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Relation between the Views and the Real Estate Application to a Mediterranean Coastal Area

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Abstract: The landscape is a factor considered when choosing to purchase a dwelling, and, therefore, it influences the price of the real estate market. However, it is difficult to measure and assess its role, since it has a series of features that work in an integrated way and are hard to quantify separately. The characteristics of the views from each dwelling must also be considered, as well as their intrinsic characteristics or proximity to public services. This study proposes an automatic method to analyze the quality of the views, including both its dimensions and its composition in order to be able to estimate the economic weight of the views in the real estate value. A series of measurements of the views from 226 dwellings are integrated into the final index equation. The results are then compared with the estimated dwelling prices. The results highlight that the average price increases up to 18.1% in dwellings with a larger high-quality visual basin. It has also been noted that it is difficult to establish a correlation between the quality of the views and the housing prices due to the multifactorial nature of the housing prices.

Keywords: landscape; visibility analysis; scenic quality; geographical information systems; real estate valuation

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1. Introduction

The 2000 European Landscape Convention [1] states in its preamble that "landscape is a key element of individual and social well-being, and qualifies the landscape as "an important element of the life's quality of populations". The European Landscape Convention also defines the landscape as "any part of the territory as it perceived by the population, whose character is the result of the action and interaction of natural and/or human factors". Views arise as a result of the perception of the landscape and, therefore, their quality has a clear link with the well-being of the citizens [2–4] even being related to a therapeutic character [5].

The wish to have open and beautiful views is a relevant factor in the search for a dwelling. Because of this, views acquire an economic weight in the value of the house or, more broadly, in the real estate potential of areas that have high- quality views. Therefore, the landscape as a whole represents an important resource for economic activity. This is something that also includes the European Landscape Convention and is not only for the most recognizable tourist or recreational activities, but also for the real estate use of the land. Following this approach, the Spanish Land and Urban Rehabilitation Act considers it a citizen's rights to enjoy a decent house "in a suitable environment and landscape" (Royal Legislative Decree 7/2015, 30 October, art. 5a).

The importance of views as a component of real estate value is evident both for professionals in the sector and for buyers. It is explicitly shown in the real estate market, as well as in advertising, especially in certain groups. Its influence on the price of the land and on the real estate product in those buildings and plots that have wide and high-quality views can be verified. Often, this aspect differentiates, on the one hand, certain spaces or buildings as having larger views or views with more appreciated elements. On the other hand, on a more detailed scale, it distinguishes parts of the same building based on the quality of the views, even by their presence/absence (e.g., attics, ground floors or houses with outdoor views compared to those oriented to closed common spaces or other buildings).

Therefore, determining the economic weight of the views in the value of the real estate product constitutes a matter of clear interest in the management of the landscape. However, progress in this quantification is a significant challenge. The composition of real estate price involves a wide variety of factors [6] whose weight is modified according to both the study area and the time considered. Among these factors, there are those linked to the so-called hedonic price (including the existence of attractive views), which have a determination and internal composition that is complex to establish.

Additionally, the estimation of the value of the views is usually focused on the size of the visual basin, using digital surface models [7,8]. However, the value of the views should also consider the quality of the landscape, that is, the types of landscape within the visual basin. Therefore, it is necessary to have objective, systematic, and automatic methods that gather together all the variables related to the views (e.g., dimensions and composition) with the aim of providing greater precision to the delimitation of the visual basin and allowing its application to other study areas. This is especially important in urban and developable environments, where the analysis of the views is more complex due to the presence of natural and artificial elements that modify them. In this context, the main objectives of this paper are as follows: (a) to provide an automatic method for analyzing the quality of the views, including both their size and elements, and (b) to make advances in the estimation of the economic weight of views on real estate value.

2. State of the Art of Landscape Estimation in the Real Estate Market

The use of GIS (geographical information systems) for visual basin analysis has been a widespread practice for almost 20 years [9]. Initially, these analyses were based mainly on digital elevation models (DEM), a specific type of digital terrain model (DTM). The use of models that included the visual "obstacles" of the territory (such as buildings, power lines, trees, etc.) was very scarce given their complexity and the inaccuracy of the data. However, the recent proliferation of digital models generated from LiDAR (light detection and ranging) data has led to the development of models based on the topographic level. In addition, they include the height of elements, such as vegetation and buildings. In practice, LIDAR data are obtained from laser pulses emitted and received by a scanner. The time difference between emission and reception allows researchers to calculate the distance of the objects and, thus, their height. This information creates a cloud with thousands of points from which the digital surface model (DSM) is calculated. The increasing use of DSM in the calculation of visual basins in scientific publications can be seen in Figure 1, which also show how the use of DSMs is increasing while the use of DTMs is decreasing, with a greater difference between the two types of models over time.

The use of DSM in the calculation of visible areas provides advantages over other models. Thus, Pellicer et al. [10] highlighted the advantages of using DSM over DTM in the calculations of visual basins due to the accuracy of the results, which were much higher in the case of basins developed with DSM (90% success) than those created with DTM (60% success). In the same line, Klouček et al. [11] also suggest the importance of using accurate digital models to properly model territory. Those authors also mention the use of DSMs as an appropriate solution, since they are based on highly accurate data. These LiDAR-based DSMs have a success rate in the visibility model created of around 90% [10], while those based on other models have a success rate of 75% [12]. Cloete [8] also points out the advantage of using DSM over DTM due to the higher accuracy of DSM, which increases success in results from 50% to 70%.

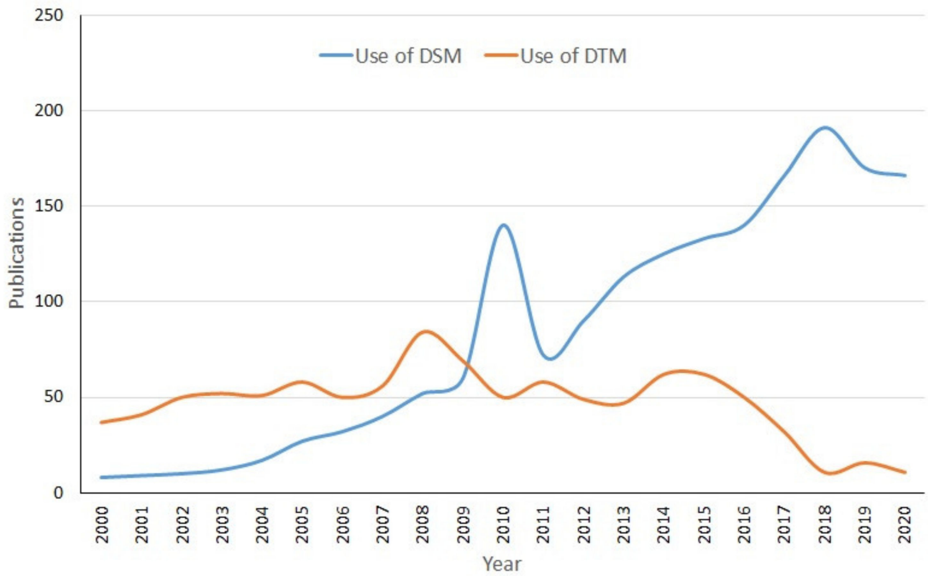


Figure 1. Differences in the use of digital elevation models compared to digital surface models in articles published in scientific journals. Data obtained from Google Scholar.

In Spain, the use of DSM data has also had a great rise thanks to the creation of these digital models by the Spanish National Geographic Institute for the entire Spanish territory. Thus, in 2020, the first DSM was created for the entire country with a pixel resolution of 5 m. Data were obtained between 2008 and 2015. In this work, the DSM with a 5 m pixel resolution has been used.

These models use binary visual basin algorithms, that is, the results show if a zone is visible or not from a certain point. However, Fisher suggests using algorithms based on probability of visibility [13], an approach that is not commonly implemented in GIS. In this work, the algorithm implemented in the plugin "visibility analysis v 1.7" of QGIS, elaborated by Zoran Čučković, was implemented. This algorithm calculates if a certain point is visible by a certain observer on a binary basis (yes/no).

One of the objectives of the present study was to consider the economic value of the dwelling characteristics and how the landscape is included among them, a current line of research [14]. In recent years, some of the more developed methodological proposals aiming at finding out the influence of the external factors of housing are those based on computational models. Some examples are artificial neural networks [15,16] and other algorithms, such as K-nearest neighbors or random forest, which try to overcome the linearity and inflexibility of hedonic models. However, the statistical regression techniques inherent to the hedonic methodology for identifying the determinants of the property price and for their quantification still play a fundamental role.

The calculation of visual basins is an essential parameter to assess the existing views from a dwelling. In general, the relationships between views and real estate value are part, together with many other variables, of the so-called hedonic price. However, in the determination of the hedonic prices, which are usually applied to estimate the economic value of environmental services in urban areas, landscape variables continue to have a relatively inconsistent treatment. In recent years, various regression models have been developed, which are often adjusted to very specific areas, but without explicitly including landscape variables. For example, Schläpfer, Waltert, Segura and Kienast [17] use data from Switzerland at a national scale to examine how land use, amenities, and environmental problems affect rental prices in the following four different segments of the housing market: urban, suburban, peri-urban, and prosperous communities. They provide a correlation report of all intrinsic and extrinsic housing services to identify explanatory patterns of price estimations. Additionally, Saphores and Li [18] based their study on the detached houses in Los Angeles to estimate the value added by urban trees and grass, distinguishing between irrigated plots with irrigation and rainfed plots, which are limited by water consumption costs. Meanwhile, also on the Spanish Mediterranean coast, Mora-García, Céspedes-López, Pérez-Sánchez, Martí, and Pérez-Sánchez [19] assess the explanatory factors of the price of housing in the province of Alicante, Spain. In general, the analysis of hedonic models of prices highlights four aspects linked to the landscape and the views:

The first is the proximity to certain components of the landscape. In this sense, the most positive effect is achieved with waterfronts, and particularly with views of beaches and the sea, which accumulate the highest scores, even more than 101.9% [20]. Other studies have also shown higher prices for dwellings oriented to lakes [21,22], rivers and creeks [23,24], golf courses [25–27], trails and greenways [28,29], or parks [30,31]. The golf courses are a very relevant element in the study area. Wyman et al. [32] calculated that the prices of undeveloped lots were 85% higher if they were in front of golf courses in good condition.

In addition to these key elements, other non-discrete elements, such as interstitial spaces or landscapes as a whole, also have an impact on prices. Several studies have established a number of other features of the landscape that generate comforts, such as the types of land cover in the surroundings of a house [33,34]. For example, mosaics and patches of green areas near houses are considered as a positive indicator, although they have a low impact on the price. In this line, Payton et al. [35] and Bark et al. [36] developed and applied a standard difference vegetation index (NDVI) through remote sensing according to the different green spaces surrounding the dwellings. Other landscape features highlighted in various studies are the presence of natural elements in non-urbanized plots [37], public open spaces according to their functionality [38], urban green spaces [17], urban tree covers [39], or the density and bearing of the vegetation [40].

The second main indicator is the quality of the views that focus on the positive assessment of natural environments. When both proximity to the perceived elements and the presence of relevant landscape types are considered together, the price increase is even greater. Benson et al. [41] recognized how proximity to and views of the ocean increased the price of housing by 147% in Point Roberts (EEUU). The pleasant views offered by natural green spaces, such as forests, have the possibility of being influenced by the risk of fires. In Alaska (EEUU), Hansen and Naughton [42] found that the impact on the value of real estate can oscillate depending on the perceived size of the fires. While small fires negatively affect housing prices, large forest fires increase housing prices, probably because they clear the visual basin and allow for farther views. There are also exceptions in urban areas, such as Hong Kong, where the results point out a preference for urban over natural views [43].

The third aspect is the quantitative dimension of the visual basin, although most of the studies assess this aspect in an integrated way with its qualitative value. In the literature, the most studied landscape element, and the one with the most convincing results, is the sea [44,45]. It is not only measured with the objective of estimating the price of the housing stock, but also from an urban point of view, and it aims to examine and characterize urban morphological designs according to the permeability to the coastal views [46].

The fourth aspect is the maximum depth of the view. Visible elements perceived from a distance can increase the viewer's visual satisfaction. As Kent et al. [47] pointed out, the positive effect of the maximum visible distance from the dwelling was greater for urban features and lower for natural elements.

Some research has already sought to deepen the economic implications of urban landscape components in an integrated way. They also consider other related criteria, such as accessibility to these territorial components in the housing market, as developed [48] in Shenzhen (China). On the other hand, we can highlight the proposal of Mittal and Byahut [49] that proposes the "Visibility index inspired by gravity". It is based on the design of an equation from two different matrices, as follows: a matrix of visible area and a matrix of distance to the views from the measurements taken from each sampled house.

Real estate stock is not homogeneous regarding the landscape and views. Some studies focus on distinguishing the influence of the landscape on the different types of dwellings.

The marginal impacts of physical characteristics are not constant: as high-level buyers value physical characteristics in a different way than low-level buyers. Zhang and Yi [50] point out that in Beijing, China, buyers of lower priced homes are mainly concerned about the existence of lake views, while buyers of higher priced homes prefer buildings with a high rate of vegetation and lower construction density. In addition, they diagnose a greater impact on the prices of the high-level group, increasing from 5% to almost 13%. One of the most common methods used in these studies is that of quantile regression, which makes it possible to identify significant variations in marginal impacts through the conditional distribution of housing prices [51]. With respect to the impact of the landscape, Lee et al. [8] found that views of the natural landscape unequally affect house prices by price range, with the highest marginal impacts on luxury dwellings.

3. Materials and Methods

3.1. The Study Area

The study area selected for the real estate analysis is the western area of the municipality of Benalmádena, on the coast of Málaga (Spain), and within the touristic Costa del Sol (Figure 2). However, the analysis of the views from this area also includes the rest of the municipality, as well as other adjacent municipalities to the west, such as Mijas and Fuengirola, and extends several kilometers into the sea. In total, the scope of the area analyzed would cover about 60 km^2, including the sea.

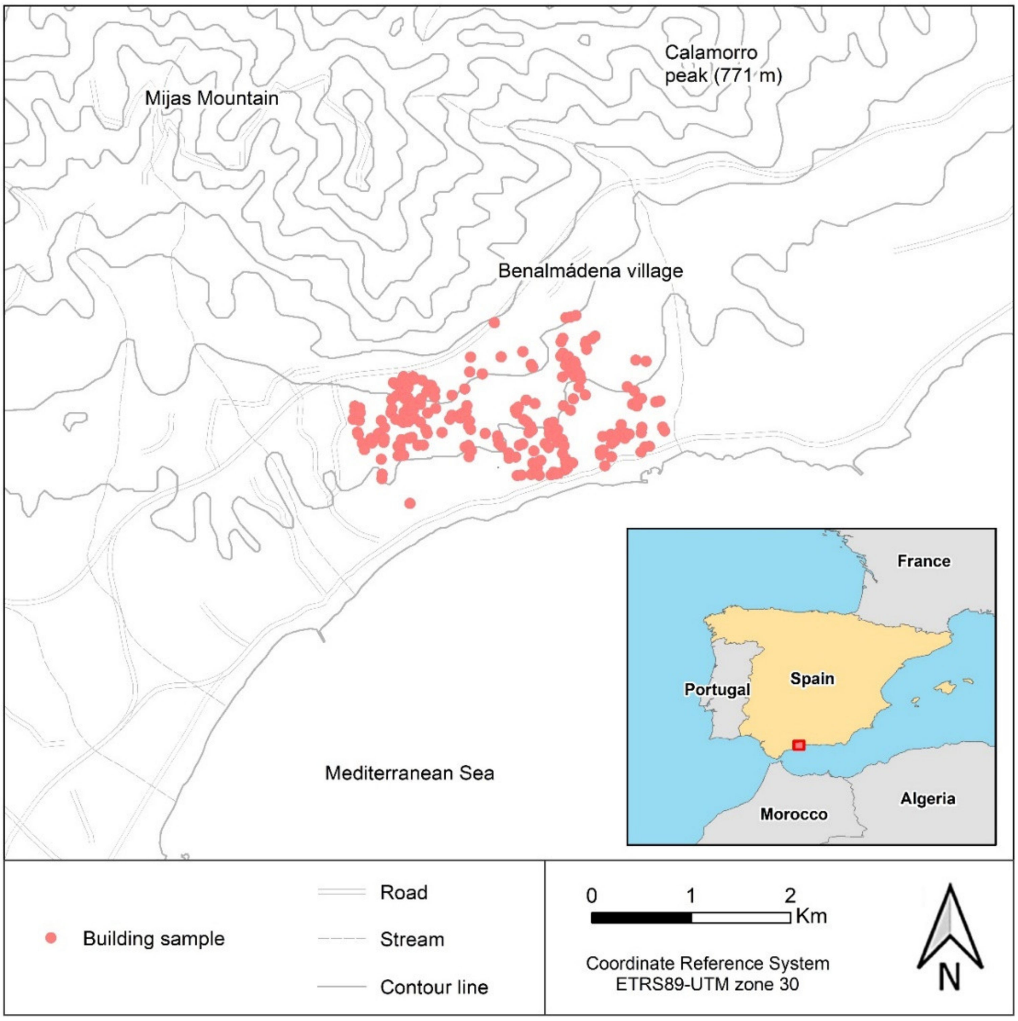


Figure 2. Location of the study area (own elaboration).

In general, the western coast of the province of Málaga is a highly urbanized area, due mainly to the development of tourism during the last half century, as well as to the recent metropolitan growth of Málaga City. As a result, Benalmádena has a considerable population size, with just over 67,000 inhabitants, distributed among the following several nuclei: the traditional (Benalmádena village) and the most recent nuclei of Benalmádena Costa and Arroyo de la Miel. Numerous single-family constructions, with a lower density, are extended among these nuclei, especially in the western part of the municipality. From an environmental point of view, the study area is located between a mountain range (Sierra de Mijas) and the sea. The mountains have step slopes due to their lithological composition (marble), reaching 1000 m above the sea level in just 4 km [52]. The urban development is located in the transition zone, between mountains and the sea. This area is arranged like a slipway, being formed of flimsier metamorphic materials, especially filites, and is configured as a succession of undulating hills, dissected by the hydrographic network, which descend towards the sea. The coastline, also rugged, is formed by cliffs with small coves between them. The arboreal vegetation is also relevant in the landscape. Paradoxically the density is low in the mountains, where the pine forest is dispersed. However, in the intermediate zone, the presence is higher, either along the river banks, or as vestiges of ancient tree crops and, especially, artificially introduced in plots and housing.

This set of characteristics has led to the choice of this area as the study area, as it is a territory which is under high pressure by both the process of intense urban expansion and the characteristics of the physical environment that favor the perception of very broad views from many points.

3.2. Methodological Phases

3.2.1. Determination of the Real Estate Sample

In this study, 226 single-family properties belonging to the first district of Benalmádena have been selected. The criteria used to select the sample were a homogeneous distribution of the points by the study area, which tried to cover all orientations and positions, including both the high zones and those located in depressed areas. Once chosen, the georeferencing process was carried out, generating a layer in points format in a central and elevated position of each reference housing.

3.2.2. Calculation of Housing Visual Basins

For the calculation of the visual basins, the plugin "visibility analysis" has been used, which is accessible from the free and open-source software QGIS 3.x.

This calculation has been made using the procedure described below:

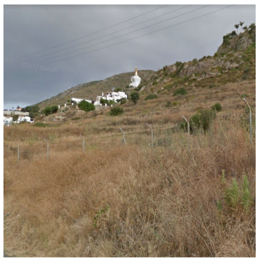
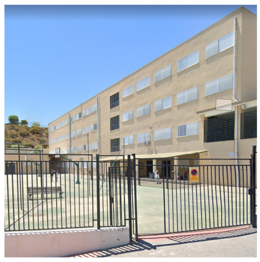
1. A layer of viewpoints is created for each of the dwellings in the study area. To do this, the polygon layer, representing the plots of the different urban buildings, is transformed into a point layer by calculating the centroid of each polygon (in this case, the layer has 226 observation points). This layer of points is associated with attributes referring to the height of the observer (in this study, a 1.65 m height has been used as the standard value of the inhabitants within the study area) and visibility radius. In this case, the radius is 30 km, which is equivalent to the visible distance from the top of a 50 m (16 floor) building. These data are 10 m above the maximum height of the buildings of the study area (12 floors, approximately), but this ensures visibility of areas, such as Málaga City, which is close of the study area, and is clearly visible.
2. After setting up the observation points, the visual basins are calculated with the viewshed algorithm with the default values for Earth sphericity and index of atmospheric refraction. In this work, DSM has been used to calculate the visual basins, that is, the land models that integrate the height of trees and buildings in the visibility calculations. This calculation process has been performed 226 times, that is, one for each point representing an observation point from a building in the study area. The result is a raster layer with the following binary values: 0 (not visible) and 1 (visible areas).

3. The visible surface value in square meters is calculated for each of the 226 visual basins. The visible surface is the result of multiplying the number of pixels of visible areas (value = 1) by the surface of each pixel and was calculated as being 25 m^2.
4. Finally, the values are grouped into five ranges according to their extent. so that they could be translated into a score to be entered into the final view quality equation.

3.2.3. Delimitation and Characterization of the Landscape Units Included in the Views

For the evaluation of the quality of the existing views from the dwellings, it was first necessary to create a map of the landscape units of the study area. Table 1 shows examples of the twelve landscape types delimited based on vegetation cover and land use, leaving aside geomorphological aspects that could generate problems of interpretation with the scale of study.

Table 1. Landscape types considered.

Wood	**Crop Mosaic**	**Urban: Multifamily**
		
Golf course	Sclerophyllous scrub	Urban: single family
		
Sea	Shore	Urban equipment
		
Road and rail network	Traditional urban fabric	Mining areas
		

Source: Images taken from Google Street View and Google Maps.

The delineation of the landscape units extends beyond 3 km of the territory on which the sample of buildings is based, in the same way as the measurements of the visual basins.

This distance was set based on the geomorphological characteristics of the study area, given that it is not possible to observe further in some directions, especially to the north. In this way, once the proportions in the type of views are logical, this distance has been taken as the radius towards all the orientations.

3.2.4. Calculation of the Distance from Each Dwelling to Each Landscape Unit

Apart from the visible surface and the quality of the perceived landscape types, the value of the views is related to the proximity and sharpness of the views that each house has of the different types of landscape units. Therefore, a proximity calculation was performed, generating a layer of points with the centroids of the residential plots. The ArcMap tool "Generate Near Table" was applied to this layer, considering the one containing the landscape units as the target layer.

3.2.5. Calibration of the Final Equation

The views must be evaluated by taking into account the extension that covers the visual basin, the quality of the contents included in them, and their proximity. This formula assigns greater weight to the quantity and quality of the views, reducing itself as the distance from the property to the landscape unit increases.

A categorization of the variables included in the analysis was performed in order to synthesize and reduce the complexity of the analysis of the quantitative and qualitative aspects of the landscape. A scale has been chosen from 1 (lowest landscape value) to 5 (highest landscape value).

For the estimated extension of the visual basin from each dwelling, the criteria followed for grouping the cases were based on marked quantitative differences. Considering the natural breaks of Jenks as orientation, we did not prioritize the size of the intervals by the number of cases included in each interval, nor by the distance between the minimum and maximum values of each interval.

With regard to the qualitative information, landscape units and their distances have been treated in an integrated manner. In order to determine the distance at which certain landscape elements are considered within the foreground, the proposal made by Escribano Bombín [53], which established a generic limit of 500 m, was considered. In the case of transport infrastructures, they were always considered as a negative factor when they were perceived less than 100 m away, resulting in a weighting by 0.9 of the result previously calculated. Table 2 below shows the criteria for each category depending on the type of landscape and the distance to the units.

Table 2. Synthetic typologies of the views.

Score	Remarkable Elements in the Views	Landscape Typology
5	The sea is perceived in the foreground, dominating the views	First coastline
4	The sea is perceived in a distant plane, although it dominates the views	Second–third coastline
3	Presence of low plant cover, due to the sum of areas of vegetation in a degraded state and the plots that are expected to be urbanized	Great vegetation presence
2	Visual basin with greater presence of constructions belonging to the urban area	Urban view areas
1	Low aesthetic appeal views, in which the sea is secondary	Mosaic of views, with predominance of the sea and the presence of scrub

Figure 3 below shows a diagram summarizing the methodological procedure followed:

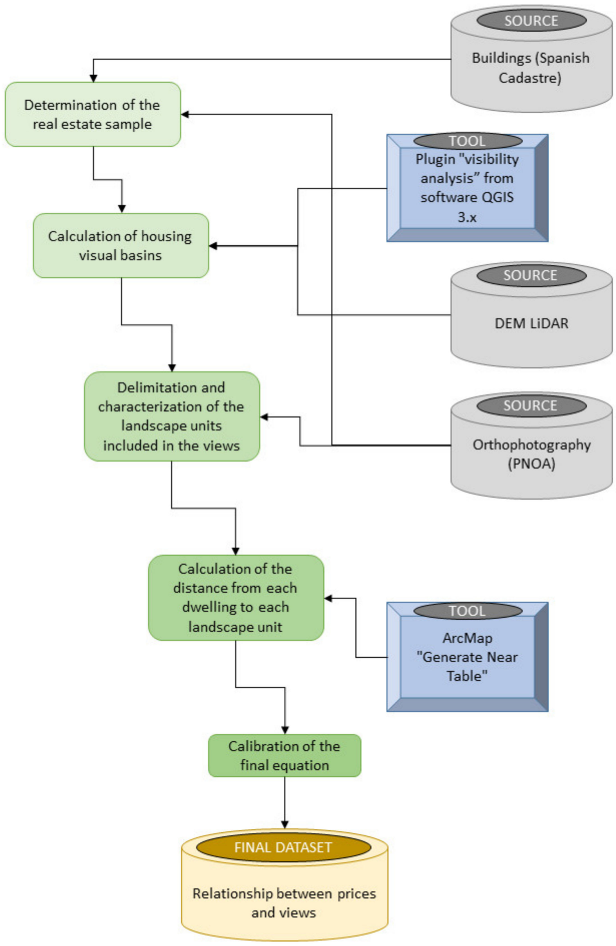


Figure 3. Explanatory flowchart of the methodological procedure.

3.3. Sources of Information

The information processed in this methodology comes from the following sources, according to the typology of the information:

The information on the economic value of the real estate was calculated following the estimation provided by the General Directorate of the Cadastre, which are the reference values for the tax base of Spain since 2022. Since the available information is on a zonal scale, bringing together several blocks, the price per square meter has had to be weighted according to the area of each of case.

The georeferenced information source for each variable is summarized in Table 3 below:

Table 3. Primary information sources of the processed data.

Variable	Sources
Real estate price	Reference values of the General Directorate of the Cadastre
Urban plots	Georeferenced information layer "Plot", from the Electronic Headquarters of the Cadastre
Visual Basin from each property	Georeferenced "Plot" layer from the Electronic Cadastre Site
	Digital Surface Model LIDAR 2nd Coverage (2 m × 2 m), from the Spanish National Geographic Institute
Landscape typologies	European Urban Atlas (2018), a product belonging to the Copernicus Programme of the European Union.
	PNOA Digital aerial orthophotography
	Fieldwork

4. Results

4.1. Characteristics of the Visual Basins

4.1.1. Direction of the Views

Due to the topographical characteristics of the area and its urban and architectural use, the predominant orientation of the visual basins of the dwellings belonging to the study area can be seen in Figure 4.

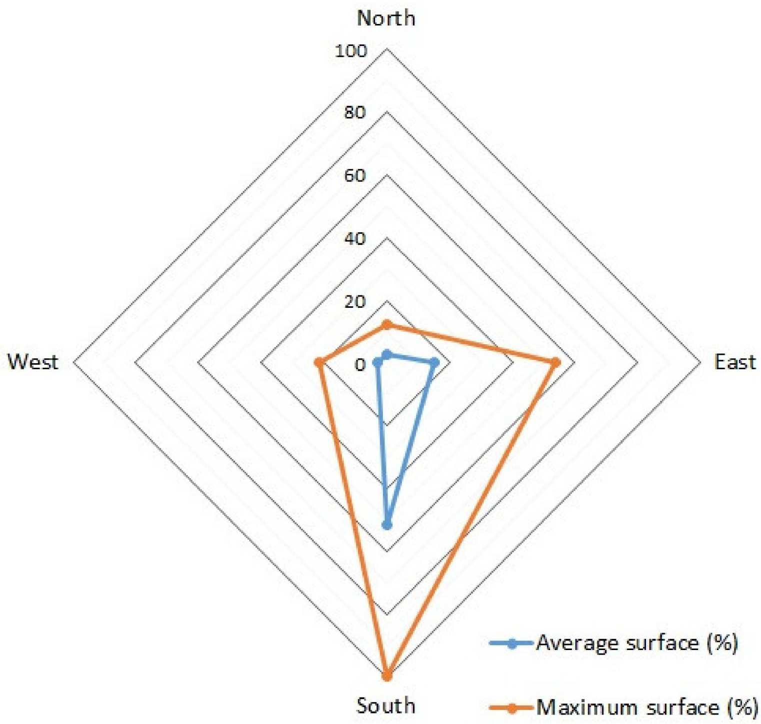


Figure 4. A more detailed analysis of the views according to their direction.

The views have their gravity center strongly displaced to the south–southeast, where the sea can be directly observed from most of the dwellings. Figure 5 provides a more detailed analysis of the views according to their direction.

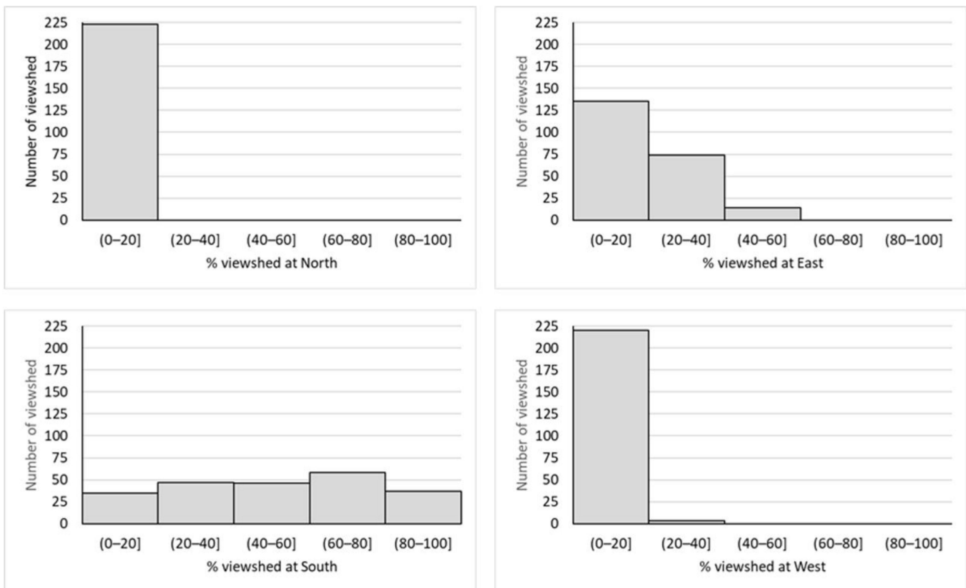


Figure 5. Percentage of visual basins emitted from dwellings according to their main orientation (own elaboration).

Overall, it can be seen that most of the dwellings combine views of more than one orientation, although views to the south are predominant, and there are only a few cases in which this is not the case. On the other hand, less than 100 dwellings have between 60% and 80% of the views facing south. Another remarkable aspect is that less than 10% of the dwellings have more than 40% of the views facing east.

Figure 6 allows us to know, beyond the orientation, the spatial patterns of the views contemplated from the dwellings belonging to the study area, depending on their main orientation.

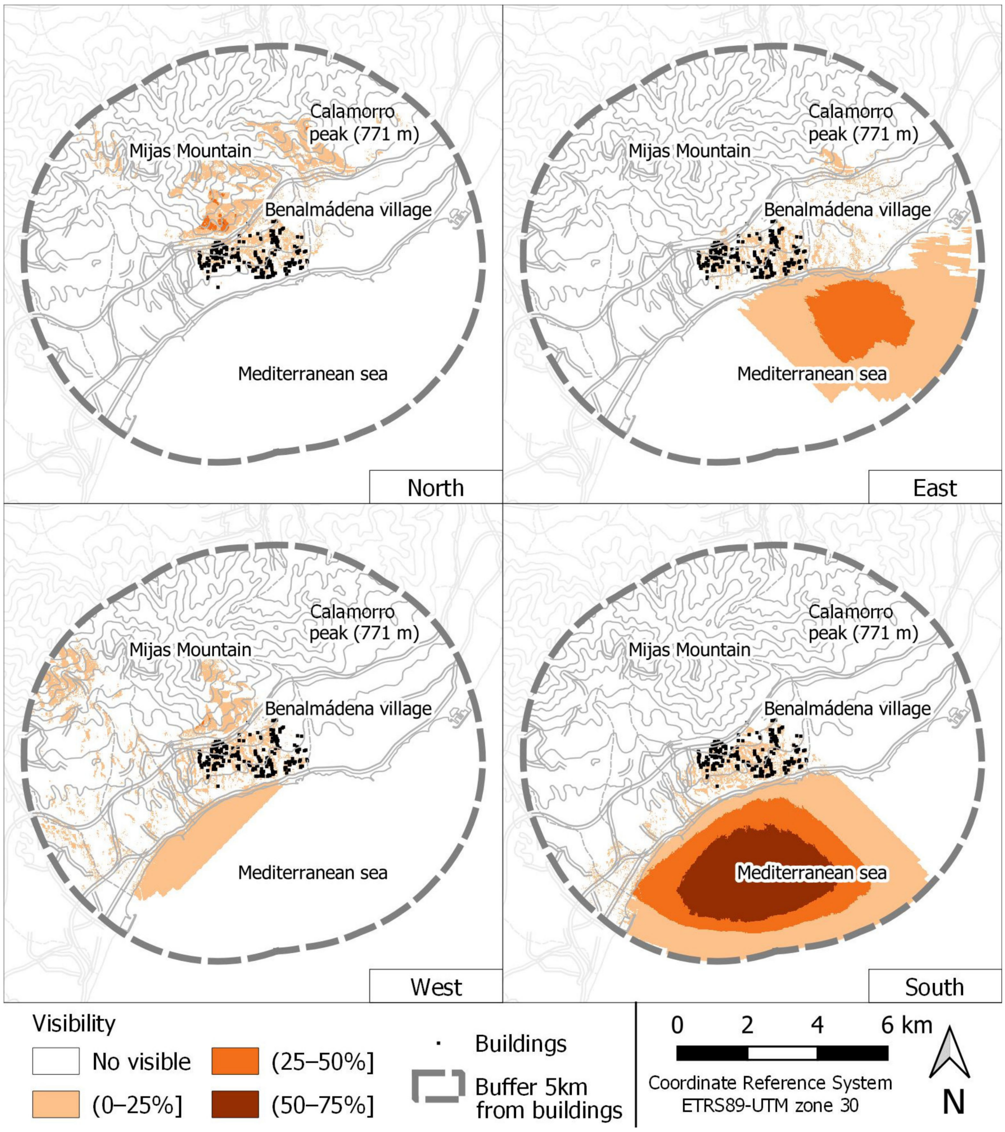


Figure 6. Areas of greater visibility from points selected at each cardinal point (own elaboration).

It can be seen how, together with certain points of great exposure to the north, the most common views are concentrated on the sea, to the south of the study area. To both the east and west, the visible land areas are much more dispersed. They vary between the study cases, and tend to coincide, again, towards the sea, which is most common in the south-facing views. Other points with some relevance can be observed to the north, although they are much more concrete and coincide with the highest areas of the Sierra de Mijas. Figure 7 shows the visibility of the study area towards all directions.

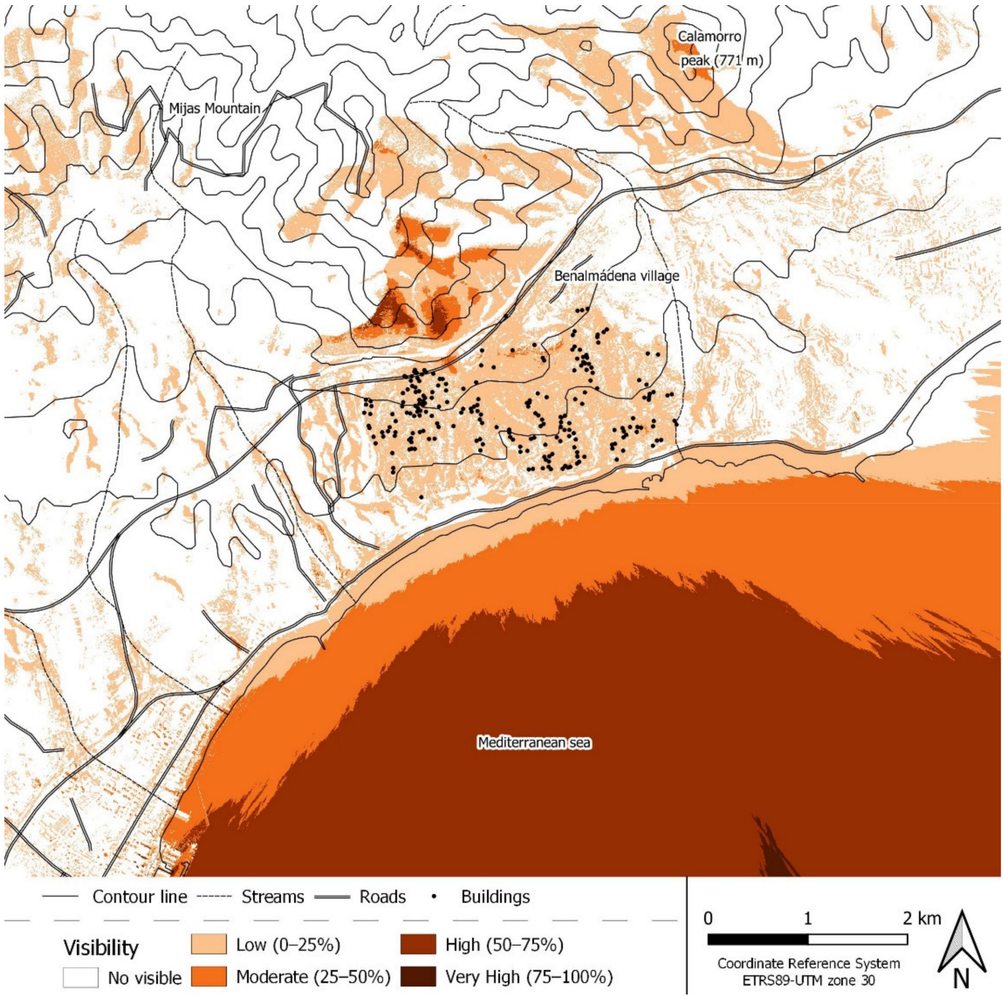


Figure 7. Concentration of views according to the percentage of dwellings from which it is perceived (own elaboration).

4.1.2. Views Size

Visual basins have been calculated from the 226 selected points, ranging from 146 m^2 to 853,185 m^2. Table 4 shows the categories specifically designed for the study case, in which Jenks natural breaks have been considered, together with the implications of the different size of the visual basins, with the aim of creating intervals with a proportionated number of cases.

Table 4. Categorization of the views by extension.

Category	Surface (m^2)	Cases (%)
1	<1000	0.4
2	>1000–<270,000	40.7
3	>270,000–<435,000	20.4
4	<435,000–595,000	22.1
5	>595,000	16.4

Although the vast majority of dwellings have a high position, the territorial layering towards the sea has determined that factors, such as the orography and the vegetation that delimits the boundaries of the plots, have influenced the results of the visual basins. As it can be interpreted in Figure 8, the main pattern behind the size of the visual basins is the topographic position of the dwelling. The topographic descent towards the sea is not homogeneous and is characterized by a succession of hills separated by small rivers and creeks. In this way, the dwellings located on the northern slope or in an intermediate zone between hills have smaller visual basins. This phenomenon is clearly observed in the western part of the study area, where a series of houses with visual basins lower than 270,000 m^2 are adjacent to others at the southeast, with visual basins greater than 435,000 m^2. Other explanatory factors are nearby higher buildings, or the presence of high vegetation used to delimit plots, which explain smaller visual basins, in red in Figure 8.

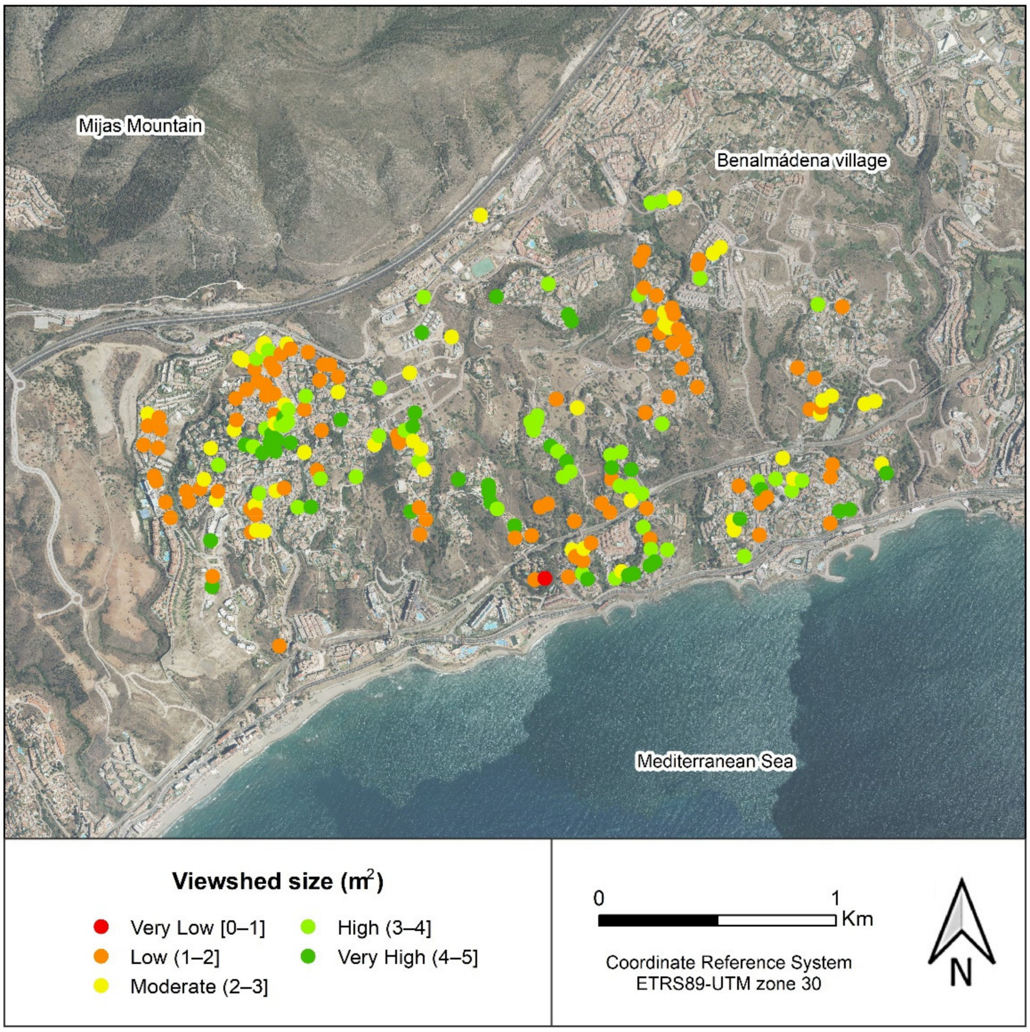


Figure 8. Buildings analyzed according to the size of the visual basin (own elaboration).

4.1.3. Contents of the Views: Landscape Units

The landscape of the study area is structured in two parts, separated by the A7 highway. To the north is a mountain wild area with natural vegetation, and, to the south, there is an area where different urban types predominate, alternating urban areas with suburban developments and peri-urban spaces (see Figure 9).

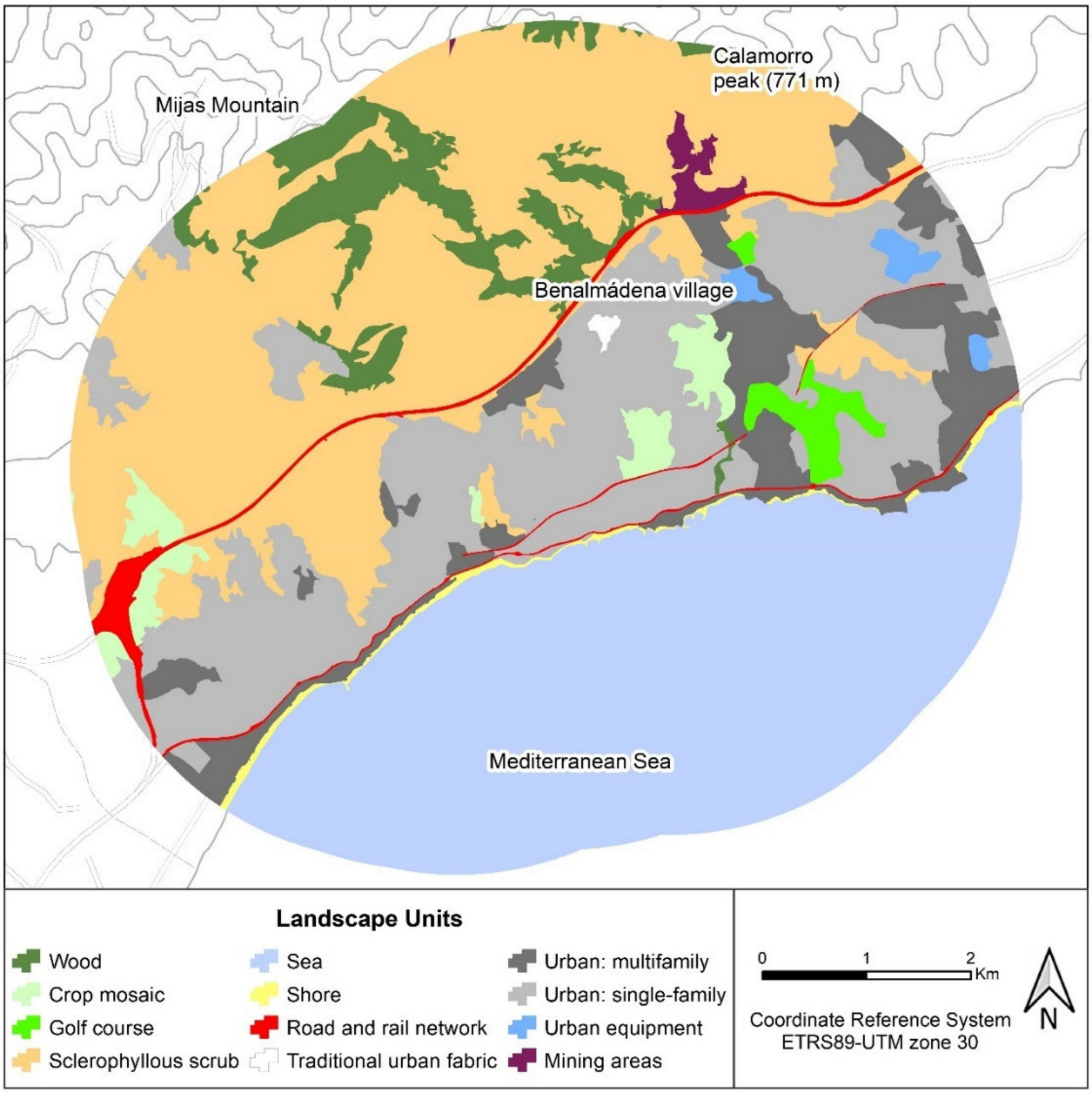


Figure 9. Landscape units of the study area (own elaboration).

An extensive and polynuclear urbanism predominates with an interstitial space of scattered dwellings. The densest and largest vegetation cover used in private spaces and plot boundaries is within urban units. The rest of the arboreal vegetation cover (forests) is very scarce, and is gathered in the northern part of the study area, predominating a zone of low scrub among the natural vegetation. The most important extensive (e.g., golf courses) and punctual (e.g., health and educational centers) landscape equipment is located in the eastern part. Finally, it should be noted that the selected study area is constrained between the two most important road transport routes in the region, and that it is also crossed by the railway to Málaga.

4.1.4. Assessment of the Views' Quality

Figure 10 shows the synthetic evaluation of the views from the sample buildings, following the criteria set out in Methods.

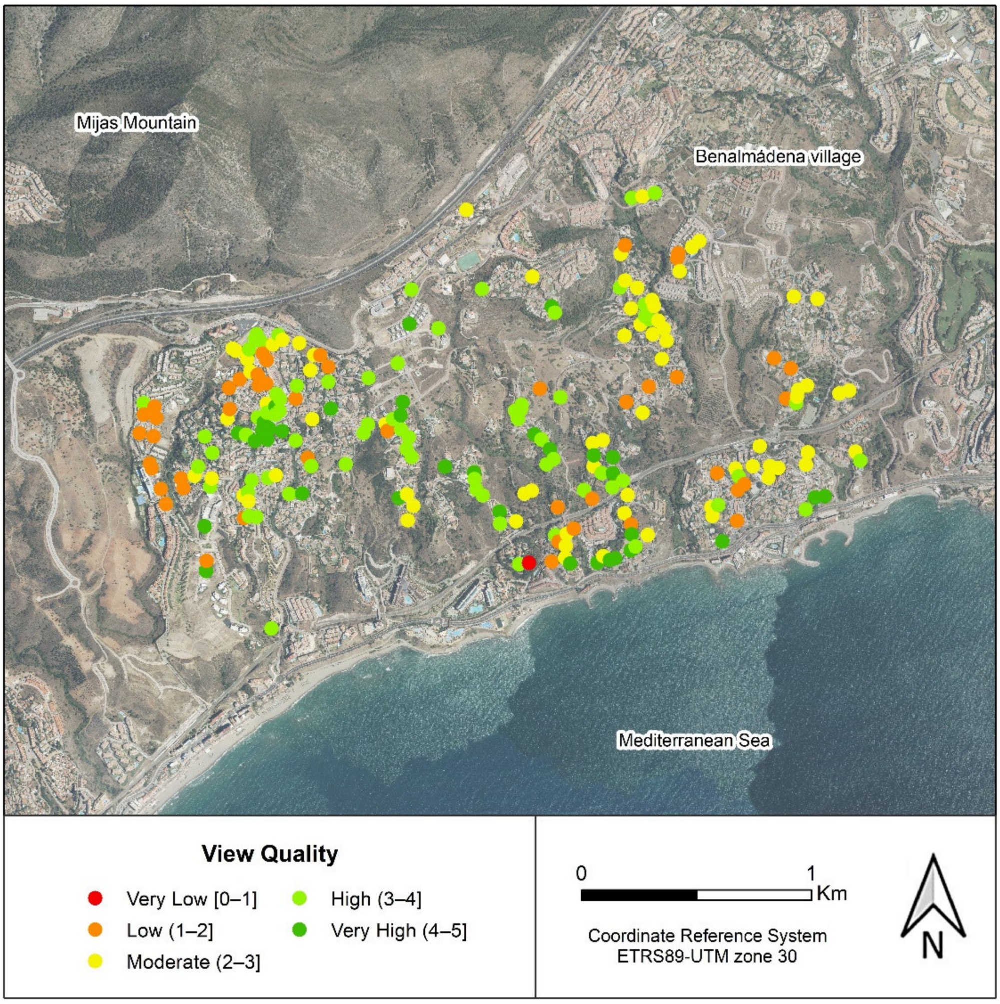


Figure 10. Buildings analyzed, according to the view quality index (own elaboration).

The distribution of the best views does not follow a clear spatial pattern, although it delimits areas where the highest quality views predominate. As an example, there is a clear division between the slopes of a hill in the western part. The score at the northwest slope ranges between 1 and 2.5, given that a recurring element of its views is the Mediterranean scrub, with moderate–low aesthetic appeal. On the other hand, the southeast slope, with a better orientation to the sea, includes numerous points with the highest quality views.

Another axis where high quality views predominate is the coastline, where, logically, the sea views are greater. Paradoxically, there are also cases with the worst score, which can be explained by a position at a lower height, where views are obstructed by a row of very tall and dense trees. Dwellings in the second coastline have lower scores due to the higher density of construction. Constructions located between hills also have lower scores than those placed on the top.

4.1.5. Dependent Variable: Real Estate Value

The average price of the 226 dwellings analyzed is 624,747.65 €. This is a high value in the context of the Spanish real estate market, which is mainly explained by the touristic character of the area and the attraction generated by the proximity to the sea. However, as can be seen in Figure 11, the sample is heterogeneous, with a huge price variability. Indeed, the standard deviation is 440,279.33 €, and the coefficient of variation is 70.47%.

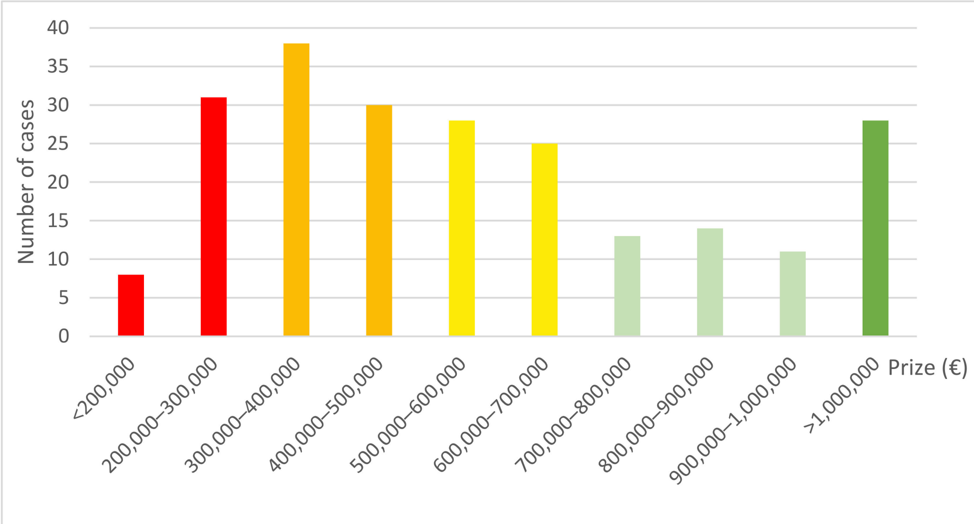


Figure 11. Histogram of the prices in the sample (own elaboration).

The sample has a high price range, from 51,696 € to 3,339,440 €. However, most real estate ranges from 200,000 € to 700,000 €, with the most noteworthy segment being between 300,000–400,000 €.

From a spatial point of view, the distribution of the value does not provide a clear distribution pattern, as shown in Figure 12. There is a certain trend in the location of houses with higher prices in the areas closest to the sea and the coastal road, as well as in the upper hills. On the other hand, lower prices are usually found in more dense urban areas.

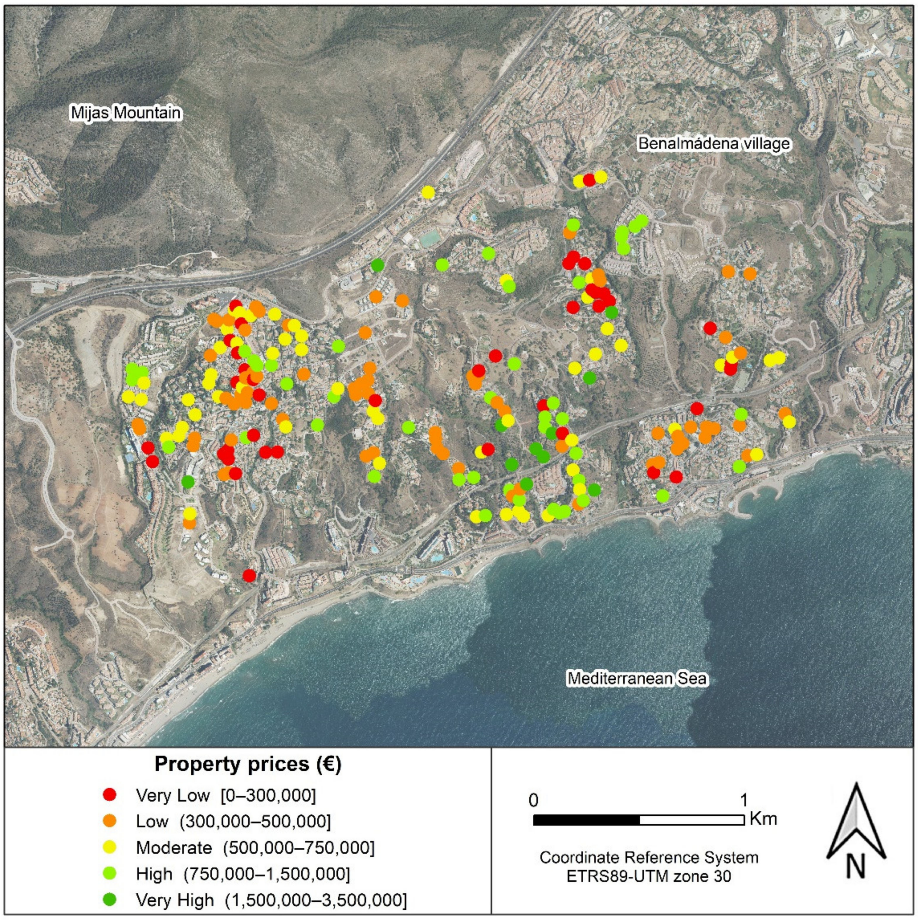


Figure 12. Estimation of real estate prices (own elaboration).

4.1.6. Relationship between Prices and Views

Different statistical parameters were used to analyze the relationship between these two magnitudes. First, the Pearson and Spearman coefficients were applied to the database. Pearson's correlation coefficient measures the strength and direction of a linear relationship between two random variables from the raw data, while Spearman's correlation coefficient is based on the ranked values of each variable. These indexes showed the absence of direct correlation between prices and the following: (a) the dimensions of the visual basins (Pearson = −0.025; Spearman = 0.080); (b) the landscape types (Pearson = −0.047; Spearman = −0.046); and (c) the landscape quality value (Pearson = 0.045; Spearman = 0.002).

Due to the low correlation between price and views, the analysis was based on average prices of dwellings with similar visual basins. As indicated in Section 4.1.5, the sample contains great price variability. Therefore, the values of the coefficients of variation of the averages will also be high, although, as it can be seen, in many cases they are significantly reduced.

The mean values show an increase in the average prices in dwellings with larger high-quality views. Thus, the average price of dwellings whose visual basins are less than 0.5 km^2 (592,892.5 €) is 18.1% lower than those with visual basins greater than 0.5 km^2 (700,344.2 €). In both cases, the high coefficients of variation decreased with respect to the general variability of prices, standing at 59.9% and 63.7%, respectively.

Regarding the content of the views, the same trend with smaller differences is observed. The average price of dwellings with values lower than 3 is 607,427.6 €, rising to 634,671 € when the values are equal or higher than 4, which is an increase of 4.5%. In the most extreme ranges (values below 2 or above 4.5), the price increase is much higher (38.7%). However, it should be noted that the number of cases included in these groups is low.

As indicated in Methods, a synthetic index of the quality of the views combining both the extension of the visual basin and the quality of the types of landscape has been made. In this parameter, scoring from 1 (lower quality) to 5 (higher quality), the price of scores above 3.5 (656,975.1 €) is 10.1% higher than the average of scores below 3.5 (596,280.1 €).

Price averages have also been analyzed on the basis of the distances between dwellings and certain elements (e.g., the sea). In this case, the price differences between dwellings located near or further from the sea are significant. Among those located at less than 500 m, the average price reaches 715,091.9 €, 20.6% higher than the average of dwellings located further than 500 m (592,829.62 €).

Finally, to corroborate the results obtained, the frequency of existing cases in each price interval has been analyzed according to the size of the views (Table 5).

Table 5. Distribution of the dwellings analyzed by price interval and visual basin size.

		Visual Basin Size (m^2)					
		<500,000	**%**	**>500,000**	**%**	**Total**	**%**
Price (€)	**<400,000**	56	72.7	21	27.3	77	100.0
	400,000–800,000	67	69.7	29	30.3	96	100.0
	>800,000	36	67.9	17	32.1	53	100.0
	Total	159	70.4	67	29.6	226	100.0

As it can be seen, there is an increase in the percentage of cases with large visual basins when the price interval is higher. Most dwellings have visual basins smaller than 0.5 km^2, but the percentage decreases when the price increases. Thus, in the highest price interval, the percentage of dwellings with large visual basins (32.1%) is 17.6% higher than in the interval of lowest prices. In addition, in the segment of >1,000,000 euros, the percentage of basins greater than 500,000 m^2 are in the majority (53.5%), decreasing with those being lower than 500,000 m^2 to 46.4%. On the other hand, in the interval of less than 300,000 euros, the percentage of visual basins smaller than 500,000 m^2 reaches 82%, while the percentage over 500,000 m^2 is only 17.9%. Therefore, there is a clear connection between more expensive dwellings with larger visual basins, and this is even more emphasized in the extreme intervals.

5. Discussion

The average analyzed prices present an increasing trend related to the presence of wide high-quality views. However, this trend is framed within a high price variability influenced by multiple factors. The price increase is more related to the size of the visual basin, that is, the extension of the views, and, in a smaller proportion, to the quality of the views. Among other potential causes, it should be taken into account that the entire study area has similar environmental characteristics and urban types (e.g., most of the dwellings have sea views). Therefore, we can predict that the trend would be more noticeable in heterogeneous areas.

It must also be emphasized that the real estate offer in the selected zone is fairly homogeneous. It oscillates between a medium-high and a high level. The infrastructure role is relatively small, since the range of services and communications is homogeneous, avoiding the spatial fragmentation. In this way, the main factors involved in the price are mainly those intrinsic to the dwelling itself (e.g., size, quality of construction, gardens, and facilities, such as swimming pools), along with others, such as accessibility, the social prestige, or the quality of the environment.

There is not a direct correlation between prices with the dimensions of the visual basins, nor with the types of landscape. This may be explained by the involvement of multiple factors, among which can be highlighted the views themselves, along with others, such as the size of the dwelling, its location with respect to services, roads and equipment, or social prestige. In addition, the weight of each factor has a great variability depending on the case. Following this approach, similar views may play an important role in the price of a dwelling, but the relevance is lower when considering the size and the facilities of the house. Therefore, in this work, the analysis of average prices was based on different variables. These average prices are highly variable, however, as has been highlighted, and are lower than the standard average prices.

In this study, the proximity to the landscape units has been considered and integrated into the qualitative dimension of the views. Unlike the proposal of Benson et al. [41], which uses estimated coefficients of both the fictitious variable of the view and the variable of the view and its distance, this research studies the different components of the views in an integrated way, creating a series of synthetic categories according to the quality of the views. In this way, those landscape elements with low relevance in the views of the study cases have not been considered, in order to avoid a disaggregation and confusion of the types of views. In this study, as in the studies of Benson et al. [41], Goetgeluk, Kauko, and Priemus [54], or Conroy and Milosch [20], the economic impact of the visual attraction of the sea is observed. However, unlike Benson et al. [41], an inverse relationship between the value of the sea view and its distance has not been identified. While Bellingham (Washington, DC, USA) is located in a flat territory with industrial and port infrastructures on the first coastline, Benalmádena is located in a territory of marked slope oriented towards the sea with a predominantly residential function, so quality views to the sea can be obtained from further afield.

On the other hand, it has been found that prices are higher in the area closest to the sea compared to areas further away, although those prices are only related to non-landscape factors, such as the accessibility to the sea and, in this case, to the main roads. In this regard, the characteristics of the study area seem an additional factor to consider.

Despite the multiple factors influencing the prices and their statistical weight, the study presents significant results. Indeed, the statistical correlation is strongly conditioned by the multifactorial character of the prices. The size of the sample is medium (226 cases) and includes single-family houses with heterogeneous characteristics. Given that practically all of them are arranged in a bleacher towards the sea, it is hard to compare the importance of the views with dwellings without sea views, as is the case in larger urban centers. Therefore, the sample represents a specific type of urban area, the coastal touristic zone of any coastal city. In this line, the average price of the sample is high, 624,747.65 €, a high average value in Spain, and even for the study area.

One aspect to consider in future research is the relation between the visible outer façade of the house and the opening of the views, since it can introduce explanatory nuances of the price. The methodology developed in the present study is 50% based on the visual basin from the house, weighting upwards the larger visual basins. However, housing in certain urban contexts may be given preference due to intimacy and privacy concerns over other attributes, such as views, although both are not necessarily exclusive. This means that the valuation of the magnitude of the views, even for inhabitants of the same real estate segment, can greatly fluctuate.

6. Conclusions

The average prices in each price segment showed an increase in average prices in dwellings with wider views of a higher quality. Among the different parameters analyzed, it can be noted that the average price of dwelling with wide visual basins is 18.1% higher than in those with smaller visual basins.

Regarding the proposed method to analyze the quality of the views, the success in integrating the different qualitative and quantitative aspects that compose the views from each building is taken cautiously, and further tests will be required to verify its usefulness. Those tests may include data obtained through other techniques, such as photography, with the aim to enrich the characterization of the views, since both the proportion of the landscape elements and their location influence the composition of the views. In short, the methodological proposal is reproducible in other areas, although the categorization of the types of views and the intervals of the extent of the views should be adjusted to the territorial characteristics of the area where it is applied.

This study has proven the difficulty of finding a correlation between the quality of the views from the houses and their price. As was also stated by Benson et al. [41], the value of the views could vary greatly, depending on the quality and scarcity of the types of views, and the characteristics of the urban development.

On the other hand, understanding people's preferences for the surrounding landscapes and how preferences shape the territory is not only an academic challenge. It also offers an applied dimension in relation, firstly, with the formulation and implementation of policies (e.g., at the local scale, it can be useful in the delimitation of urban expansion areas, as well as in determining the building typologies that best fit the landscape environment, in a way that does not compromise it), and, secondly, it is also related to its usefulness for the sustainable exploitation of an economic asset, such as the landscape.

The main future line of research has to focus the analysis of specific real estate segments with similar intrinsic characteristics in order to obtain results with greater statistical certainty. Another potential future application is the introduction of indicator values in a spatial spillover model, where the ecological welfare performance of larger territorial units can be studied. Undoubtedly, urban development and the consequent privatization of spaces will affect visual quality as a public resource. Other additional information of interest will be to determine the relationship between the visible outer façade of the house and the opening of the views, as well as to assess the composition of the views from several shots.

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methodological proposal developed. All authors have read and agreed to the published version of the manuscript.

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