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# Using a VGI and GIS-Based Multicriteria Approach for Assessing the Potential of Rural Tourism in Extremadura (Spain)

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Academic Editors: David Harvey and Marc A. Rosen
Received: 18 September 2016; Accepted: 2 November 2016; Published: 7 November 2016

**Abstract:** Extremadura (Spain), being one of the less-developed EU regions, is also eligible for European funds, including those related with the development of tourism activities in rural areas. To assess the spatial distribution of rural tourism potential (RTP), a methodological approach was followed by combining the synergetic use of geographic information systems (GIS) and the analytical hierarchical process (AHP). For the evaluation model, six factors were examined and hierarchized by a panel of eighteen experts: tourism accommodation offer, activities in natural areas, gastronomic offer, cultural activities, bath offer in natural environments, and activities in active tourism. These factors were then decomposed into thirty-two evaluation criteria and the relative importance of their weights was estimated using pairwise judgments. Using publicly available data and volunteered geographic information (VGI) platforms, the related spatial and non-spatial data were collected, collated, and standardized, employing appropriate tools developed with open-source GIS software. The results, represented by a series of intensity maps, indicate the RTP scores, highlight the strengths and weaknesses in each county, and could serve as a planning tool for public and/or private investments.

**Keywords:** VGI; GIS; AHP; rural tourism potential; Extremadura (Spain)

## 1. Introduction

According to the latest report of World Tourism Organization (WTO), Spain was the third most visited country with a total of 68.2 million visitors in 2015 [1]. This implies a direct and an indirect impact on 6.5% and 10.9% of gross domestic product (GDP), respectively [2]. Tourism is, therefore, one of the key factors in the economic development of Spain [3], expecting 11.9% growth of total employment created by the different economic sectors [4]. Sun and beach tourism has a strong seasonal pattern, which has a negative impact on the economy of regions that they do not have these natural benefits. Therefore, the financial support provided by the LEADER and PRODER [5] programs of national investment plans, in line with other European countries, aims to promote rural tourism as an alternative to the "sun and beach" tourism. This alternative encourages sustainable development opportunities with public and private investments and, consequently, prevents depopulation [4,6–8].

Assessing the potential of tourism, in an objective and a quantitative way, is a fundamental prerequisite in the implementation of optimal strategies for regional development. Moreover, this should also be the first action that must be carried out in a tourism planning process [9]. According to [10,11], the tourism potential of a destination depends not only on the existing resources, but also on those created. It can be defined as the set of resources, products, and services that may be included in the available tourism markets of a particular territory. To evaluate the potential of rural tourism, it is necessary to be under a strategic perspective of development [12] and of a business model, with the cooperation between the public and private sectors [13,14]. This perspective will then account for agrotourism, village tourism, ecotourism, cultural tourism, and natural tourism. Thus, this assessment is closely related to the analysis of quantitative and qualitative characteristics that influence tourism activities in the study regions [15,16]. In fact, rural tourism works well with existing rural enterprises, such as farms, by generating an important income for its households, and so can be identified as a relevant driver for sustainable rural development [17,18]. According to Rivero et al. [19], they calculate the rural tourism potential of regions exclusively based on the qualitative character due to the complexity that involves the collection, collation, and treatment of quantitative spatial data. On the other hand, Lee et al. [20] analyze the tourism potential with respect to the quantitative nature, position, and number of rural tourism resources. However, they do not take into account the qualitative nature of these resources.

Analytical hierarchical process (AHP) methodology has been used together with geographic information systems (GIS) tools in several research studies that have, in common, the territory as the physical framework: land use and general suitability analysis [21–24], natural resources management [25,26] suitable location of engineering projects [27], and urban and regional planning [28–33]. Although this methodological approach is considered as a new and powerful research tool, the difficulty and complexity of the methodology can produce inaccurate results if it does not consider the specificity of the tourism sector. In fact, in this context, some authors [31] combine the AHP with public field inquiries to assign the relative weights and to determine evaluation criteria. In other cases [24], although the AHP has been correctly used, the spatialization and standardization of the evaluation criteria could be improved, which could lead to a more accurate and detailed geographic distribution of rural tourism potential (RTP).

The knowledge of tourism potential in regions is a key factor for planning, management, and evaluation of tourism resources, and for writing business plans for funding rural development. Within this framework, this paper proposes a methodology for assessing the potential of rural tourism. It combines the synergetic use of AHP with GIS to establish the relative importance of each rural tourism resource, to conduct the necessary spatial analysis, and to create the intensity maps. Moreover, the relative weights of the determinant evaluation criteria will be done by interpreting the results of a public field inquiries by an expert's panel. Previous tourism studies only considered the existing resources of geospatial information due to the complexity of collection, collation, and processing of spatial data and non-spatial data [19]. For this reason, the collection and processing of data (spatial and non-spatial) resources in the GIS stage will play an important role here. Unlike other studies, where GIS has been used as a mere display or feature calculator, in this study GIS was used as a tool for processing, managing, and integrating, in a spatial database, the various geometries and attributes of spatial data.

## 2. Materials and Methods

### 2.1. Study Area

The study area, Extremadura (41,635 km$^2$), is located in the southwest of the Iberian Peninsula. It is bordered by Castilla y León to the north, Andalusia to the south, Castilla-La Mancha to the east, and Portugal to the west. It has two provinces (Badajoz and Cáceres) with 26 regions and its capital is located in Mérida as shown in Figure 1.

Extremadura has the population of about 1 million and the lowest Spanish GDP per capital (15,026 euros), which is 32.6% lower than the national average [4]. This region has the first priority of financial support provided by the European Union (EU) to improve sustainable rural development with the aforementioned LEADER and PRODER programs. These programs are public programs that adopt a local initiative method [34] and are more concentrated on rural regions with higher economic imbalances. Their principal objectives are to improve rural tourism as a complementary economic alternative to agricultural incomes, which also promotes rural sustainable development [5,12,35,36].

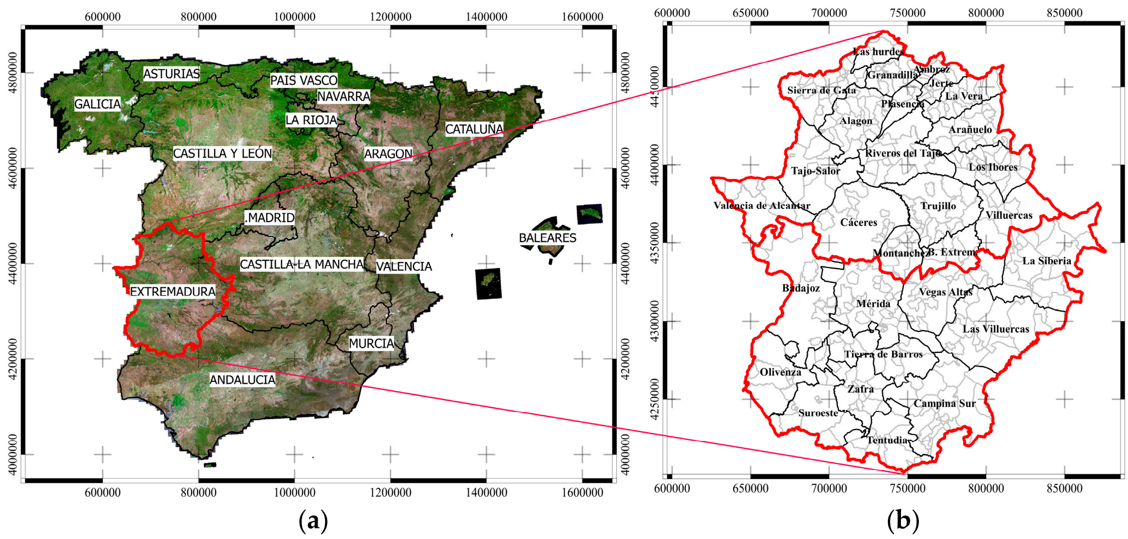



**Figure 1.** Location of the study area (**a**) and its administrative divisions (**b**): counties (bold line) and municipalities (grey line).

## 2.2. Methodology

There are several steps to assess the rural tourism potential (see Figure 2). Broadly, they can be grouped into two general stages: (i) the AHP stage, where the model evaluation factors and criteria are established and prioritized; and (ii) the GIS stage, where each criterion is spatialized for the evaluation unit and where the intensity maps representing the potential of rural tourism are created and thoroughly analyzed, using the previously-defined evaluation model.

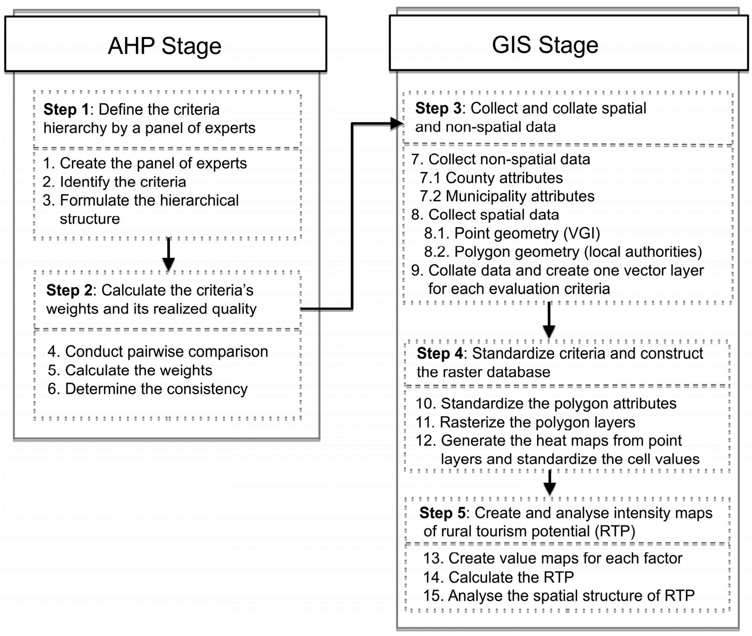



**Figure 2.** Flowchart of the proposed methodology.

At the AHP stage, the expert panel has to decide the hierarchy of the criteria and give the correct evaluation in the paired comparison. This is a prerequisite for obtaining a high consistency in the pairwise comparison matrix (PCM). This matrix will provide the weights of each criterion [37–39]. At the GIS stage, the spatial and non-spatial data are collected and collated in order to spatialize the corresponding evaluation factors and criteria. Then, using the evaluation model previously defined, the potential of rural tourism is computed for each spatial unit of the third level (i.e., raster cells). Finally, using the counties' polygons, as the minimum spatial unit at level 1, and the zonal statistics for the raster cells that are within each polygon, the potential of rural tourism is computed for this level. Contrary to what was done in other similar works, here, the potential of rural tourism is computed at two different spatial units: raster cells at the lower evaluation level (higher spatial resolution) and the counties polygons at the higher evaluation level (lower spatial resolution).

#### 2.2.1. Design and Establishment of the Evaluation Model

The panel of experts was constituted by professionals with extensive skill and knowledge in rural tourism and experience in the elaboration of public and/or private projects and investments [39]. In this study, the expert panel was made up of eighteen professionals: twelve tourism promoters of regional administration; two directors of rural hotels; two tourism promoters of district administration; and two tourism guides. Similar to other studies [40,41], these experts determined and established the criteria system to be used for assessing the rural tourism potential and arranged the evaluation criteria in a hierarchical order. Moreover, these experts' advice was corroborated by reviewing the specialized literature on the subject, analyzing the performed investments and the public consultations of the regional administration [38,39]. As a result, the evaluation system was decomposed into a hierarchy of four levels—0, 1, 2, and 3, denoting objective, factor, criteria, and sub-criteria levels. At the top of this hierarchical structure (level 0) is the goal—the rural tourism potential. The lower level is formed by more detailed sub-criteria, which were related to the criteria at the next higher level. This hierarchical structure is presented in Table 1. Note that the factor level is decomposed into six factors: tourism accommodation offer, activities in natural areas, gastronomic offer, cultural activities in natural environments, bath offer in natural environments, and activities in active tourism.

**Table 1.** Main factors, criteria, and respective weights (W.) used to assess the potential of rural tourism. Spatial data can have either point (*Pt*) or polygon geometry (G.). Non-spatial data is denoted by *Attr.* Bi. denotes the spatial layer associating with specific criteria (or sub-criteria).

| Factor Level | W. | Criteria Level | W. | Sub-Criteria Level | W. | G. | Bi. |
|---|---|---|---|---|---|---|---|
| Tourism accommodation offer | 0.3743 | Camping | 0.0288 | | | *Pt* | B1 |
| | | Rural hotel | 0.0630 | | | *Pt* | B2 |
| | | Rural house | 0.1934 | | | *Pt* | B3 |
| | | Rural apartment | 0.0892 | | | *Pt* | B4 |
| Activities in natural areas | 0.2597 | Visits to touristic places | 0.0781 | National park | 0.0255 | *Pol* | B5 |
| | | | | Natural park | 0.0159 | *Pol* | B6 |
| | | | | Natural reservoir | 0.0159 | *Pol* | B7 |
| | | | | Zone of special conservation (ZSC) | 0.0034 | *Pol* | B8 |
| | | | | Zone of special protection for birds (ZSPB) | 0.0074 | *Pol* | B9 |
| | | | | Natural monuments | 0.0061 | *Attr* | B10 |
| | | | | Suburban parks of conservation | 0.0021 | *Pol* | B11 |
| | | | | Unique trees | 0.0018 | *Attr* | B12 |
| | | Hiking trails | 0.0513 | | | *Attr* | B13 |
| | | Hunting | 0.0065 | | | *Pol* | B14 |
| | | Nature photography | 0.0268 | | | *Pt* | B15 |
| | | Bird watching | 0.0375 | | | *Pol* | B16 |
| | | Festivals of regional touristic interest | 0.0360 | | | *Attr* | B17 |
| | | Cycling | 0.0144 | | | *Attr* | B18 |
| | | Fishing | 0.0091 | | | *Pol* | B19 |

**Table 1.** *Cont.*

| Factor Level | W. | Criteria Level | W. | Sub-Criteria Level | W. | G. | Bi. |
|---|---|---|---|---|---|---|---|
| Gastronomic offer | 0.1849 | Gastronomic routes | 0.1233 | | | *Attr* | B20 |
| | | Restaurants guide "Pata Negra" | 0.0616 | | | *Pt* | B21 |
| Cultural activities in natural environments | 0.0864 | Itineraries by historical monuments | 0.0240 | | | *Attr* | B22 |
| | | Workshops of agricultural labors | 0.0341 | | | *Attr* | B23 |
| | | Visits to ethnographic museums/interpretation centers | 0.0141 | | | *Attr* | B24 |
| | | Activities of environment education | 0.0141 | | | *Attr* | B25 |
| Bath offer in natural environments | 0.0621 | Medicinal spa | 0.0101 | | | *Attr* | B26 |
| | | Natural swimming pool | 0.0335 | | | *Attr* | B27 |
| | | Bathing zones | 0.0184 | | | *Attr* | B28 |
| Activities in active tourism | 0.0325 | Hiking | 0.0172 | | | *Pol* | B29 |
| | | Adventure sports | 0.0076 | | | *Attr* | B30 |
| | | 4 × 4 routes/quads | 0.0054 | | | *Attr* | B31 |
| | | Rappelling/climbing | 0.0023 | | | *Attr* | B32 |

#### 2.2.2. Weighting of Evaluation Factors and Criteria

After the expert panel established the hierarchical structure, they determined the relative importance of all decision criteria through pairwise comparison. This analytical method involves the pairwise comparisons of the main criteria and sub-criteria within the same hierarchical level in order to determine the PCM. Here, a numerical scale ranging from 1 to 9 [37] was used to rank the relative importance of each criterion pair. Following the same procedure used by several researchers [24,39,42], the results obtained from PCM, which are a set of numerical values, should be normalized to get the relative weight of each criterion. This step involves the following operations: (1) divide each element of PCM by the sum total of its column (PCM is normalized); and (2) compute the average of the elements in each row of the normalized matrix. These averages obtained provide the priority vector, also called the normalized principal eigenvector, which are the relative weights of the criteria being compared. Repeating this procedure for each hierarchical level, the weights of all criteria relative to a whole level directly above were obtained and ranked from the upper level to the lower level. The weight of each evaluation criterion is shown in Table 1.

The confidence index of the results was determined through the consistency degree of PCM. A consistency index (CI) and consistency ratio (CR) were used to present these values. Their permissible maximum values, which depend on the matrix size, can be found in [39]. In this research, for level 1, the values obtained were CI = 0.00631 and an error of CR = 5.05% < 10% (maximum allowable value).

#### 2.2.3. Data Collection and Collation

In order to calculate the potential of rural tourism, each evaluation criterion must be spatialized (see Table 1). However, the Extremadura authorities do not have enough investments in free geospatial data due to its low economic resources. To overcome this limitation, it was necessary to collect and collate spatial and non-spatial data (attribute data) from different freely-available data sources: (i) administrative authorities (national, regional, and municipal web servers); and (ii) volunteered geographical information (VGI) platforms. The available geospatial data (GD) is characterized by two different geometries: point and polygon. The GD with point geometry was related with criteria B1, B2, B3, B4, and B21, and was obtained from two VGI platforms: Google Earth and WEB Panoramio. The data quality (including its geospatial accuracy) provided by these types of VGI platforms have already been checked by other researchers [43–45]. For obtaining the GD related with the B15 criterion, a Python application was implemented in the open source desktop GIS QGIS (Quantum GIS). This application extracts from WEB Panoramio, the position of each photo uploaded by the citizens to this VGI platform. The GD with polygon geometry was related with criteria B5, B6, B7, B8, B9, B11, and B14, and the geometry of municipalities and counties was provided by the Regional Government (RG) of Extremadura. The GD related with B16 and B19 came from National Government (NG), which was in a polygon determining occupation zones (natural park, natural reservoir, etc.). The non-spatial data (attribute data) was associated with two different administrative regions: (i) counties (criteria B12, B13, B19, B22, B23, B24, B25, B30, B31, and B32); and (ii) municipalities (criteria B18, B20, B26, B27, and B28). This data came from the RG. Developing a GIS database to be used in a multicriteria evaluation requires all of these attributes, tables, and shapefiles, which can be converted to spatial layers readable in the GIS desktop platform [32]. Therefore, the data associated with these 32 evaluation criteria were imported to a GIS database characterized by two geometries: point and polygon.

#### 2.2.4. Selection of the Evaluation Unit

Since the evaluation criteria have different spatial dimensions (points and polygons) and extents (the polygons can be counties, municipalities, natural areas, etc.), it was impossible to use them directly in the evaluation model. In order to generate a detailed intensity map for the rural tourism potential, the selection of the minimum evaluation unit is crucial. In this context, for the spatialization of the evaluation factors (first level), the adopted evaluation unit is the county, which is the same used in previous studies [6,46]. First, it is the spatial unit used by local authorities for the European structural and investment funds (such as LEADER and PRODER). Second, it is the geographic element that groups the tourism indicators.

For the spatialization of the evaluation criteria (third level), we have adopted the raster cell as the spatial evaluation unit. In fact, this spatial structure can easily accommodate the different spatial dimensions (points and polygons) of the criteria involved in the evaluation model, and allows us to have a detailed mapping of the continuous variation of rural tourism potential over the study area. The spatial unit of 100 × 100 m was chosen to discretize all of the GD and it was also used in other similar studies [33,47].

#### 2.2.5. Standardization of Evaluation Criteria

Before the rasterization of the GIS layers to the minimum spatial unit of level 3, it was necessary to perform a standardization of the attributes of vector data layers related with the evaluation criteria. This operation, made by range transformation in the interval 0–100, was performed in a different manner for the various attributes and geometries of these data layers.

First, for the 10 evaluation criteria related with polygon without attributes (B5, B6, B7, B8, B9, B11, B14, B16, B19, and B29), the related spatial data was considered as data already standardized with the maximum unit of assignable value to them ($V_{max}$ = 100). Second, for the evaluation criteria related with polygon with attributes, these attributes were assigned to the polygons that defined the counties or municipalities (see Table 1). Each polygon had a particular surface with a determined number of resources (rural houses, camping sites, rural hotels, etc.). Therefore, this standardization was realized to the maximum value using Equation (1), as in the work of [46]:

$$V_{standarized} = \frac{V_{relative}}{V_{max}};\ V_{relative} = \frac{\text{Attribute Value}}{\text{Surface}};\ V_{max} = 100, \tag{1}$$

Moreover, to determine the absence of atypical values in this process of standardization, a box-and-whisker diagram was applied. An atypical value $x$ was detected if it satisfied any condition of Equation (2):

$$x = \begin{cases} 0 & \textit{if} \quad x < Q_1 - 1.5 \times IQR \\ 100 & \textit{if} \quad x > Q_3 + 1.5 \times IQR \end{cases};\ IQR = Q_3 - Q_1; Q_i \text{ are the quartiles}, \tag{2}$$

Figure 3 shows the case obtained for the standardization of the attributes of county polygons. In this case, no atypical value was detected.

Finally, a special treatment was done for the standardization of the evaluation criteria related with point geometry (B1, B2, B3, B4, B15, and B21). First, a kernel density analysis was applied in order to identify areas with a higher concentration of point events (for example, areas with high potential for nature photography, criterion B15). In fact, a kernel density estimator (KDE) function transforms a sample of georeferenced observations (point events in a 2D space) into a continuous surface, indicating the intensity of individual observations over the 2D space [48]. A symmetric surface (called kernel function *K*) is placed at the center of each spatial unit(s) and distances between the center point and the locations of point events are evaluated in order to compute the point density at this location. The process is then repeated for all the remaining cells (*s*). The general form of a KDE is given in Equation (3):

$$f\left(s\right)=\begin{cases}\sum_{i=1}^{n}\frac{1}{\pi r^2}K\left(\frac{d_{is}}{r}\right) & ;\ 0<\frac{d_{is}}{r}<1\\ 0 & ;\ otherwise\end{cases}\ ,\ where\ K\left(\frac{d_{is}}{r}\right)=\frac{3}{4}\left(1-\frac{{d_{is}}^2}{r^2}\right), \tag{3}$$

where $f(s)$ is the point density at location s; $r$ is the search radius (or bandwidth) of the KDE; $K$ is the weight (called the kernel function) of a point $i$ at a distance $d_{is}$ to location $s$.

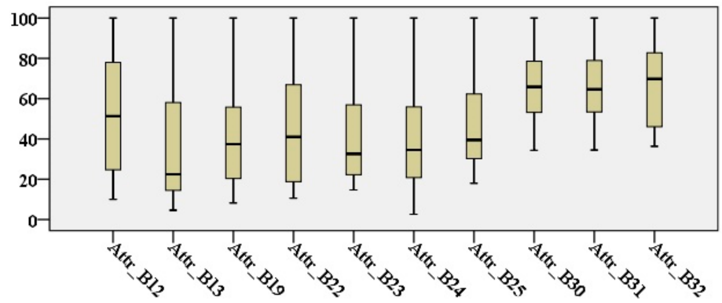



**Figure 3.** Box-and-whisker diagram used in the standardization of county polygons.

A number of kernel functions, such as the triangular, the quartic, and the Gaussian, have been proposed in the literature. In this work, we choose the Epanechnikov kernel (a quartic function), given in Equation (3), because: (i) it is optimal in a mean square error sense [49]; (ii) it is one of the most used kernel function [50]; and (iii) it was already applied in other similar works [51,52]. For the choice of the bandwidth, we have used the same values as in the work by [19], where the resource values depending on the distance were taken into account. Thus, we choose the values of $r$ = 10 km for B1, B2, B3, B4, and B21 and $r$ = 15 km for B15. In the case of the criterion B15, to determine the number of photographs taken in natural environments, the layer of photograph density was spatially intersected with the layer of natural landscapes, as seen in Figure 4.

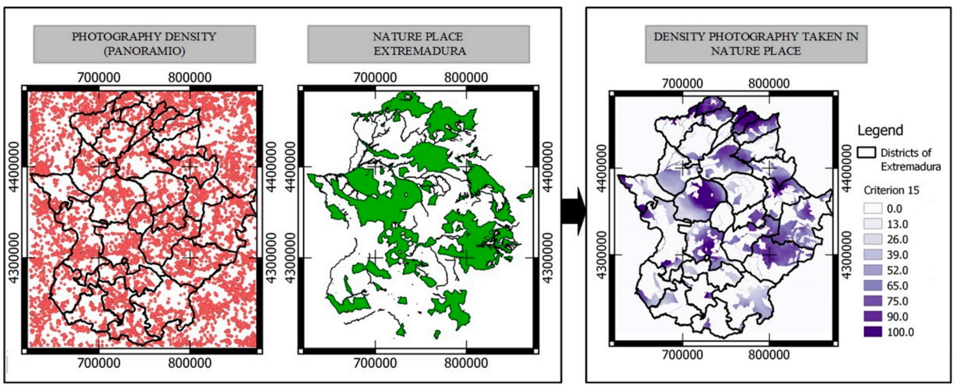



**Figure 4.** Photograph density taken in natural areas.

2.2.6. Assessing the Potential of Rural Tourism

To assess the RTP, the values of all criteria are overlaid in each evaluation unit. This means that for the evaluation criteria at level 3 the RTP is quantified for each cell (the minimum spatial unit), as the sum of the corresponding weight values of all related criteria by using the Equation (4):

$$\text{RTP} = \sum_{i=1}^{n} w_i B_i \quad (4)$$

where $n$ is number of criteria; $w_i$ is weight of criteria; and $B_i$ is the value of each criterion (see Table 1).

The assessment of RTP was aimed not only to quantify this potential in the form of an intensity map, but also to analyze the weakness and strength of each county in terms of each evaluating factor (level 1) and criterion (level 3). In this context, following [24,26,53], thematic maps relating to each evaluation factor were first created by using an open-source desktop GIS, QGIS. Second, to quantify the RTP, an intensity map was created based on Equation (4). Finally, two RTP intensity maps were constructed for the two counties with higher and lower potential. These maps will enable us to analyze the spatial distribution RTP in-depth within the municipalities forming those counties. It is worth mentioning that these maps can also allow: (i) the investors to determine the location of rural accommodations and/or business activities; (ii) the public administrations to focus and commercialize the public and/or private investments; and (iii) the tourism promoters to promote and commercialize the rural tourism destinations on the basis of their potential.

Figure 5 illustrates the complete flowchart of data (spatial and non-spatial) processing used in the RTP computation for each spatial unit of level 3. Note that, as the raster base is composed by an image with thirty-two bands (as much as the total number of evaluation criteria), clicking on any point of the computed intensity map we get the global score (the RTP), as well as the score of each criterion. Finally, by using zonal statistics for each county polygon (the minimum spatial unit of level 1), we can get the RTP for level 1. By using standard statistical indicators (maximum, minimum, average, etc.), we can further analyze the strength and weakness of each county.

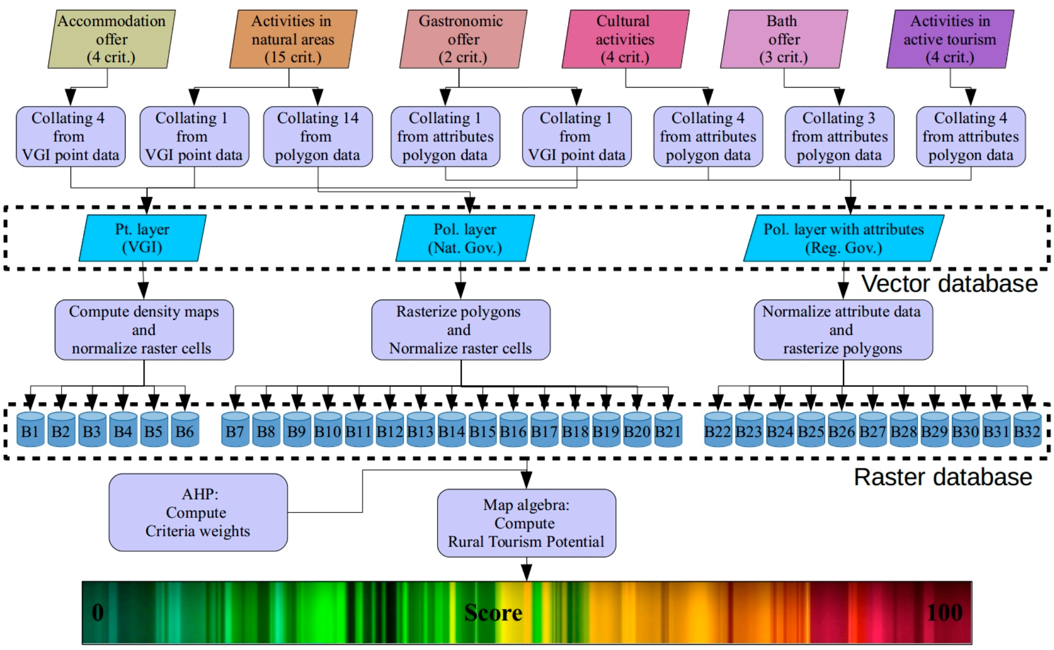



**Figure 5.** Flowchart of data processing used in the computation of RTP.

## 3. Results and Discussion

Firstly, the previous six evaluation factors were analyzed together with their criteria and then the RTP of different counties was thoroughly analyzed by using intensity maps of RTP.

### 3.1. Analysis of the Evaluation Factors

Figure 6 presents the spatial distribution of RTP for the six evaluation criteria. Concerning the accommodation offer, Jerte has the highest score (35.67 of 37.43) followed by La Vera and and Valle del Ambroz (33.24 and 30.75, respectively). On the contrary, Llanos de Olivenza and Campiña Sur have the lowest score due to the non-existence of rural accommodations. With regard to activities in natural environments, the northern regions have a difference compared to the rest of the regions due to the existence of the natural reservoir. Jerte, again, has the highest score (16.23 of 25.97), followed by Valle de Ambroz (8.26) and La Vera (7.86). Although having higher environmental resources, Monfragüe, Tajo-Salor, and Serranía de las Hurdes have the lowest scores due to fewer activity offers. The regions obtained the lowest score are Badajoz and Campiña Sur. For the gastronomic offer, the best offer is las Hurdes with a score of 12.38 (of 18.49), followed by upper Las Vegas and Campiña Sur. In both cases, the products offered are promoted by the RG and have a direct effect on their tourism consumption. Concerning the cultural activities in nature, Jerte obtains the highest score (7.24 of 8.76), especially with currently popular agrotourism [54,55] in spite of having less artistic and cultural heritages. For the bathing offer, it is worth noting that Extremadura has many important water resources. It is the only Spanish province having an interior beach with a WTO "Blue-Flag" [56], which is located in Serena. Therefore, La Serena has the highest score followed by Mérida, where the Prosperina reservoir is located. The northern regions (Jerte, La Vera, and Valle del Ambroz) have natural swimming pools, which are important centers of rural tourism attraction due to their high landscape values [57], especially during the summer season. Finally, with regard to the activities in active tourism, the data shows that 38% of counties have all services (hiking, adventure sports, climbing, etc.). However, the northern regions have more mountainous areas with more favorable orographic characteristics.

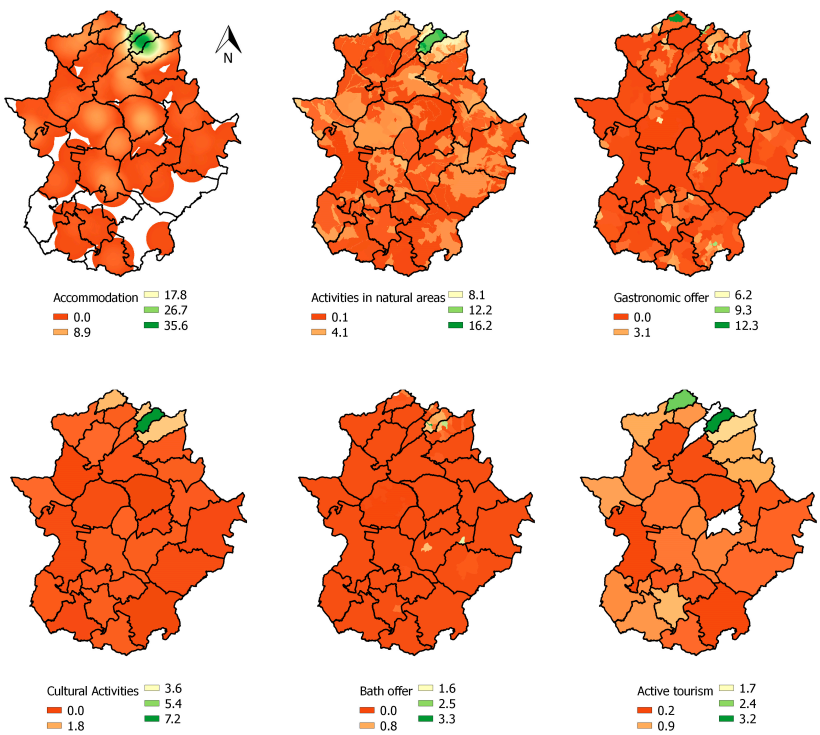



**Figure 6.** Spatial distribution of the six evaluation factors.

### 3.2. Analysis of the Potential of Rural Tourism

Figure 7 shows the intensity map of RTP, evaluated at level 3, where a cell of 100 × 100 $m^2$ is the minimum spatial unit. Taking zonal statistics, this intensity map can be converted into an RTP map evaluated at level 1 for which the county is the minimum spatial unit.

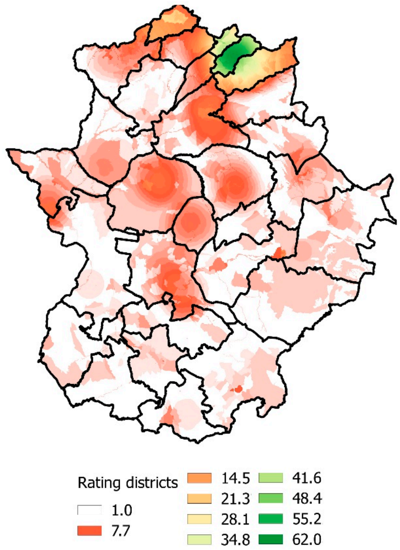



**Figure 7.** Intensity map of RTP.

Figure 8 illustrates the RTP evaluated at the county level using the mean and maximum values of the cells' attributes in each county. Unlike [24] where the values are homogeneous for the lowest hierarchical level, the intensity map, shown in Figure 7, can provide a thorough analysis of RTP spatial distribution. Moreover, it can be used to obtain the rural tourism potential of a specific location (cell), where the value of each evaluation criteria can also be viewed. The maximum value is produced in the municipality, which usually has the supply of accommodations, restaurants, museums, etc. On the other hand, the average value takes into account a period of building, such as a rural house on the outskirts of the municipality, maintenance or empowerment of environment, etc. Jerte (62 of 100) gets the maximum score, followed by La Vera and Valle del Ambroz. Note what happens in the Vera region: once there are municipalities with high and low RTP values, the average goes down significantly. The opposite phenomenon occurs in the region of Las Hurdes, where municipalities have a homogenous score. The region of Valencia de Alcántara has a low score despite having a great scenic attraction, like el Tajo-Salor. The region of Plasencia has its high score located in a geographically strategic point: equidistant to regions offering bird watching (Cáceres), high landscape level (Monfragüe national park in Riveros del Tajo), dining (Las Hurdes), or tourism offer (Jerte). Its tourism promoters have promoted the region by establishing dining and accommodation services. The landscape attractions of Villuercas and Los Ibores are undervalued due to the lack of public and private investment forcing tourists spend the night elsewhere.

In Figure 9, the two counties with the maximum and minimum RTP score (Jerte and Sierra del Suroeste, respectively) are thoroughly analyzed. First, in Jerte county, Piornal obtains the highest score, not only because of its physiographic characteristics similar to other municipalities of this region, but also because of the great deal on accommodation, food, natural swimming pools, and famous festivals of cultural interest (el Jarramplas). On the contrary, Sierra del Suroeste has the lowest score and the only municipality with a certain tourist attraction is Salvatierra de los Barros due to the gastronomic route of ham and wine.

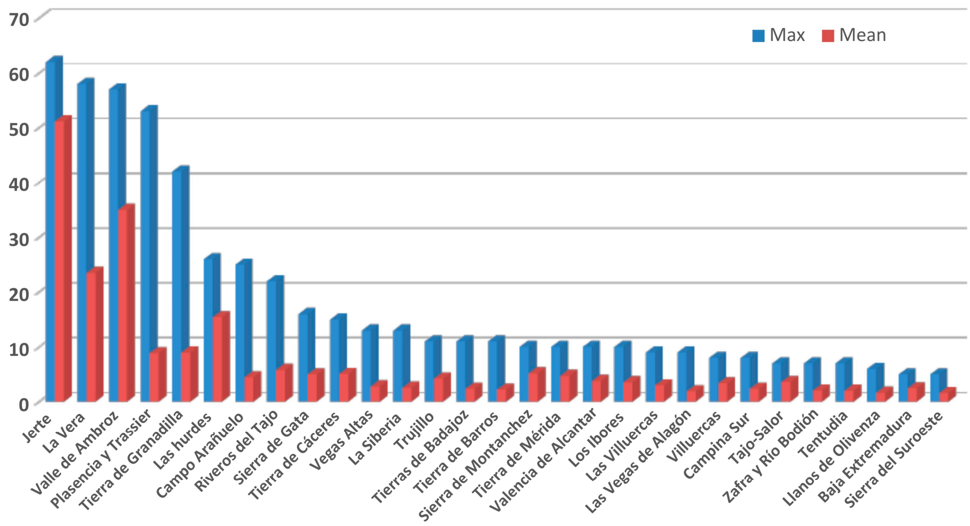
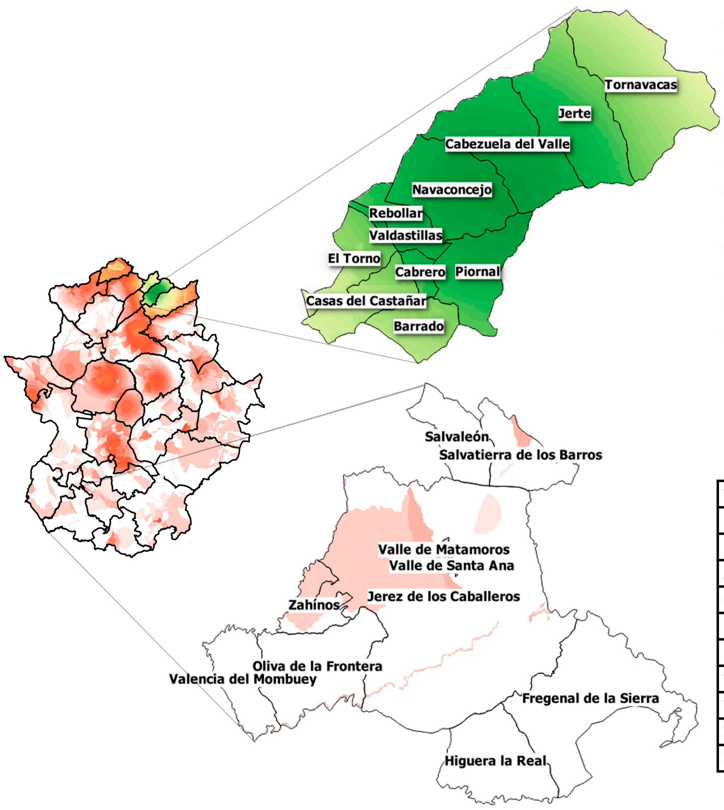



**Figure 8.** Maximum and average values of RTP at county level.




| Village | Max | Mean |
|---|---|---|
| Piornal | 62 | 56.2 |
| Navaconcejo | 61 | 59.1 |
| Cabezuela del Valle | 61 | 58.3 |
| Rebollar | 58 | 53.8 |
| Jerte | 58 | 52.6 |
| Cabrero | 57 | 53.9 |
| El Torno | 55 | 44.6 |
| Casas del Castañar | 55 | 42.5 |
| Barrado | 52 | 44.1 |
| Tornavacas | 51 | 42.2 |

| Village | Max | Mean |
|---|---|---|
| Fregenal de la Sierra | 4 | 1.8 |
| Higuera la Real | 1 | 1.0 |
| Jerez de los Caballeros | 4 | 2.0 |
| Oliva de la Frontera | 4 | 1.0 |
| Salvaleón | 2 | 1.0 |
| Salvatierra de los Barros | 5 | 1.2 |
| Valencia del Mombuey | 4 | 2.3 |
| Valle de Matamoros | 4 | 1.5 |
| Valle de Santa Ana | 4 | 1.2 |
| Zahínos | 3 | 2.9 |

**Figure 9.** Thorough analysis of the counties with maximum and minimum RTP: Jerte and Sierra del Suroeste.

## 4. Conclusions

This study allows us to draw several conclusions regarding the assessment of the RTP of a region. First, we must highlight the importance and necessity of assessing the tourism potential, especially for areas with limited economic resources, such as Extremadura, where efficiency and profitability of public/private investments are essential, due to the fact that these regions have limited economic resources, where there are no data (spatial and non-spatial) suitable for such studies. In this paper, we presented that these necessary data can be successfully collected and collated by using VGI-platforms and administrative web servers. As these data have different geometries (point and polygon) and are very dispersed (the attributes are associated with both the counties and the municipalities), we applied a specific treatment for each type of spatial data and for each type of non-spatial data. Second, in order to overcome the subjectivity that could lead to different assessments of the RTP of the same region, it is necessary to use a methodology that categorizes the different criteria, establishes a hierarchical structure, and allows for a qualitative and quantitative assessment of these criteria. In this paper, we used the synergy between GIS and AHP as a methodological approach to assess the potential of rural tourism in Extremadura (Spain). Third, the results, represented in the form of intensity maps of RTP, showed that the counties of Jerte, along with Valle del Ambroz and La Vera, were those with a major tourist attraction. This is not only because of the land physiography, flora, and/or fauna, but also because of public and private investments that, under a sustainability perspective, strengthened some tourism indicators (accommodations and tourism activities) and preserved current rural environments. Moreover, these two counties are currently the main poles of sustainable tourism attraction of Extremadura, as they receive approximately a third of its total visitors. Therefore, knowing these indicators is strategic information for policy-makers, especially if we consider the exclusive and competitive nature of the tourism practice since, at this time, we can choose a particular destination and we can deny the others.

The lack of investments and service infrastructures in regions such as Valencia de Alcántara has a low score despite of its great scenic attraction, proximity to the International Tagus Natural Park, and border with Portugal. Although these are protected areas with similar characteristics, they also have different management in each country, with the Portuguese policy-makers that traditionally promote greater tourism activities in the region. This contrast with the low scores on the Spanish side highlights the importance of proper sustainable tourism planning and development.

Finally, the proposed methodology indicates the main strengthens and weaknesses in each county, which are necessary for proper rural tourism planning. The planning in this work provides a new empirical approach to evaluate the existing infrastructure and environment. Additionally, this methodology is supported by open-source software and uses available public data and VGI. Thus, public and private entities with limited resources are allowed to use it freely. Moreover, it can be reused in other studies with territories or regions having similar conditions. Particularly, it will be suitable for less-developed regions legible for EU funding programs related with rural tourism development and a tool for policy-makers involved in rural tourism quality assessment, as well.

**Acknowledgments:** The work of Gil Gonçalves was supported in part by the Fundação para a Ciência e a Tecnologia (FCT) under project grant UID/MULTI/00308/2013.

**Author Contributions:** Abel González-Ramiro and Gil Gonçalves conceived the idea, developed the appropriate GIS tools, carried out both the calculations and analysis and wrote the paper. Alonso Sánchez-Ríos and Jin Su Jeong participated in the discussion regarding the structure of the paper and the writing. All authors have read and approved the final manuscript.

**Conflicts of Interest:** The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

## References

1. World Tourism Organization (UNWTO). *Tourism, Key to Development, Prosperity and Well-Being*; World Tourism Organization (UNWTO): Madrid, Spain, 2016.
2. Gutiérrez-Domènech, M. Impacto Económico del Sector Turístico en España. Available online: http://www.caixabankresearch.com/1405im-d4-es (accessed on 4 November 2016). (In Spanish)
3. Albaladejo, I.P.; González-Martínez, M.I.; Martínez-García, M.P. Quality and endogenous tourism: An empirical approach. *Tour. Manag.* **2014**, *41*, 141–147. [CrossRef]
4. Exceltur Valoración Turística Empresarial de 2015 y Perspectivas Para 2016. Available online: http://www.exceltur.org/perspectivas-turisticas/ (accessed on 4 November 2016). (In Spanish)

5. Masot, A.; Gascón, J. The rural model and the impact of the LEADER and PRODER program in Extremadura (Methodological proposed). *Scr. Nova-Revista Electron. Geogr. y Ciencias Soc.* **2010**, *14*, 1–25.
6. Antonio, J.; Jiménez, M.; Vargas, M.V. An Analysis of Cultural Tourism in Castilla-La Mancha (Spain): The impact of the European Rural Tourism Development Programs LEADER and PRODER. *Estud. y Perspect. en Tur.* **2008**, *17*, 359–370.
7. Ciolac, R.; Csosz, I.; Petroman, C.; Petroman, I.; Marin, D.; Dincu, A.; Rujescu, C.; Stanciu, S. Public-private Partnerships on Rural Tourism Field in Europe an Innovation for Rural Development—Achievements and Proposals. *Anim. Sci. Biotechnol.* **2013**, *46*, 387–392.
8. García Henche, B. Características diferenciales del producto turismo rural. *Cuad. Tur.* **2005**, *15*, 113–133. (In Spanish)
9. Pascariu, G.C.; Tiganasu, R. Tourism and sustainable regional development in Romania and France: An approach from the perspective of new economic geography. *Amfiteatru Econ.* **2014**, *XVI*, 1089–1110.
10. Dwyer, L.; Kim, C. Destination Competitiveness: Determinants and Indicators. *Curr. Issues Tour.* **2003**, *6*, 369–414. [CrossRef]
11. Gomezelj, D.O.; Mihalič, T. Destination competitiveness—Applying different models, the case of Slovenia. *Tour. Manag.* **2008**, *29*, 294–307. [CrossRef]
12. Maleki, M.R.; Moradi, E.; Parsa, S. Rural tourism as a way to rural development. *Int. J. Acad. Res.* **2014**, *6*, 79–84.
13. Komppula, R. Developing rural tourism in Finland through entrepreneurship. In *Tourism in the New Europe: Perspectives on SME Policies and Practices*; Thomas, R., Marcjanna, A., Eds.; Elsevier: Oxford, UK, 2007; pp. 123–133.
14. Komppula, R. The role of individual entrepreneurs in the development of competitiveness for a rural tourism destination—A case study. *Tour. Manag.* **2014**, *40*, 361–371. [CrossRef]
15. McDonald, G.T.; Brown, A.L. The land suitability approach to strategic land-use planning in urban fringe areas. *Landsc. Plan.* **1984**, *11*, 125–150. [CrossRef]
16. Malczewski, J. GIS-based multicriteria decision analysis: A survey of the literature. *Int. J. Geogr. Inf. Sci.* **2006**, *20*, 703–726. [CrossRef]
17. Hjalager, A.-M. Agricultural diversification into tourism: Evidence of a European Community development programme. *Tour. Manag.* **1996**, *17*, 103–111. [CrossRef]
18. Sidali, K.L.; Kastenholz, E.; Bianchi, R. Food tourism, niche markets and products in rural tourism: Combining the intimacy model and the experience economy as a rural development strategy. *J. Sustain. Tour.* **2013**, *9582*, 1–19. [CrossRef]
19. Rivero, M.S.; Martín, J.M.S.; Gallego, J.I.R. Methodological approach for assessing the potential of a rural tourism destination: An application in the province of Cáceres (Spain). *Curr. Issues Tour.* **2016**, *19*, 1084–1109. [CrossRef]
20. Lee, S.-H.; Choi, J.-Y.; Yoo, S.-H.; Oh, Y.-G. Evaluating spatial centrality for integrated tourism management in rural areas using GIS and network analysis. *Tour. Manag.* **2013**, *34*, 14–24. [CrossRef]
21. Aklıbaşında, M.; Bulut, Y. Analysis of terrains suitable for tourism and recreation by using geographic information system (GIS). *Environ. Monit. Assess.* **2014**, *186*, 5711–5719. [CrossRef]
22. Stojanov, S.; Besermenji, S. Measuring Tourism Potential of Places of Interest and Memorial Objects Using Analytical Hierarchy Process (AHP)—Case Study City of Nis, Serbia. *Eur. Res.* **2013**, *59*, 2306–2316.
23. Valle Junior, R.F.; Varandas, S.G.P.; Sanches Fernandes, L.F.; Pacheco, F.A.L. Environmental land use conflicts: A threat to soil conservation. *Land Use Policy* **2014**, *41*, 172–185. [CrossRef]
24. Xu, Y.; Sun, J.; Zhang, J.; Xu, Y.; Zhang, M.; Liao, X. Combining AHP with GIS in synthetic evaluation of environmental suitability for living in China's 35 major cities. *Int. J. Geogr. Inf. Sci.* **2012**, *26*, 1603–1623. [CrossRef]
25. Kumar, T.; Gautam, A.K.; Kumar, T. Appraising the accuracy of GIS-based Multi-criteria decision making technique for delineation of Groundwater potential zones. *Water Resour. Manag.* **2014**, *28*, 4449–4466. [CrossRef]
26. Varju, V.; Suvak, A.; Dombi, P. Geographic Information Systems in the Service of Alternative Tourism—Methods with Landscape Evaluation and Target Group Preference Weighting. *Int. J. Tour. Res.* **2014**, *16*, 496–512. [CrossRef]

27. Ardeshir, A.; Mohseni, N. Selection of a Bridge Construction Site Using Fuzzy Analytical Hierarchy Process in Geographic Information System. *Arab. J. Sci. Eng.* **2014**, *39*, 4405–4420. [CrossRef]
28. Xiaorui, Z.; Chuanglin, F.; Zhenbo, W.; Haitao, M. Urban Construction Land Suitability Evaluation Based on Improved Multi-criteria Evaluation Based on GIS (MCE-GIS): Case of New Hefei City, China. *Chin. Geogr. Sci.* **2013**, *23*, 740–753.
29. Javadian, M.; Shamskooshki, H.; Momeni, M. Application of Sustainable Urban Development in Environmental Suitability Analysis of Educational Land Use by Using Ahp and Gis in Tehran. *Procedia Eng.* **2011**, *21*, 72–80. [CrossRef]
30. 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* **2013**, *32*, 108–118. [CrossRef]
31. Jeong, J.S.; García-Moruno, L.; Hernández-Blanco, J.; Jaraíz-Cabanillas, F.J. An operational method to supporting siting decisions for sustainable rural second home planning in ecotourism sites. *Land Use Policy* **2014**, *41*, 550–560. [CrossRef]
32. Pourebrahim, S.; Hadipour, M.; Mokhtar, M.B. Integration of spatial suitability analysis for land use planning in coastal areas; case of Kuala Langat District, Selangor, Malaysia. *Landsc. Urban Plan.* **2011**, *101*, 84–97. [CrossRef]
33. Vaz, E.D.N.; Nijkamp, P.; Painho, M.; Caetano, M. A multi-scenario forecast of urban change: A study on urban growth in the Algarve. *Landsc. Urban Plan.* **2012**, *104*, 201–211. [CrossRef]
34. Jaraíz Cabanillas, F.J.; Mora Aliseda, J.; Gutiérrez Gallego, J.A.; Jeong, J.S. Comparison of regional planning strategies: Countywide general plans in USA and territorial plans in Spain. *Land Use Policy* **2013**, *30*, 758–773. [CrossRef]
35. Gannona, A. Rural tourism as a factor in rural community economic development for economies in transition. *J. Sustain. Tour.* **1994**, *2*, 51–60. [CrossRef]
36. Cànoves, G.; Villarino, M.; Herrera, L. Public policies, rural tourism and sustainability: A difficult balance. *Boletín la Asoc. Geógrafos Españoles* **2006**, *41*, 199–217.
37. Saaty, T.L. *The Analytic Hierarchy Process*; McGraw Hill: New York, NY, USA, 1980.
38. Saaty, T.L. How to make a decision: The analytic hierarchy process. *Eur. J. Oper. Res.* **1990**, *48*, 9–26. [CrossRef]
39. Aznar Bellver, J.; Guijarro Martínez, F. *Nuevos Métodos de Valoración. Modelos Multicrieterio*; Editorial Universitat Politècnica de València: Valencia, Spain, 2012. (In Spanish)
40. Lozano-Oyola, M.; Blancas, F.J.; González, M.; Caballero, R. Sustainable tourism indicators as planning tools in cultural destinations. *Ecol. Indic.* **2012**, *18*, 659–675. [CrossRef]
41. Malczewski, J. Ordered weighted averaging with fuzzy quantifiers: GIS-based multicriteria evaluation for land-use suitability analysis. *Int. J. Appl. Earth Obs. Geoinf.* **2006**, *8*, 270–277. [CrossRef]
42. Pacheco, J.F.; Contreras, E. *Manual Metodológico de Evaluación Multicriterio Para Programas y Proyectos*; Comisión Económica para América Latina y el Caribe (CEPAL): Santiago, Chile, 2008. (In Spanish)
43. Ciepłuch, B.; Mooney, P.; Jacob, R.; Winstanely, A.C. Comparison of the accuracy of OpenStreetMap for Ireland with Google Maps and Bing Maps. In Proceedings of the 9th International Symposium on Spatial Accuracy Assessment in Natural Resuorces and Enviromental Sciences, Leicester, UK, 20–23 July 2010; p. 337.
44. Ciepłuch, B.; Mooney, P.; Jacob, R.; Zheng, J.; Winstanely, A.C. Location-based services research and applications. *Arch. Photogramm. Cartogr. Remote Sens.* **2011**, *22*, 105–116.
45. Zielstra, D.; Hochmair, H.H. Positional accuracy analysis of Flickr and Panoramio images for selected world regions. *J. Spat. Sci.* **2013**, *58*, 251–273. [CrossRef]
46. Blancas Peral, F.J.; Guerrero Casas, F.M.; Lozano Oyola, M. The spatial location in the planning of the rural tourism in Andalusia: An approach multicrite rion. *Rev. Estudios Reg.* **2009**, *7585*, 83–113.
47. Liu, Y.; Lv, X.; Qin, X.; Guo, H.; Yu, Y.; Wang, J.; Mao, G. An integrated GIS-based analysis system for land-use management of lake areas in urban fringe. *Landsc. Urban Plan.* **2007**, *82*, 233–246. [CrossRef]
48. Yu, H.; Liu, P.; Chen, J.; Wang, H. Comparative analysis of the spatial analysis methods for hotspot identification. *Accid. Anal. Prev.* **2014**, *66*, 80–88. [CrossRef]
49. Epanechnikov, V.A. Non-Parametric Estimation of a Multivariate Probability Density. *Theory Probab. Appl.* **1967**, *14*, 153–158. [CrossRef]

50. De Smith, M.; Goodchild, M.; Longley, P. *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools*; Troubador Publishing Ltd.: Leicester, UK, 2007.
51. Brunsdon, C. Estimating probability surfaces for geographical point data: An adaptive kernel algorithm. *Comput. Geosci.* **1995**, *21*, 877–894. [CrossRef]
52. Jiménez, A.M. Modelización cartográfica de densidades mediante estimadores Kernel. *Treballs Soc. Catalana Geogr.* **2005**, *155*, 445–460. (In Spanish)
53. Dhami, I.; Deng, J.; Burns, R.C.; Pierskalla, C. Identifying and mapping forest-based ecotourism areas in West Virginia—Incorporating visitors' preferences. *Tour. Manag.* **2014**, *42*, 165–176. [CrossRef]
54. Leco, F.; Hernández, J.; Campón, A. Rural Tourists and Their Attitudes and Motivations towards the Practice of Environmental Activities such as Agrotourism. *Int. J. Environ. Res.* **2012**, *7*, 255–264.
55. Gao, J.; Barbieri, C.; Valdivia, C. Agricultural Landscape Preferences: Implications for Agritourism Development. *J. Travel Res.* **2013**, *53*, 366–379. [CrossRef]
56. Blue-Flag. Beaches and Marinas with Blue Flag. Available online: http://www.blueflag.org/ (accessed on 4 November 2016).
57. Sánchez Ríos, A. Criterios de Actuación Para el Aprovechamiento Paisajístico de las Masas de Agua en el Suelo Rural: Caso Particular de Extremadura. Ph.D. Thesis, Universidad de Extremadura, Extremadura, España, 2008. (In Spanish)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