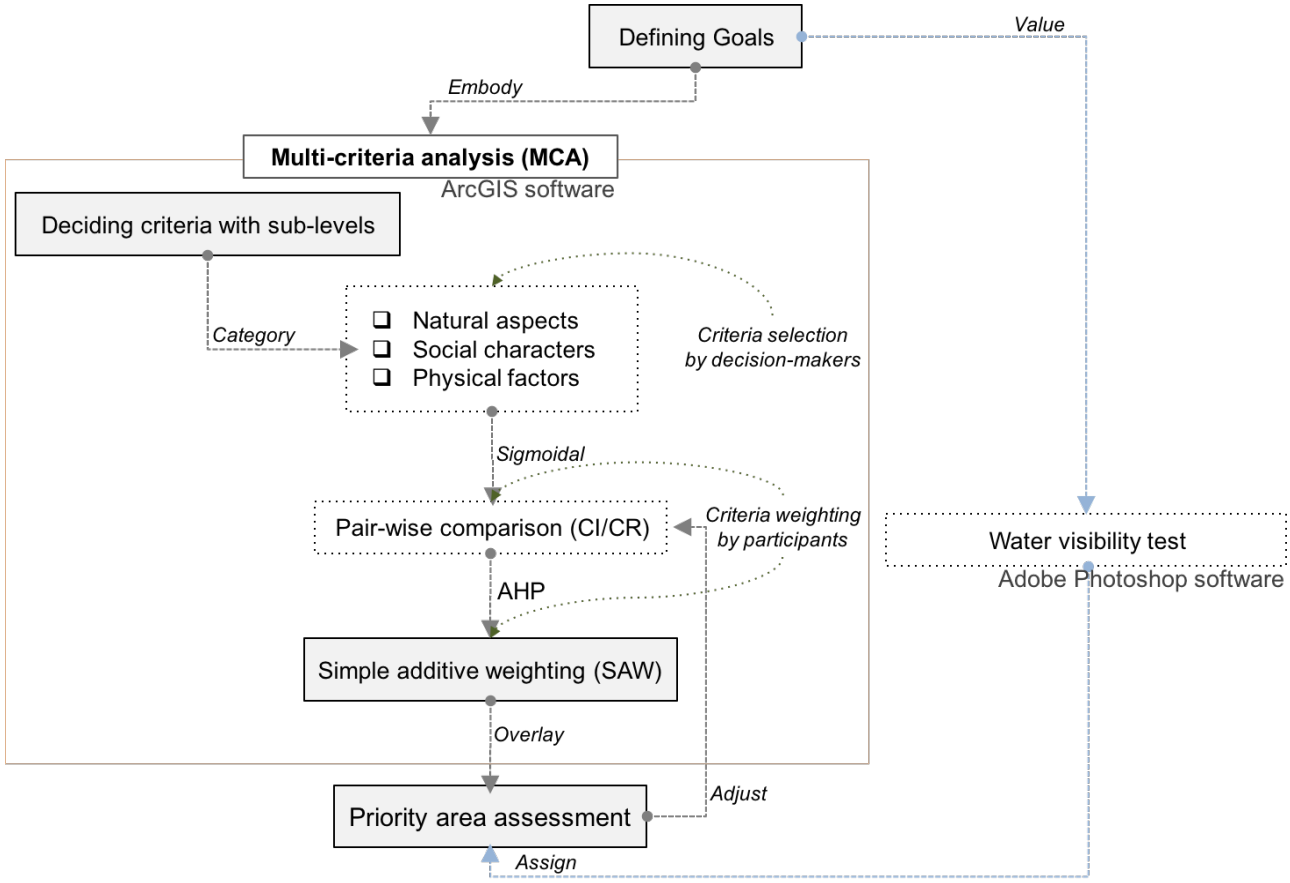

Fig. 2: Flowchart of eco-design and eco-innovation of rural-housing development

in Alange areas with reservoirs, which is under significant development pressure and construction sprawl. After literature review and discussions with experts and researchers, the criteria were designated from a long list, which integrated natural attributes, social conditions and physical issues [40]. The public was invited to answer in pair-wise comparisons to construct the weighting matrix thru the web together with the water visibility. The methodology proposed presented the AHP for the MCA united with fuzzy sets' standardization. The simple additive weighting (SAW) was in a GIS environment [19,40]. This study classified the specific interest for public participants in the analyzed suitability map and water visibility. Therefore, the mechanism after participation objective can be recognized through the results and is instructive towards enhancing the participatory attitudes in integrated and sustainable management to eco-design and eco-innovation in rural-housing in reservoir areas under tourism and mass-tourism. Then, it is demonstrated using a case study in Section 2. The methodology and materials applied in this paper performs in Section 3. Section 4 includes the results and discussion, while Section 5 concludes the paper.

2 Description of Case Study Area Proposed

The municipality of Alange is the case study area proposed. This area is located in the county of Tierra de Mérida - Vegas Bajas that is the province of Badajoz, Spain as displayed in Fig. 1. The area has a total area of about 160.3 km^2. In terms of topographical and structural personalities, the presence of a reservoir in Alange near the urban center is one of the most important geographical features in this area proposed. Along with the water basis has numerous and abundant zones with high scenic, biological, natural and leisure significance that are tourist destinations during the all seasons. Due to geographical features, the study area has experienced gradual increase in the development of rural homes and illegal construction, especially along near the reservoir of Alange. This development has promoted foremost changes in land

Table 1: Criteria of natural characteristics with weighted and adjusted value

Natural criteria	Criteria context	Weighted value	Adjusted value
Hydrology	Areas analyzed representing water bodies such as springs and/or wells, etc. and main and second water surface stream, which followed by EU Water Framework Directive obligations.	0.4860	0.4940
Ecological condition	Areas analyzed environmentally and ecologically protected by the European commission regulation for nature & biodiversity policy, NATURA 2000 and the regional law, LESOTEX.	0.2560	0.2270
Landscape	Areas analyzed demonstrating the ecological and environmental uniqueness of vegetation and its spatial spread formation based on the normalized difference vegetation index (NDVI) using the Landsat satellite images of the digital elevation model (DEM).	0.1250	0.1290
Geology and topography	Areas analyzed displaying basic parameter and atmospheric procedure for environmental factors' derivation of land surface flow.	0.1330	0.1490

use arrangements, which are leading to widespread and after all cause their consequential impacts, though the demarcation of what embodies a rural zone might fluctuate between regions of a country or countries [11,19].

Accoring to Terluin [41], he has noted that rural area development depends on the processes of complex economic, social and political activities. In the case study area proposed, several European initiatives in Extremadura, LEADER and PRODER projects, exercised new efforts to alter this region to attain sustainable rural development in the early nineties. These initiatives suggested concentrated more on those rural municipalities, which have higher economic inequalities and imbalances. So, the regional law, LESOTEX, Extremadura Law 15/2001 in land, territorial and landscape planning, is linked with territorial and regional planning. That contains plans, programs and different actions, which include the territorial consequence and repercussion effect. In Alange municipality, the complexity of urban development has led to the substitute of the Subsidiary Regulations of Planning along with the general municipal plan (GMP), which is a planning tool associated with urban development dynamics and its municipality structure. Owing to the adaptation of the GMP requirements, present technical criteria have already been founded in Article 5.2, LESOTEX. The universal objectives are deliberated in the new GMP: 1) the preservation and maintenance of the biological aspects in the land; 2) the management of existing areas of urban development; 3) the delineation of urban residential and industrial development; 4) the retrieval of traditional urban land use strength; 5) the development of existing quality and equipment treatment; and 6) the homogeneous conservation of the existing patrimonial urban arrangement. Notwithstanding these reflections, the changes of rural development are advancing quicker than the upsurge in their understanding and awareness. Also, we can detect similar topics in other countries [42,43]. Therefore, the planning procedure is proposed for the participation of public with other associations and individuals to gain various recommendations and views.

3 Materials and Methods

As shown in Fig. 2, firstly, the research procedures lead to obtain a digital GIS data combined with all spatial information. Then, it is standardizing the layers of map in a GIS environment. In order to classify the priority areas for eco-design and eco-innovation of rural-housing development in a case study area, an extensive multi-criteria evaluation process with multiple criteria sets had been decided with the literature review and discussions of experts and researchers, and then public participation through the web model. Here, the SAW technique as a class operator of multi-criteria evaluation is expended to rank criteria and to address the vagueness from their interactions. Consequently, the criteria weights' aggregation and attribute values in the SAW can produce the scores of suitability in the

Table 2: Criteria of social characteristics with weighted and adjusted value

Social criteria	Criteria context	Weighted value
Social area	Areas analyzed designating cities, towns and villages, which embodying a high concentration of human social activities and actions.	0.1930
Economic development	Areas analyzed directing economic development, which covers different land use and cover types according to LESOTEX based on the Landsat satellite images of the DEM.	0.3920
Economic area	Areas analyzed exhibiting human economic activities and actions such as urban, touristic, industrial and agricultural area based on land use and cover type.	0.2780
Population density	Areas analyzed exhibiting the populated zones of city, town and human settlement based on the national statistical institute (INE) of Spain.	0.1360

Table 3: Criteria of physical characteristics with weighted and adjusted value

Physical criteria	Criteria context	Weighted value	Adjusted value
Site positionality	Areas analyzed representing the aspect and orientation of site as an aesthetical reason not for any legal restrictions according to the geographical analysis.	0.2770	0.2670
Economic location	Areas analyzed exhibiting the economic location along with prohibited zones for building constructions by the local building ordinance legislation.	0.0540	0.0610
Visibility	Areas analyzed looking for aesthetic valuation and protection from site accessing points such as roads, highways and local roads, and railroads.	0.5730	0.5870
Transportation location	Areas analyzed directing the transportation location of site access infrastructure such as highways, local roads, train railways, etc.	0.0950	0.0860

case study areas and can represent the priority areas, which resolve the multiple criteria problem [44]. Specially, we had asked the visibility to water presence to the survey participants to appreciate better-balanced and tourism and mass-tourism actions and environmental conservation. Also, the methodology presented did not initially exclude unsuitable areas and the whole area was evaluated for eco-design and eco-innovation in rural-housing development. The methodology, hence, developed as the evaluation of territory on the basis of the priority indexes and valued visibility to water presence. In a certain criteria map, the priority ranking allocation for each class is transmitted out in the ArcGIS tool.

3.1 Preferred zones from MCA participatory valuation

In Alange municipality as a case study area proposed, the undercurrent design and planning policies cannot support completely to deal with actual problems and will not provide the apt answers yet although people that had an approximate knowledge of the area have practiced some of them. According to the means of criteria impact evaluation to eco-design and eco-innovation of rural-housing development, extensive criteria and evaluation steps with an attention to the reservoir of Alange are measured to classify the priority areas of rural-housing. The way is also to delete subsequent effects and contrasting long-term effects. The selection of selected criteria was objectively founded upon real data of the relevant literatures, regional policies and European Union (EU) directives and an expert discussion that were local authorities, professors, regional policy makers and planners. The selected criteria with four layers are

Table 4: The samples and variables of socio-demographic background of participants

Registered Questionnaires	Frequency	%
Sex		
Male	257	50.00
Female	257	50.00
Age		
30 or younger	156	30.30
31-40	226	44.00
41-50	95	18.50
More than 51	37	7.20
Occupation		
Professionals/Entrepreneurs/Specialists	246	47.90
White-collar occupations	156	30.40
Blue-collar occupations	11	2.10
Retirees/Students/Housewives	101	19.60

classified into three criteria, namely, natural, social and physical criteria. These twelve criteria are elaborated in the computation process, more exactly: (1) hydrology; (2) ecological condition [45]; (3) landscape; (4) geology and topography; (5) social area; (6) economic development; (7) economic area; (8) population density; (9) site positionality; (10) economic location; (11) visibility; (12) transportation location. The first criteria group contains (1) to (4) (see Table 1); the second criteria one involves (5) to (8) (see Table 2); and the third criteria one includes (9) to (12) (see Table 3). Then, for extended criteria weighting, the public was demanded to tell pair-wise comparisons engendering the weighting matrix via the web. The weight of offered criteria describes the significance with regard to all other criteria and directs how criteria compensate for each other of each group. Mostly, if the public participatory weights were not satisfying consistency index (CI) and consistency ratio (CR), it was recommended the accustomed weights, which meeting the CI and CR and being near to the unique weights. For the standardization of above three criteria with subordinated layers using the weighted factors, theirs maps are produced in sequent sections.

3.2 Practice of public participation through the web

The work comprised a participative multi-perspective method that criteria weights and waster visibility process was measured from the perspective of those elaborated, containing the process of decision-makers. So, to better realize the different types of web users and their perceptive factors, we embraced a user analysis system, which led the web pages' design with five usability necessities [46]. Remarkably, scheming survey questionnaire is the practice of up-to-date standards that will generate individual preferences from the huge number of survey participants [47]. As such, it did not hold extra plug-ins or demand any distinct software on the users' machine [47].

In this work, the data were gathered thru the web survey with supportive information. To gather as many partakers as possible, an interactive web data gathering is established on not only for offering a qualitatively improved disclosure of favorites but also straightforwardly storing the results in a data server. Altogether, these comprised 514 participants with different socio-demographic background. Through the internet, participants had stipulated two results' arrays that are the assignment of criteria weight as filling in the PCM and of water visibility. Both samples were first verified in a pilot study and then advanced further. First test is the weighting consignment of the criteria in different layers that quantifies by means of a common scale 1 to 10 grading rate. The grading rate 1 was allocated to the

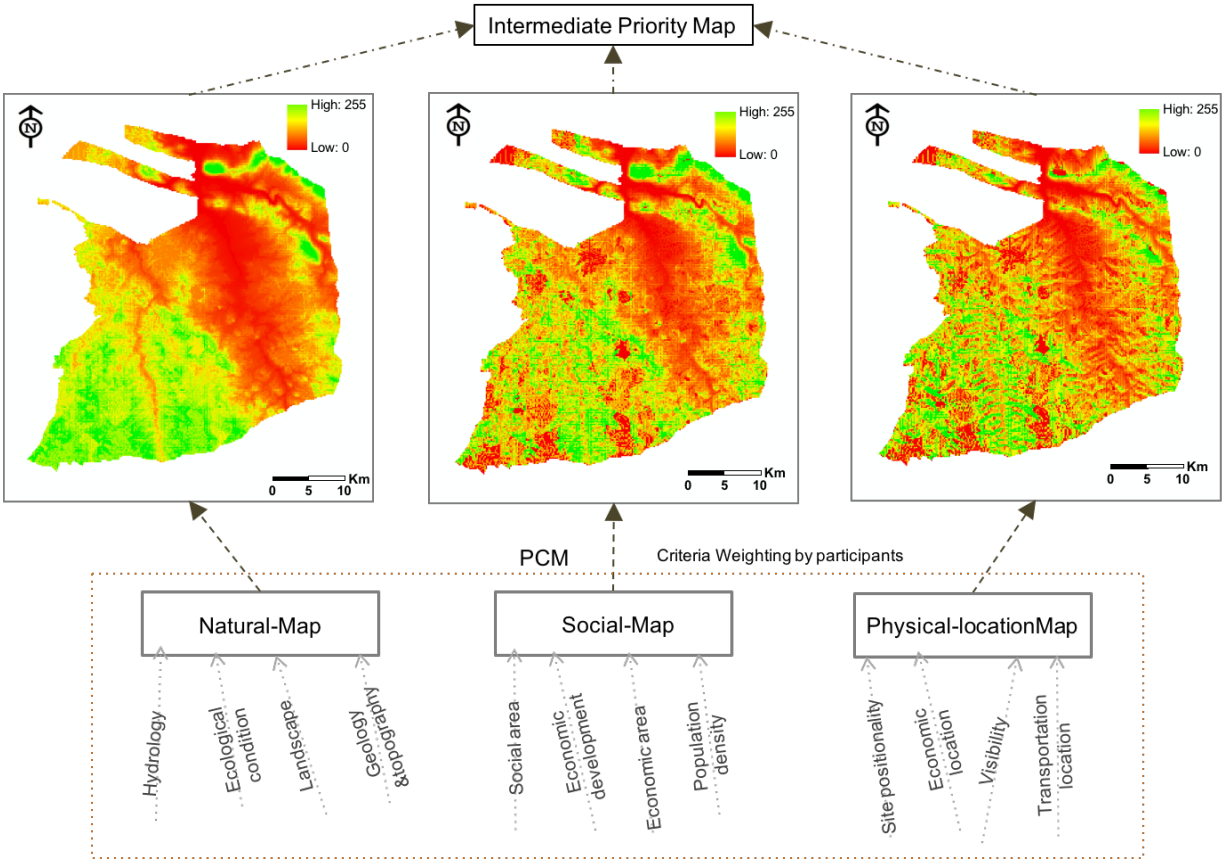

Fig. 3: Three analyzed intermediate map layers of the case study area proposed

least favorable criteria and 10 to the most favorable criteria, converting the different dimension units of the criterion images into equivalent priority rates. Then, the water visibility survey of water presence towards eco-design and eco-innovation of rural-housing development commissioned in 5 continuous ranged rate, which is 1 to 5.

4 Results and Discussion

Few lines have been presented for eco-design and eco-innovation of rural-housing integration using GIS and MCA in the recent studies [2,3,43]. However, for the present work, besides presenting all the rewards of the above-mentioned techniques, a significant contribution has been realized through the solicitation of the participatory weights with water visibility survey. The results are organized to reproduce the chief patterns that emerged from the data analysis. The findings from each of the two stages of web survey were integrated to allow a consistent explanation and evaluation of the results. Moreover, the peculiarity of the parameters was convoluted in the siting process into three groups, natural, social, and physical criteria.

4.1 Participants' socio-demographic background analysis

The socio-demographic survey profile was indicated and was examined to strengthen the interpretation and to confirm the generalizability of the survey results. Total 514 samples gathered via the web survey that was from different ages and backgrounds. The analysis of socio-demographic profile on the survey participants is described in Table 4. The gender dissemination, male and female, was exactly equal. The participants' age is spreading from 18 to over 50 years old. Closely half of the participants have an occupation as the following: professionals, entrepreneurs, and specialists. Half of them have a high educational background, reflecting their occupations. Hence, the participants had adequate qualifications to allocate the criteria weighting and following water visibility. So, the major respondents said that rural tourism and mass-

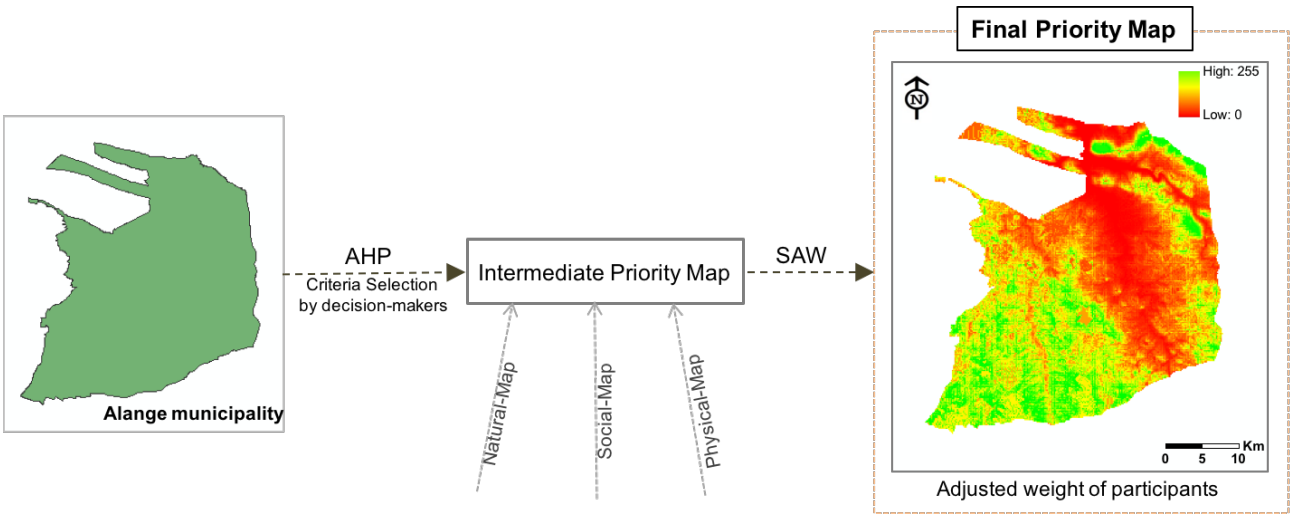

Fig. 4: Final map analyzed based three intermediate map layers

tourism are their favorite trip or one of their favorite means to appreciate their holiday. Nearly about one in two typically goes on holiday with family, friends or alone, and the rest of them enjoys to go with their spouse with or without their children. Particularly, the remoteness factor for the holiday is not a single problem for the most participants: they do not care to travel more than 300 km. Hence, the sample signifies the generalizability as also partaking a match with a general level data of annual statistics (Tourism Studies Institute of the General Secretary of Tourism Industry Ministry, the Spanish Tourist Movements).

4.2 Analyzed results of the proposed case study area

Regarding the final priority map, firstly, the preferred areas were acknowledged for eco-design and eco-innovation of rural-housing development of Alange municipality with reservoir. As displayed in Fig. 3, the participative clustering scenario was demonstrated as using three major criteria aforementioned. The final map in Fig. 4 uses the participatory weighing matrix, which shows the process to find out land priority for rewarding the research objectives.

The priority location results of three intermediate map layers were measured and then aggregated. Here, based on the earlier participatory weightings consignment, we found out participants' attitude to the specific criteria assignment: they gave more important weight to natural among criteria; hydrology in natural, economic development in social and visibility in physical criteria. Together with the previous results, areas with priority indexes from 0 to 4 can be commonly deliberated as unsuitable for eco-design and eco-innovation of rural-housing development. Sites with marks varying from index 9 to 10 projected to be the best priority sites for eco-design and eco-innovation of rural-housing development in the proposed case study area (Alange). For instance, it displays the branded percentage area: the best area is 8.6074% with high membership marks from total study area. As we have stated earlier, some participating weights were not fulfilling the CI and CR. Consequently, we did a comparison test with the corrected weights: the most priority areas of regulated weights are 8.6872% that signified 0.0798% higher than the original weights (see Fig. 5). The results of grouping process are also stimulating to point out that different spatial outlines. Those outlines have been produced by the weights given to the natural, social and physical objectives and to specify that the presented methodology is able to expose the most priority areas for eco-design and eco-innovation of rural-housing development to its environment, as well as to present an initial ranking of the priority areas. Therefore, integrated operational multi-criteria spatial decision-making model with the developments can be very opportune in the final decision. Later, the results obtained from a hypothetical scenario and situation of the water visibility that participants had made through the framework of web-based survey. Particularly, the

results of the regression analysis established the visibility presence of water bodies in the landscape that are basics considered in tourism and mass-tourism planning in the reservoir areas. Thus, the latent value for preference users of these amenities is this planned information, if they are deliberating the competitive and exclusive nature of the tourism and mas-tourism practice [26]. The mathematical expression stipulates the economic value that adopts the presence of water visibility in the landscape.

Subsequently, the results gained from a hypothetical scenario, represented the water visibility that participants had made through the web-based survey. Here, we denominated three units that were directed at the water: W1, W2 and W3 (in the water wing), as well as three units that were directed at the vegetation: V1, V2 and V3 (in the vegetation wing). To locate statistical forecasts of the variables that calculate the presence or non-presence of water in the landscape, we affected regression analysis to the willingness to pay for the two variables: w_visibility and v_visibility. The results of the regression analysis established the presence of water bodies in the landscape and environment that are basics measured in tourism and mass-tourism planning. So, the probable value for users' preference of these services is this strategic information, if they are reflecting the exclusive and competitive type of the tourism and mas-tourism practice. The mathematical expression delivers the economic value of water visibility that accepts the presence of water in the landscape and environment. Now, we regulate the correlation matrix between two variables that is a very chief aspect stated in the regression analysis. From an analysis of the Pearson correlation coefficients of variables proposed, we deduce two findings. That is, the variables, w_visibility and v_visibility, are intensely correlated with an index value of a Pearson correlation of 0.7430 and a degree of bilateral significance of 0.01, which otherwise confirm that the research design was sufficient. Consequently, we achieve a simple regression analysis with the dependent variable (w_visibility), which will be clarified by the independent variable (v_visibility). That is, the equation that we get attempts to forecast the price that a potential user would pay for a room having a view of water, knowing how much a user would pay for the same room with a view without water. We certainly forecast the value of a panorama with a valued landscape and environment element: the presence and visibility of water. The coefficient of determination, $R = 0.743$, is near to accord, and the corrected coefficient fortitude $R2 = 0.552$, denoting that 55.2% of the variance in the dependent variable is elucidated by the independent variable.

The results of the criteria combination and water visibility process are inspiring to point out that different spatial patterns and forms were shaped by the weights assigned to the natural, social and physical objectives from web public participations and water presence was very important. It is thus fairly simple to study different siting scenarios and situations and water bodies visibility or a more sensitive environmental substitute is intended. According to the estimated required study area proposed of 160.3 km^2, priority sites should be at most the scope of the study area proposed if only one rural-housing is to operate the complete study area. This needs to be selected in a static quantity of top-ranked places, equivalent to the obligatory area. In the incident of the water visibility, it was an accurate method to the valuation and estimate of environmental assets, specifically the reservoir ones. Hence, integrated and sustainable multi-criteria spatial decision model with economic valuation based on the methodology untaken in this work with the developments can be very useful in the final decision to integrate rural-housings as eco-design and eco-innovation in the reservoir areas under tourism and mass-tourism.

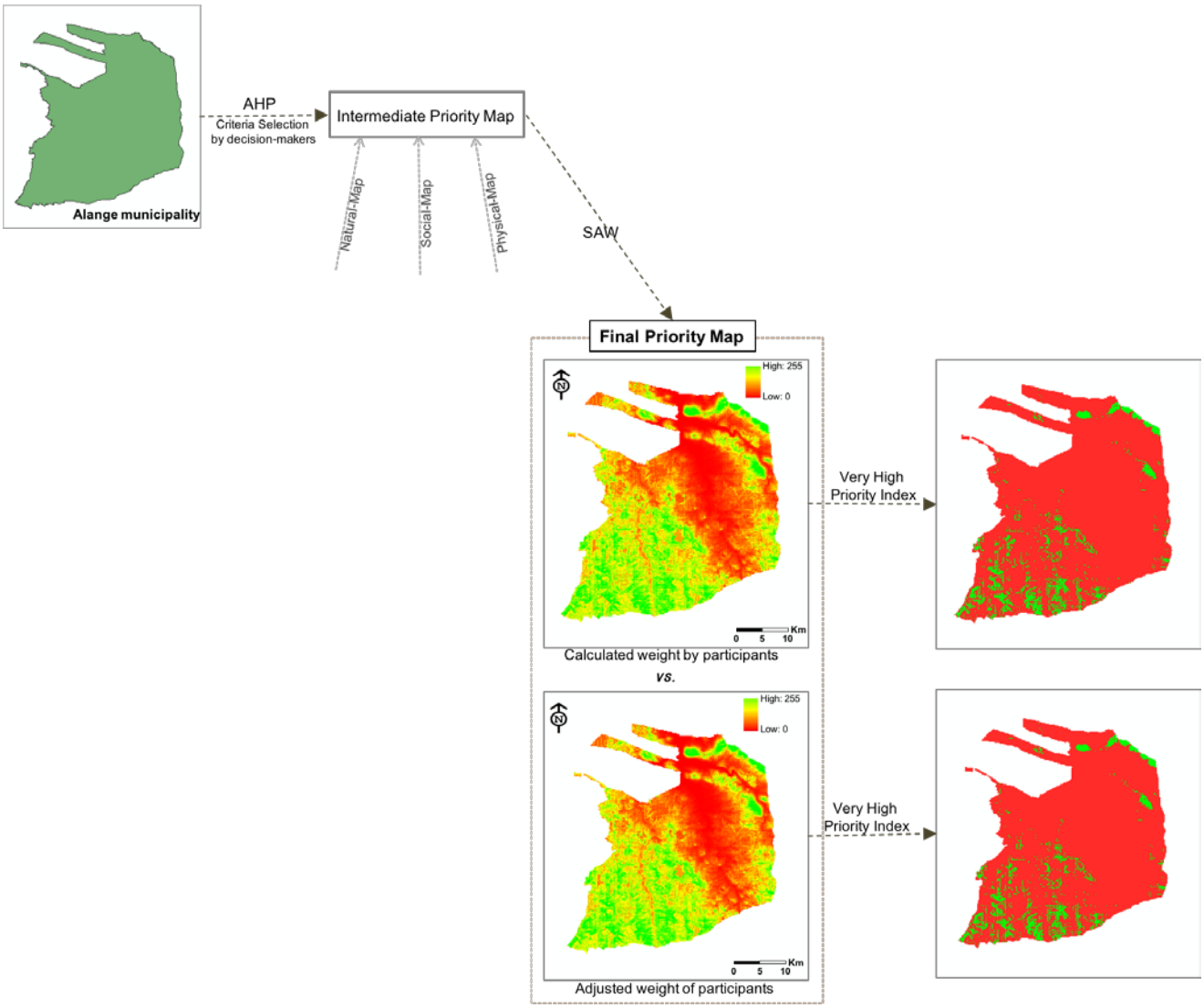

Fig. 5: Comparison of priority index between web participatory and adjusted weights

5 Conclusion

In this work, the methodological approach was used in combination with GIS capabilities in MCA method. The research findings and results denote the effectiveness of this method for eco-design and eco-innovation of rural-housing based on the understanding and measurements of all possible aspects and implications of tourism and mass-tourism of sustainable development in reservoir areas. In the computation and calculation process, the criteria characterized in three groups. Three intermediate suitability map layers were produced, which were united to form the composite suitability map. The AHP was used and was offered a quite objective process of weights assignment. Additionally, the use of the second set weights as applied provides great flexibility in the aggregation procedure, posing as rank-based weights and constant value of SAW that is irrespective of number of objectives aggregated.

This paper presents an operational integrated and sustainable methodology using participatory multi-criteria evaluation and water visibility method to eco-design and eco-innovation of rural-housing development in the Alange reservoir region, Spain. In particular, firstly, the case study has shown an approach of the participative clustering procedures for creating a decision-making for these rural-housing priority problems. Then, we did an additional particular analysis about the water visibility based on the participatory web survey.

Based on the consignment of participatory weightings, the participants' attitude was to the exact criteria consignment. Here, they untaken more important weight to natural among criteria; hydrology in natural, economic development in

social and visibility in physical criteria; 8.6074% (index rate 9 to 10) of the best suitable area from the results. The adjusted weights denoted the most priority area fulfilling the all CI and CR were 8.6874% that were 0.0798% higher than the original participatory weights. In the incident of water visibility, it was a suitable method to the valuation of environmental assets and properties, specifically the reservoir assets. The water visibility was vital that people reflected the importance that provides the economic worth, adopting the presence of water in the environment and landscape.

The findings of this research donate to the current literature on rural-housing research and studies, in that they discourse the absence of participatory commitment in the literature and link eco-design and eco-innovation of operational rural-housing to land use, and economic and place vulnerability. These results specify the flexibility of the methodology proposed as it mixes heterogeneous datasets throughout quantitative and qualitative criteria. As previous studies and researches designate, since new rural-housing integration depends on rural-housing planning policy and the force and power of public opinion, we propose that this approach holds significant hypothetical activity to support the complication of decision-making in real world solicitations. The approach is flexible and adaptable as it can integrate weight-detailed criteria for unlike problems or study areas proposed. It can be applied for individual or group decision-making. Likewise, the flexibility lets us to adjust the stages of importance for each criterion, and delivers the liberty to advance various modeling scenarios and situations for acceptable levels of decision risks, which could not be contemplated in the previous rural-housing literature. Hence, it is noticeable that these preliminary findings and results improve our knowledge on rural social science.

Therefore, an integrated operational eco-design and eco-innovation decision model with water visibility gave firstly a new experiential approach to probing the existing ecosystems and substructure and environments with the rural-housing developments. Afterwards, it can be very appreciated in the final decision to mix rural-housing in the reservoir areas that better balance tourism and mass-tourism activities' expansion and ecological conservation. Correspondingly, the methodology can easily spread as captivating other parameters of criteria, which could produce different decision substitutes. Hence, the methodology and analyses can be adapted to other targets demanding more well-organized and united planning for the administration of eco-design and eco-innovation development in tourism and mass-tourism. In a way, this model advises an approach to the sustainable development of reservoir areas with the main aim of increasing the quality of life for water bodies' environment for residents and the satisfaction of visitors as well.

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