

Article

A New Spatial Criteria Method to Delimit Rural Settlements towards Boundaries Equity: Land Use Optimization for Decision Making in Galicia, NW Spain

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Abstract: Rural settlements (RS) are a reality of rural areas. They consist of cluster of buildings and ways of life mainly associated with activities related to agriculture. As economic policies applied in rural development have evolved, the physical delimitation of rural areas has become more important because such areas are recipients of financial support, which depends on an area's characteristics. Thus, it is necessary to formulate a new spatial approach for RS delimitation. The objective of this study is to define spatial criteria for identification and delimitation of the RS to recognize the morphological context of each RS. With respect to methodology, RS in the community of Galicia, Northwestern Spain were studied, and factors for spatial characterization were defined according to experts' evaluations. Subsequently, spatial restrictions and conditions were identified for the delimitation of boundaries. The criteria that this research proposes reveal numerically adjustable factors that can recognize and interpret the morphological characteristics of each RS, which is also evidenced by the results of RS delimitations. It can be concluded that the numerically defined criteria associated with a spatial operation allow the adaptation to the morphological characteristics of any RS, as well as spatial equity by recognizing the differentiation of building structures and land uses of each RS, rather unlike the criteria defined by the law.

Keywords: rural planning; rural settlements; physical delimitation

1. Introduction

Rural settlements (RS), such as those in the northwest of the Iberian Peninsula subject to this research, are located in the spaces between cities. They are models of representative population settlement in rural areas presenting a variety of interesting cases for the analysis of territorial planning, management of land use, vernacular architecture and sociology. RS represent a reality of space and rural heritage [1,2] through their built structures and way of life essentially associated with agricultural activities. RS are small clusters of buildings where housing and activities related to agriculture are predominant [3] in which traditional forms reflect an identity [4,5] and represent social and cultural constructions [6–8].

Although some socioeconomic conditions and contexts could differ [9], spatial organization patterns could be similar in developing countries for the purposes of comparing rural identity associated with the built-up environment. Thus, the main function of the surroundings of primary activities and the oldest buildings is residential as a spatial organization design [10,11].

The spatial structure is established by relationships with neighbors and the built space is distributed as a function of spatial elements, such as a square, road structure or the existing topography. The parcel structure is a factor that influences the spatial organization of the settlement due to the size and shapes of each plot. All these and other factors such as proximity to roads and types of buildings and their functions interfere in the delimitation along spatial lines.

Urban–rural relations have been widely studied whether from perspectives of territorial density or socioeconomic contexts. According to Zonneveld [12], urban–rural relationships deal with functional linkages between urban and rural areas. In recent years, the concept of urban–rural relationships has emerged as a way of challenging this long-standing and persistent dichotomy and promoting an integrated conception of cities and countryside based on both their spatial and functional interdependencies [13]. Nilsson stated [14] the peri-urban zone is a transition zone where rural–urban linkages are particularly intense, and the rural and urban features coexist in the peri-urban zone. In this context, the peri-urban zone is intimately associated with the transition from a dense urban structure to that of a rural character [15].

Some studies, such as the one carried out by Serra [16], analyze the variables that have shaped the urban–rural relationship in Spain over the last 20 years. Zhao [17] examined urban–rural integration initiatives from the perspective of mobility in the urban fringe and rural areas. Other studies focused on landscape transitions, such as Pedroli [18] identifying types of recent transitions in landscapes and discussing the potential of new governance approaches at the local level. Moreover, Primdahl [19] addressed how combinations of drivers, including combinations of change perspectives affecting today's landscapes, challenge rural landscape governance.

Spatial identification methods are also relevant in the planning context due to the linkage within municipal land use planning, as well as their regulation. A new definition and classification of urban and rural areas emphasizes the morphology of rural settlements. Bibby [20] and Goncalves [21] presented a transdisciplinary approach applied to the Lisbon Metropolitan Area to identify typologies of peri-urban areas. Tang [22] examined how to optimize the spatial organization of rural settlements through three aspects—the integration of rural settlement spatial functions, optimization of spatial structure, and regulation of spatial scale. Mortoja [23] developed a valuable contribution to identify which methodological approach is most appropriate to demarcate peri-urban areas based on a broad geographical view. Nevertheless, Cattivelli [24] considered the classification methods traditionally used to identify peri-urban areas based on the distinction between urban and non-urban areas as no longer functional to describe the territorial outcomes of these transformations.

It is important to contextualize past studies for an adequate perception of the evolution of the characteristics and classifications that contribute to the identification and spatial delimitation of RS. Dickinson [25] identified two types of RS, isolated and nucleated (clustered) ones, classifying them by their size and clustering. Smailes et al. [26] classified the RS as scattered, grazing agglomeration and RS agglomerations. According to Jones [27], the spatial distribution of the built structure is what defines the differences between scattered and concentrated RS. Stone [28] suggested defining RS as a description and analysis of the distribution of the buildings associated with the people and their own land since the buildings represent the way of life in this area. Murkeji [29] analyzed the morphology of the RS in a region of India according to the type (based on functional relations), the shape (geometric contour of the group of buildings and roads) and the pattern (geometric set of several RS with correlation to natural and cultural characteristics). Donnelly et al. [30] defined homogeneous groups of RS and described the common features. Grossman et al. [31]

identified the spatial pattern of RS in Israel based on building density, the field system, the physical size and the presence or absence of RS.

Recent studies have proposed a RS type classification by their economic resources, accessibility and production method [32–34] or the spatial separation between the residential area, agricultural area and their activities in order to achieve more compact RS, as well as more objective boundaries to achieve productive agricultural land [35]. For Vuksanovic et al. [36], the typical RS morphology is the formation of clusters as groups of buildings near to each other. Feng et al. [37] considered RS morphology by distinguishing between concentrated and uncompact, while Theodoraki et al. [38] distinguished RS shapes between regular and irregular with the surrounding farmlands. According to Günċe et al. [39], RS are organized according to the topography as harmony of the environment in contrast to a geometric organization, while Johansen et al. [40] showed that for the conception of rural character, open space with several types of land cover where there was a concentration of residential buildings and other functions is important. According to Banski et al. [41,42], the successive periods of RS development promote spatial differentiation, creating many RS systems, as well as a morphogenetic diversity of various types of RS.

These latter studies are not limited to identifying the spatial distribution system of the RS as is the case in the aforementioned studies; on the contrary, they expand the analysis to formal and functional characteristics of RS. Among them, the most recent studies reveal an approach to the RS space with a view to establishing relationships between space and place [43,44] by distinguishing functional areas outside the RS, as well as considering them as organic structures [45–47]. Most of these studies focused on the analysis and characterization of RS, whereas this research establishes and defines criteria for the identification, delimitation and zoning of the physical area of the RS.

As economic policies on rural development evolve, the physical demarcation of rural areas takes on more importance since these areas are assigned as recipients of financial support according to their characteristics. Therefore, the appropriate delimitation [48] of RS in the context of the European countryside assumes preponderance by association with new identities and social–economical relationships [49,50]. Since the rural space takes up a broader dimension than agricultural production [51], an identification of the different areas enhances the differentiation of policies adjusted to different contexts [52,53].

Currently, the rural space continues in a process of transformation due to the intensive land use and agricultural industrialization [54], resulting from flows of an urban–rural continuum and their interdependencies [55], with deep changes in character, function and the built environment [56,57]. Thus, the appropriate delimitation of the RS will be essential so that rural space can acquire new features [58,59], as well as a planning that responds to social needs and identity.

A novel approach is presented due to the differentiated insertion of buildings that represent the shape of the rural space in terms of their social and cultural importance—that is, as spatial organizers. The originality of this approach is associated with the definition of a flexible distance that can be adapted to the morphological diversity patterns.

1.1. Territorial Context in Galicia

The research area is the Autonomous Community of Galicia, located in the North-West of Spain (Figure 1a), with a prevailing territorial polycentric model [60], representing 30,769 village entities, of which 10,278 are classified as RS and 20,491 as disseminated RS [61]. These RS have a dispersed spatial distribution, which characterizes the territorial structure of rural Galicia, where seven representative municipalities were studied (Figure 1b). Faced with such a reality, the delimitation of the RS area is particularly difficult due to spatial heterogeneity challenging the planning of appropriate criteria to delimit the RS. This spatial heterogeneity is due to the conditions of a rugged topography, to the variability of plot structure and the diversity of types and amount of RS.

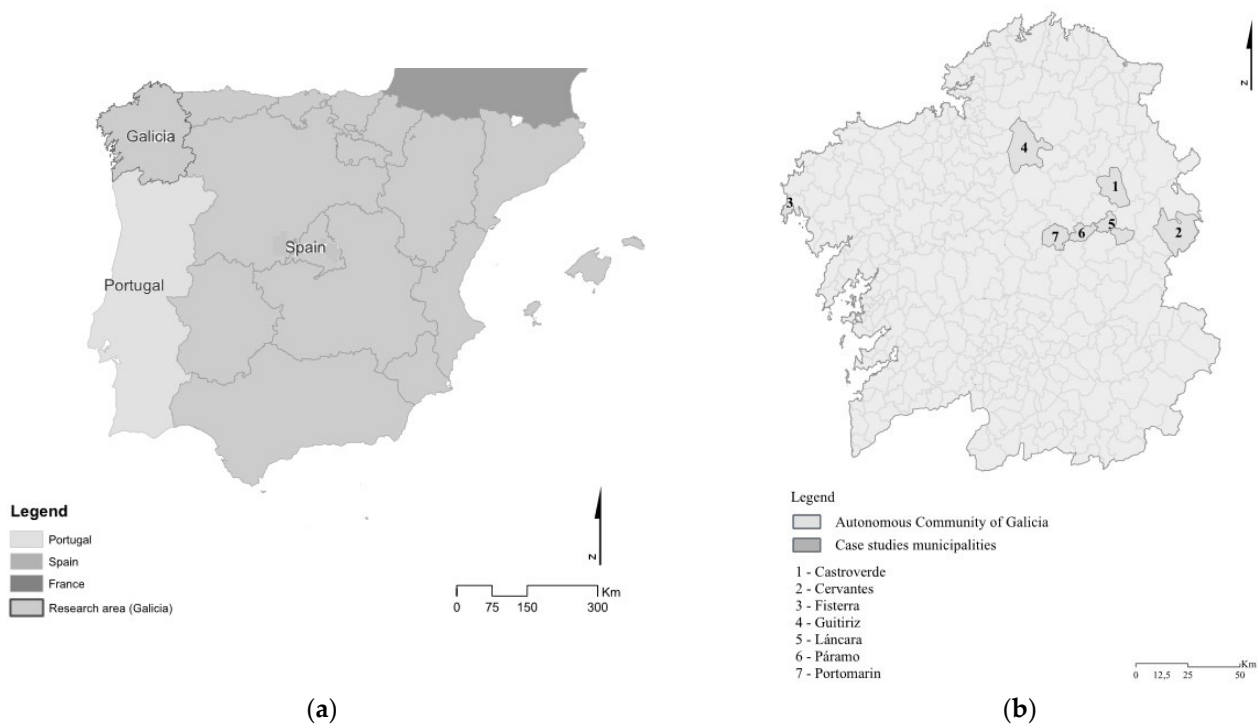


Figure 1. Research area location (a) and municipalities (b). Source: Authors.

1.2. Rural Planning and Land Use Law Context in Galicia

Studies performed in recent decades on RS in Galicia focus on the definition of the type and shape of the RS [62,63], as well as the RS classification according to the spatial distribution of the built-up set [64]. In the legal context of territorial planning in Galicia, the first land use law, which defines the class of “rural settlement land” in the “Land Use Law 11/1985 of Adaptación del Suelo de Galicia”, has the objective of creating a legal concept of this reality of human settlement. This concept has evolved over successive laws culminating in the “Land Use Law 2/2010 of urgent measures of modification of 9/2002 law of Urban Design and Protection of Rural Environment of Galicia” (LS 2/2010). Throughout this period, the rural settlement typologies and criteria for the identification and delimitation were successively altered according to the changes in the Land Use Laws, but they were lacking objectivity and efficiency due to the consecutive increase in the possibilities of spatial interpretations.

As these criteria are incorporated into the land use law, and as rural settlements are part of the spatial regulation on land uses of each municipality, the output of a methodology to delimit the rural settlements to which the study seeks to contribute becomes relevant given the practical condition to support decision-making in municipal planning.

These demarcation criteria are mainly based on fixed values, such as the distance between traditional buildings and on the degree of consolidation of the building occupation, applying to all existing RS without any adjustments to land use and to the morphological characteristics of each RS.

For all the aforementioned reasons, it is necessary to formulate a new spatial approach in the delimitation of RS, as well as to spell out the criteria for the identification and delineation of RS. This study aims to design criteria that form suitable RS delimitation boundary solutions for the type of buildings and their distribution in order to establish a spatial differentiation to promote territorial competitiveness [65,66]. Therefore, this study intends to design criteria to reach suitable solutions for the delimitation of RS with the built-up area and its distribution in order to establish a spatial differentiation according to its spatial characteristics. Although the case study deals with RS in Galicia using data collected through fieldwork, the criteria should be designed so that they can be applied

in any rural area outside of Spain in order to ensure greater universality. This is possible and guaranteed by the use of spatial criteria in relation to rural space universal functions—that is, residential buildings, spatial antiquity, land uses and rural heritage approaches. Thus, the objective of this study is to define criteria for identifying and delimiting RS that will successfully recognize the morphological context of each RS, setting up a spatial differentiation that allows different place functionalities [67,68].

2. Materials and Methods

2.1. Criteria for the Identification and Delimitation of RS Set by LUL 2/2010

The Law Use Law 2/2010 establishes the following RS soil categories as spatial typologies: traditional historical RS (THRS), common RS (CRS) and complex RS resulting from the simultaneous existence of the two previous categories. For RS identification, the following criteria are defined (Article 13th, 1): institutional recognition, which is a unique, identifiable and differentiated settlement in the administrative censuses; spatial relationship of the built structure based on the number of buildings and on the degree of consolidation by the building and settlement structure with historical typology that classifies the built structure according to the age. Article 13th, 3a: morphological characteristics of the settlement based on the typology of the buildings and sustainable use of natural resources. Finally, Article 29th, 1a: area condition for buildable plot defining the minimum area of 300 m² for the THRS plot. For delimitation, the criteria (Article 13th, 3a) of the maximum area of RS in which the delimitation polygon limits cannot exceed more than 50 m from the traditional buildings and consolidation of the built structure by defining a consolidation of 50% for THRS and 33% for CRS. In summary, the unique quantified criteria establishing this law are a degree of consolidation by edification higher than 50% for THRS and 33% for CRS and a maximum distance of 50 m from the polygon limit to the traditional building, within THRS delimitation.

2.2. Criteria Proposed for the Identification and Delimitation of RS

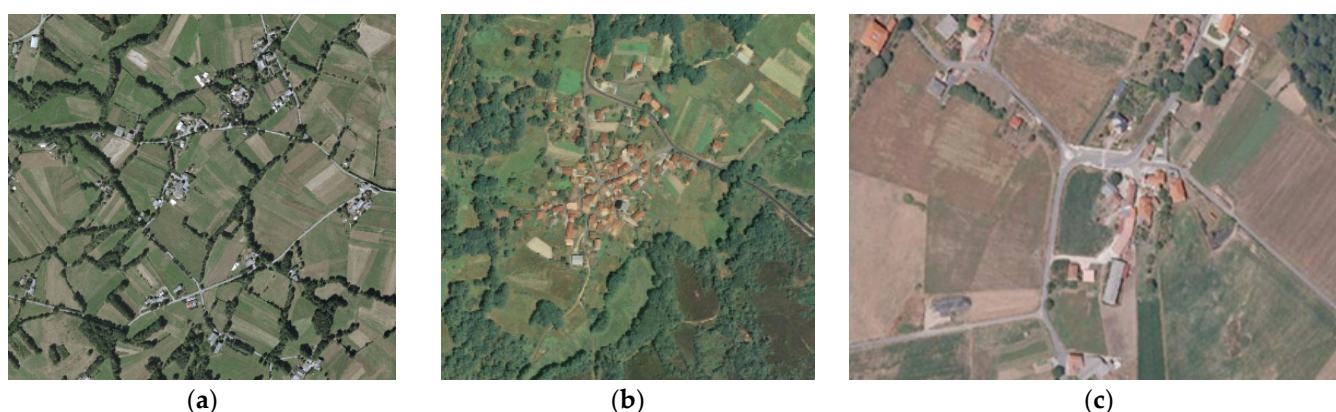
Rural areas are a central concept of rural geography [69]. The concept of rural space jointly includes social, economic and environmental dimensions [70], and this same rural space is associated with its own identity, as well as attachment to space and rural place design [71]. Against this background, the rural concept is inherently spatial as the space to be understood more broadly [72], and the immaterial context [73] is also representative of rural space, in addition to primary activities such as the main economic production of rural space [74]. However, it should also be noted that the concept of rural and urban areas is increasingly unclear in terms of form and function [75]. For the purposes of this research, this rural conceptualization is related to the study area of Galicia, since it coincides with the economic activities in the spatial production of rural places, as well as a certain intangibility that is necessary to quantify, according to this new spatial approach that is proposed to delimit the rural settlements.

A relationship between built structure of RS and sociocultural processes associated with space and place at different scales [76,77] occurs in rural settlements through which the concepts of essence and relatedness [78] should be reflected in the criteria design to identify and delineate the RS (Table 1) in order to contextualize the meaning of the place of a RS as a product of social space [79,80].

Table 1. Space and place contexts for delimitation of a RS. Source: Adapted from Healey [81] and Yang [82].

	Essentialist Conception of the RS	Relational Conception of RS
	RS Space	RS Place
Scale treatment	Adaptation to the scale among RSs	To establish interaction of the RS
Materiality and identity	Physical dimension of RS as a spatial meaning	To interpret distribution of the built set as social significance
Development concept	Even spatial evolution of RS	The quality of a place must produce several shapes in a RS
Representation form	Multiple RSs with no integration relationships among them	Morphological diversity expresses several social relationships

To delimit RS, a space was linked to a place using the evaluation criteria of concepts of space and place. This evaluation is framed by Healey [81] in the essentialist and relational context which is associated with the construction of individual and collective identities [83,84], as well as the different temporalities adapting them to the RS delimitation. The essentialist conception refers to the RS space as unique in terms of meaning and spatial quality. The relational conception refers to the RS place as having several qualities due to their morphological diversity to relate social to spatial integration. The treatment of scale in the essentialist conception refers to the ability of criteria to adapt and to recognize various RS scales, and to their spatial hierarchy, whereas the relational conception refers to the place with the possibility of producing interactions in its delimited area. Materiality and identity in the essentialist conception means that a physical dimension of space is associated with an individual spatial meaning as the main material objective. The relational conception intends to interpret the place through the distribution of the built set as a sociocultural meaning according to the complexity of the relationships in the site. The development concept of the essentialist conception suggests that its evolution has a single linear direction regardless of the different characteristics it presents, while the relational conception assumes the characteristics of the place to differentiate the qualities and, thus, design several shapes. The number of RS heterogeneous spaces does not reveal the relationships between them as represented in the essentialist conception, whereas, in the relational conception, the morphology of the place is expressed according to its diversity (Figure 2), representing the social conditions that must be related in the RS.

**Figure 2.** Different morphologies of rural settlements in Galicia: mixed (a), concentrated (b) and dispersed (c). Source: Authors.

According to the morphological differences, their heterogeneities and social characteristics of the rural area built up, a set of spatial components is established (Table 2). This approach aids the understanding and definition of the morphological value of the RS. Therefore, the following components are defined as spatial patterns and social composi-

tions of the rural space, namely: physical features, social features, spatial relations and human–physical relations.

Table 2. Components of the rural settlements and their relationality identified by the different morphological approaches. Source: Adapted from Geddes [85].

Approach	Physical Features	Social Features	Spatial Relations	Human–Physical Relations
Historical–geographical	- Rural site - town plan (street, plot, building)	- Function - Land use - Pattern	- Street pattern - Plot pattern - Building pattern	- Social context - Economic context - Religious context
Process typological	- Building (traditional or new) - Rural tissue - Type of RS (traditional or common)	- Cultural context - Historical context	- Aggregation - Individualization - Social interaction	- New construction - Heritage preservation
Configurational	- Street - Building function - Open space	- Use - Occupation - Movement	- Network structure - Interconnectivity - Centrality	- Social aggregation - Social dispersion
Spatial analytical	- Plot - Built up area - Street network	- Uses (traditional or new)	- Network structure - Compact - Scattered	- Integration

Thus, the context of space and place over essentialist and relational concepts reveals functional and historical factors that allow characterizing the RS. Considering the relational conception of the RS place and the analysis of a RS set of seven municipalities of Galicia, the features and factors (Figure 3) that spatially characterize the RS and that served to define the criteria for delimitation of RS were identified (Carter, 1990). The following RS were found and analyzed: 108 RS in the municipality of Castroverde, 138 RS in the municipality of Cervantes, 87 RS in the municipality of Fisterra, 310 RS in the municipality of Guitiriz, 104 RS in municipality of Láncara, 104 RS in the municipality of Páramo municipality and 101 RS in the municipality of Portomarin. The study of these settlements includes fieldwork on each of them in order to gather sufficient data for their proper characterization, as well as visually analyzing their delimitation in the official land use planning draws of rural settlements for the seven municipalities.

The spatial characteristics identified to define the place of the RS were as follows: RS areas, morphology, built up structure, plot structure, infrastructure and natural structure, as aspects according to which the planning of a RS should integrate when acting in a holistic fashion. Thus, the importance of each feature for space and place was identified through a direct qualitative rating according to the average value obtained with the participation of twenty researchers from the areas of architecture, geography, sociology, landscape architecture, agronomy, forestry and environmental sciences.

Experts from related areas referenced within rural spatial planning responded to a closed survey based on six factors—that is, rural settlements areas, morphology, built-up structure, plots structure, infrastructure and natural structure related to a set of parameters to assign a value to each. This makes it possible to define their relevance through the average values according to the previously established valuation.

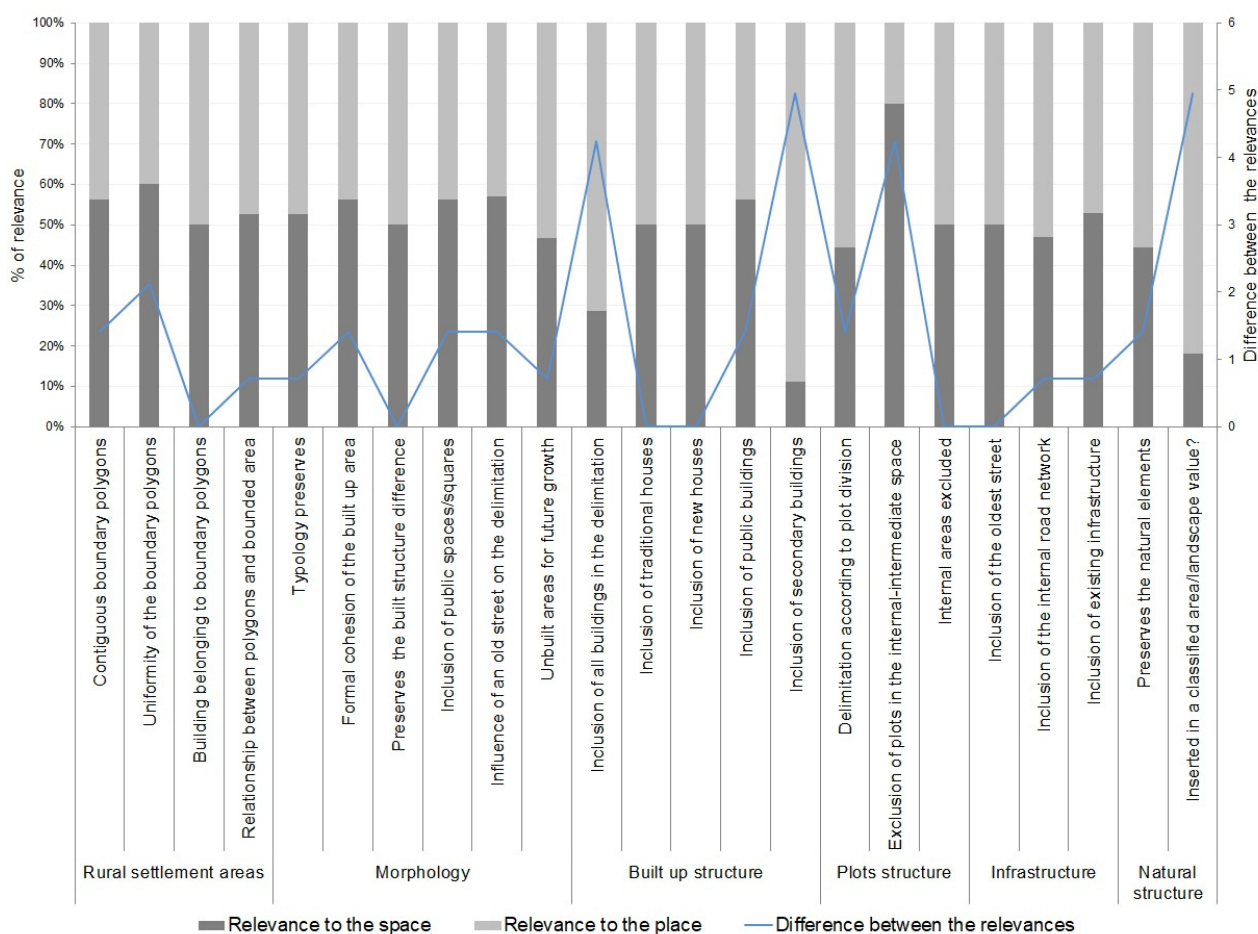


Figure 3. Factors for spatial characterization of a RS. Source: Authors.

It could hence be determined which of these characteristics are more relevant and should therefore be considered to define the delimitation criteria of the RS. The valuations of relevance for the space and the place according to expert participation in territory design areas were carried out based on the following scale: extremely irrelevant, with values of 1 or 2; moderately irrelevant, with values of 3 or 4; important, values of 5 or 6; moderately important, with values of 7 or 8 and extremely important, with values of 9 or 10. The relevance attribution score was derived from the information obtained from the analysis of the RS. By comparing the valuations of the relevance to space and to the place of RS, the differences between the relevance of the most important features to be considered for the design of the criteria were established. The results show that the spatial characteristics of the difference of relevance with value 0 are: buildings belonging to the delimitation polygons, it preserves the difference of the built-up structure, inclusion of traditional houses, inclusion of new houses, excluded internal areas and inclusion of the oldest street. The following are those with relevance difference with value of 1: relationship between polygons and delimited area, typology preservation, empty areas for further growth, inclusion of internal road network and inclusion of existing infrastructure.

From the factors showing a difference between 0 and 1 relevance factors, the following restrictions and conditions for the identification and delineation of RS were set (Table 3). The restriction refers to the fulfillment of an obligation, while the condition refers to spatial quality. They were grouped according to the identification or delimitation of the RS.

Table 3. Restrictions and conditions for identification and delimitation of a RS.

Spatial Characteristic	Restriction/Condition	Identification and Delimitation of RS	Rural Settlement
Preserving typology	Condition for THRS and CRS	Identification	To differentiate between main built set and surrounding building
Inclusion of traditional houses	Restriction for THRS	Identification	Minimum number of traditional houses in a polygon
Inclusion of new houses	Restriction for CRS	Identification	Minimum number of houses in a polygon
Buildings belonging to delimitation polygons	Restriction for THRS and CRS	Delimitation	Minimum number of buildings and the distance from each other in a polygon
Inclusion of the oldest street	Condition for THRS and CRS	Delimitation	Difference between plots in direct or indirect contact
Inclusion of the internal road network	Condition for THRS and CRS	Delimitation	Difference between plots in direct or indirect contact
Inclusion of internal infra-structures	Condition for THRS and CRS	Delimitation	Difference between plots according to the distance
Relationship between polygons and delimited area	Restriction for THRS and CRS	Delimitation	Minimum consolidation % per polygon
To preserve the difference of the built facility	Condition for THRS and CRS	Delimitation	Difference between the 1st polygon and the remaining ones according to the buildings by typology (traditional or new) and use (residential or others)
Empty areas for further growth	Restriction for THRS and CRS	Delimitation	Maximum surface according to % among traditional houses over new houses
Excluded inner areas	Restriction for THRS and CRS	Delimitation	No polygon may have empty areas

The elaboration of these restrictions and conditions aids the design of spatial criteria to delimit rural settlements. This new spatial criteria approach is applied through a developed iterative algorithm, which predicts the final result between the law criteria and the research criteria [86,87]. Thus, this instrument, combined with spatial criteria, becomes relevant to decision-making, as it permits the direct comparison between the final boundaries delimitation and the RS, which are explained below.

The elaboration of space context and place for RS delimitation, factors for the spatial characterization of a RS and the restrictions and conditions to identify and to delimit a RS resulted in the design criteria for delimiting a RS (Table 4) associated with identification and delimitation as spatial dimensions. The restriction of the minimum number of traditional houses in a polygon, which refers to the requirement of the existence of buildings with residential and traditional characteristics within the polygons, resulted in criteria 01 and 02—in particular, the minimal main built-up area and minimal surrounding built-up area for THRS identification. Criterion 03 results from the minimum number of buildings and distance between them per polygon as a restriction that associates the distribution of the buildings to an area of a polygon—that is, the characteristic average distance for delimiting THRS. The restriction to differentiate between the main built set, and the surrounding build up refers to an obligation of the buildings to be associated with an area, while the condition of the difference of the first polygon and others according to the buildings per type (traditional or new) and by use (residential or others) refers to the support spatial typology quality and use provided for differentiating polygons. Associating restriction with the condition results in criteria 04 and 05; in particular, the main built for the first polygon

and surrounding building for the second polygon delimiting THRS and criterion 08 as the main building set for delimitation of CRS. Criteria 06 and 07 resulted from restricting the minimum number of houses in a polygon, observing the legal legislation requiring a polygon to have houses, particularly the minimum area of the main building and the minimum area of the surrounding buildings for CRS identification. Criterion 09 (new residential buildings for delimiting THRS and CRS) results from the maximum surface restrictions according to the % of traditional houses over new houses, which requires the fulfillment of a relationship between buildings, together with the difference in conditions between plots in direct or indirect contact, as well as the difference between plots according to the distances quality of distance to which the plots are subject to a spatial characteristic. Criterion 10 for delimitation of THRS and CRS results from the restriction of a minimal percentage of consolidation per polygon and no polygon having empty areas, referring to the occupation of a polygon according to the space occupied by the buildings.

Table 4. Criteria for identification and delimitation of a RS. Source: Authors.

Criterion Number	Spatial Dimension	Criterion Identification	Criterion Description—Tradition Historical Rural Settlement Area (THRSA)
01	Identification	Minimum area of the main buildings.	A minimum of three (3) traditional housing buildings (THbu) should exist—that is, “traditional house” in one polygon at least to form a RS area.
02		Minimum area of the surrounding buildings.	The following polygons (no. 2) for their minimal conditions of existence should have two traditional houses at least to form a RS area.
03		Average characteristic distance.	With a minimum of three (3) traditional houses—that is, residential character buildings, the average characteristic distance (ACD) of the RS is calculated from the THbu centroids (traditional or others to be selected) by the average (25%, 50% or 75%) of the number of THbu (traditional or others to be selected) with the shortest distance among them.
04	Delimitation	Main building for the first polygon.	A first <i>buffer</i> is designed in all THbu (traditional or selected) where $1.5 * ACD$ of the RS is considered and those intersecting, directly belonging to the THRS area as the main building set, defining the 1st delimiting.
05		Surrounding building for the second polygon.	The calculation $0.5 * ACD$ is carried out around the previous polygons of THRS (with more than two THbu, traditional or newer other selected), and those not intersected in the 1st <i>buffer</i> but in the 2nd <i>buffer</i> will belong to the 1st proximity as surrounding building. The new polygons should have two (2) THbu.
Criterion number	Spatial Dimension	Criterion identification	Criterion description—Common rural settlement area (CRSA)
06	Identification	Minimum area of the main buildings.	At least two (2) housing buildings (traditional or new THbu) should exist in the first polygon, (when there is no THRS area), whose distance is $2 * DMC$ to form RS area.
07		Minimum area of the surrounding buildings.	The following polygons (number 2) must have at least two residential buildings (Rbu) (traditional or new) for their minimal existing condition to form RS area.
08	Delimitation	Main building set	A <i>buffer</i> $2 * DMC$ of RS is designed in all Rbu (or others to be selected) and those that are intersected now belong to the main commonly built set.
Criterion number	Spatial dimension	Criterion identification	Criterion description—Maximum surface of rural settlement

Table 4. Cont.

Criterion Number	Spatial Dimension	Criterion Identification	Criterion Description—Tradition Historical Rural Settlement Area (THRSA)
09	Delimitation	New residential buildings.	Whether the number of new residential buildings (NRbu) is greater than 50% of Rbu, the objective is to allow the building of NRbu all over the RS as maximum, equal to the number of existing Rbu. Whether the number of NRbu is between 25% and 50%, the objective is to allow the building of NRbu all over the RS as a maximum, equal to the number of existing NRbu for CRS or half (50%) of existing NRbu in THRS. According to the condition of existing THRS and CRS, the number of NRbu will be half (50%) of the existing NRbu for each area. Whether the number of NRbu is fewer than 25%, the objective is to allow the building of NRbu: in CRS as a maximum of the half (50%) of existing NRbu all over the settlement and in THRS as a maximum of 25% of NRbu existing all over the settlement. Whether the settlement has only THRS, it can be built only up to the maximum of the half (50%) of the existing Rbu.
Criterion number	Spatial dimension	Criterion identification	Criterion description—Rural settlement consolidation
10	Delimitation	Polygon consolidation	The degree of consolidation of a settlement is defined by the relationship between the existing plots (those that have an established building according to the occupied area) and the sum of new plots of type I and II. Type I plots are those with no consolidated building presenting a surface equal to or greater than the minimum buildable surface (MBS) with the first neighboring track. Type II plots are those with no consolidated building with a surface smaller than the MBS and with the first neighbor to the road. Such plots are united if the union surface is greater than the MBS; then, they are also inserted into the consolidation.

3. Results

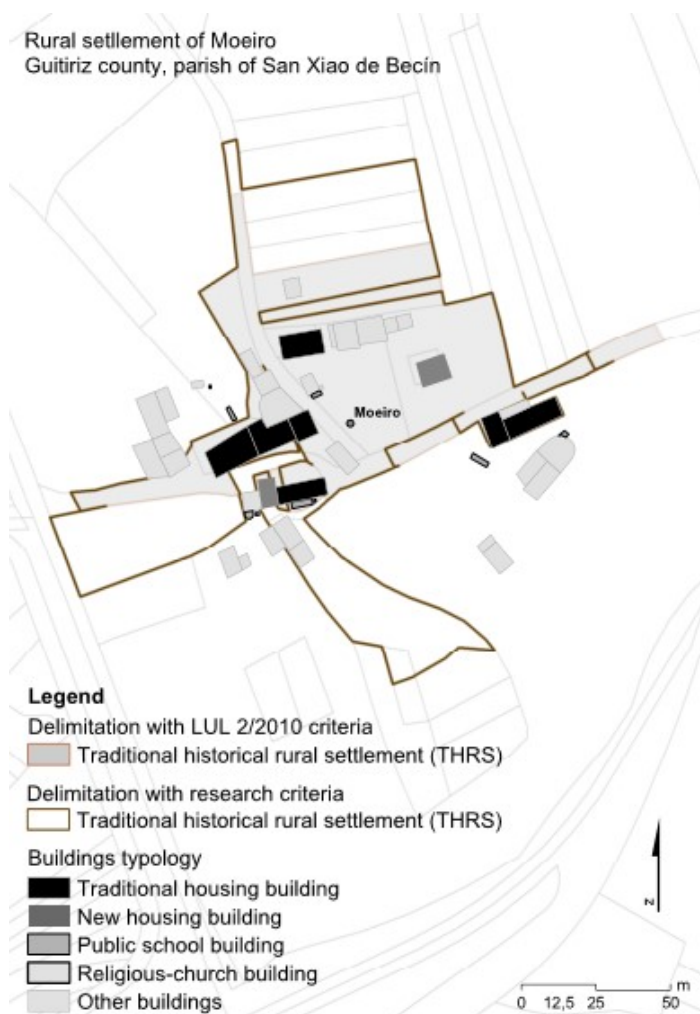
In this context, delimitations obtained according to application of the criteria set by the research and the LUL 2/2010 make it possible to compare between delimitations and further conclusions. The delimitations obtained by the criteria refer to the RS of Moeiro, RS of Corredoios and RS of Becín in the municipality of Guitiriz. They were chosen because they represent different morphological characteristics.

Delimitations obtained in the RS of Moeiro (Figure 4), according to the research criteria and LUL 2/2010, identify different areas. Both define the spatial typology as historical and traditional—that is, THRS, and include the same number and types of buildings with different limited areas, however. The delimitation obtained according to LUL 2/2010 is smaller in area when compared with the delimitation obtained, according to the criteria proposed by the study. With the help of these criteria, it can be established that the delimitation solution, the existence of two areas, the north and south, delimited with no buildings but constituting the areas of future growth of RS are emerging areas, since there are new houses and buildings, indicating a growth trend. The delimitation according to LUL 2/2010 does not permit areas for the future construction of buildings.

In the RS of Corredoios (Figure 5), the obtained delimited areas are also different to the research criteria, although LUL 2/2010 defines the same THRS spatial typology. The delimitation according to LUL 2/2010 presents a smaller area, delimiting only traditional houses and buildings, excluding all new housing buildings in the south and a traditional building that corresponds to the RS church in the north. This is because the new housing buildings are not inserted inside the proximity of 50-m distance from each other, as defined by one of LUL 2/2010 criteria. The delimitation solution proposed by the investigation criteria includes most of the new residential buildings and the church as a built part of

the RS, excluding only a new housing building in the south. It also predicts a future construction zone as emerging areas southwards of the delimited area.

A difference in the land use category in the RS Becín (Figure 6) can be obtained—that is, according to the criteria of LUL 2/2010, the delimitation solution presents two THRS areas separated from each other by one of the two existing areas of the CRS in the intermediate zone in the south. There is a rupture in the spatial delimitation of the RS. According to the research criteria, the obtained solution presents a single area of THRS, continuous to the spatial organization of the built-up structure. It does not include in its definition the new housing buildings that are located in the east, keeping the formal regularity through a compact geometric area. A further construction zone inserted in the CRS category is located in the adjacent south to the area of new buildings housing—that is, opposite to the set with the traditional buildings, including the church, which corresponds to the THRS category.



(a)



(b)

Figure 4. Delimitations according to LUL 2/2010 and the research criteria applied to RS of Moeiro (a). Aerial photo view of the RS on the right (b).

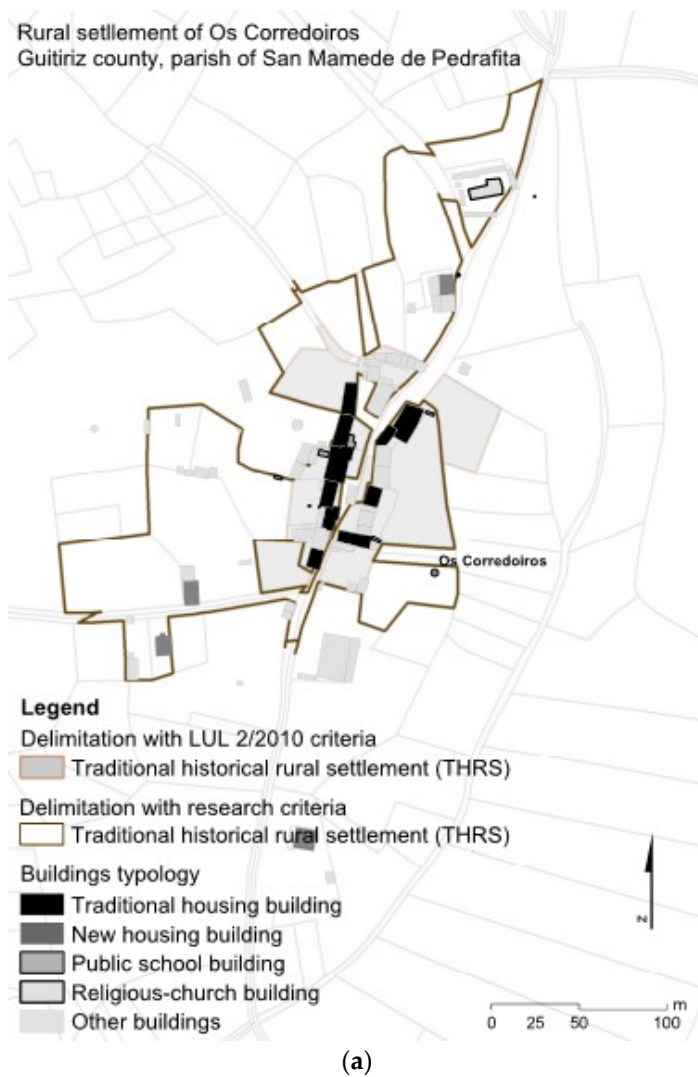


Figure 5. Delimitations according to LUL 2/2010 and the research criteria applied to RS of Os Corredoiros (a). Aerial photo view of the RS on the right (b).

In both case studies, which represent the morphological diversity that characterize the region of Galicia, the boundaries obtained from rural settlements according to the research criteria are more adequately defined than by the criteria of the law given the nature of the consolidated area, the incorporation of representative buildings in the rural space and the allocation of expansion areas on the rural settlements peripheries.

The results obtained are relevant because the final delimitation proposals based on the research criteria integrate buildings that perform important social functions in rural areas. These new criteria interpret spatial and built-up space differences in a spatially inclusive way, taking into account the diversity of spatial patterns. These are universal characteristics of rural areas, which can therefore be applied to other rural regions.

Although the research has considered a diversity of morphological patterns and seven provinces as study areas, the results can be considered most significant if spatial data on the surrounding landscape is applied, since this element represents social and heritage values in rural planning. Moreover, these spatial data point to social behaviours that can be considered to support the delimitation of rural settlement areas.

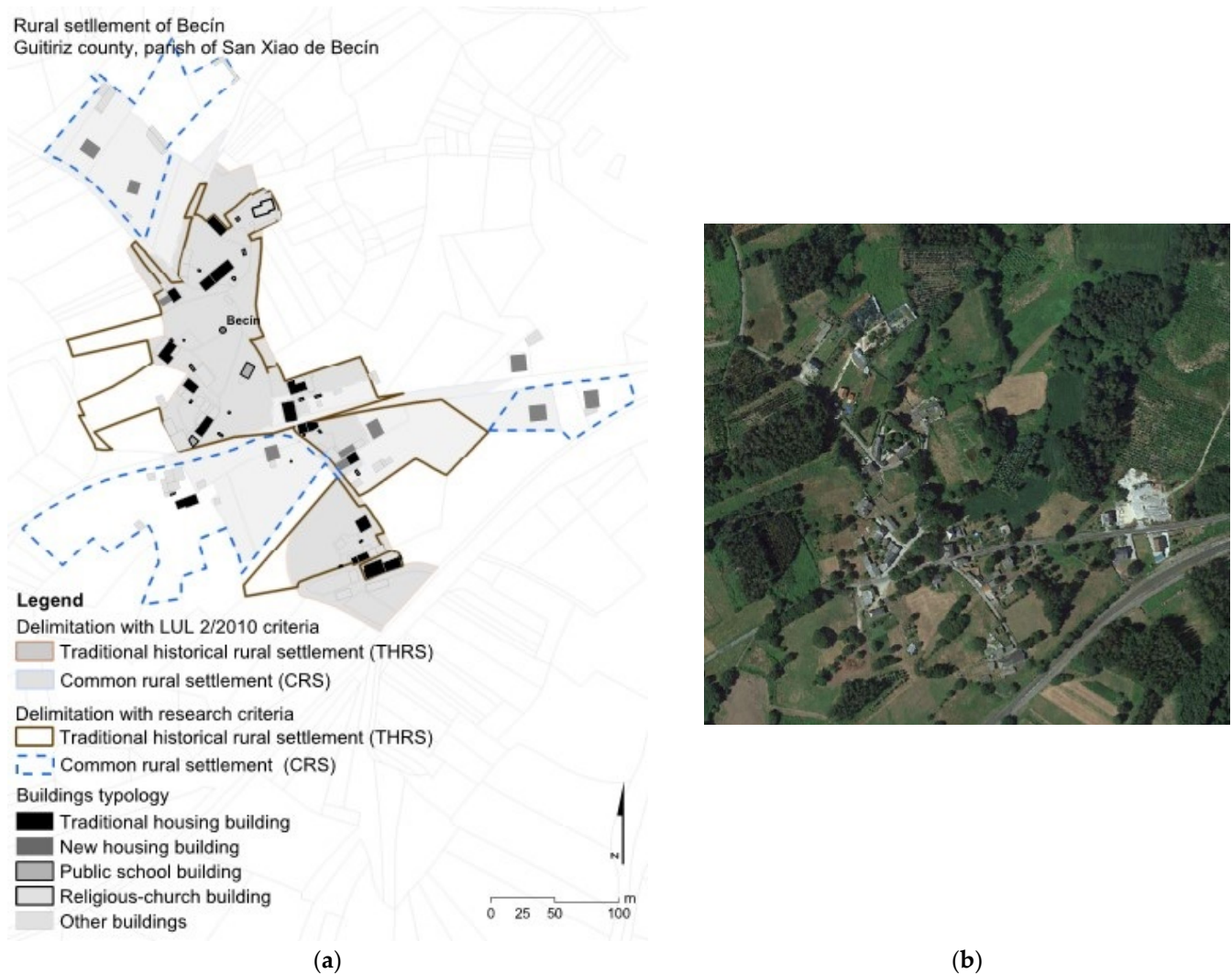


Figure 6. Delimitations according to LUL 2/2010 and the research criteria applied to RS of Becín (a). Aerial photo view of the RS on the right (b).

4. Discussion

According to the new spatial approach, the new criteria enable the delimitation of rural settlements more assertively in spatial terms when compared to the legal criteria defined by land use law. According to the research criteria, this allows for more homogeneous delimitations in the spatial perimeters, as well as a more rigorous interpretation of the differences in social values that buildings and their functions have.

Furthermore, the results obtained based on the methodology supported by the new criteria determine new areas of rural land expansion in peripheral areas of rural settlements. This has particular significance in rural spatial planning due to the enhancement and preservation of the difference between traditional and new spaces, thus maintaining the preservation of the historic value of rural settlements without, however, posing meaningful difficulties to spatial growth. This framework could make a contribution to the Galician land use law and subsequent municipal planning in order to establish a more equitable regulation between rural settlements.

The 2030 Agenda for Sustainable Development lists the topic of inequalities as an axis in social development. The proposed criteria and their spatial conceptualization insert parameters that allow for greater equity in the delimitation of rural settlements. This is not possible when applying the legal criteria of municipal planning, as can be seen in the results obtained, given the irregularity and exclusion of relevant parts in the

delimitations. Moreover, these views are referenced by the European Spatial Planning Observation Network on rural settlements in mountain areas.

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Although the research has considered a diversity of morphological patterns and seven provinces as study areas, the results can be considered most significant as spatial data on the surrounding landscape, as this spatial element represents social and heritage values in rural planning. Moreover, these spatial data point to social behaviours that can be considered to support the delimitation of rural settlement areas.

The Common Agricultural Policy (CAP) as the agricultural policy of the European Union defines ecosystems, social inclusion and economic development as objectives for rural development. Therefore, these can effectively be future lines of action for the spatial planning of rural settlements. Since the new Common Agricultural policy (CAP) contributes to a balanced development of European Union rural areas, the set of new criteria aims to obtain more equitable spatial delimitations.

As a future development, the possibility of incorporating the theme of the rural landscape into the spatial surroundings of rural settlements opens new research areas—namely, landscape heritage and the preservation of rural ecosystems. It is important to mention that these themes must be associated with biodiversity as one of the strategies that define the New Common Agricultural Policy (new CAP) from 2023 onwards, as well as the vision of rural areas towards 2040.

An additional important aspect is the possibility of complementing or adding a new vision to the rural land management policy—namely, parcel concentration. Since this is a policy of optimizing the productive space, this new approach as proposed in this research should in the future incorporate parameters or conditions of partial concentration, so that, in territorial and in rural planning, these legal instruments are applied in accordance with each other and not as individualized policy instruments in rural land management.

In the new criteria design, this novel spatial approach includes buildings and their functional relationships in rural areas as the main parameters to delimit rural settlements through classification—that is, residential buildings or buildings with other functions, as well as buildings by constructive period (traditional or new). Given these parameters, which are transversal to other rural geographies according to the social and functional meaning in a rural space, it becomes possible to apply them in other contexts and morphological constraints. How about: These parameters are transversal to other rural geographies in terms of social and functional meanings, so that they can be applied in other contexts and to other morphological constraints.

5. Conclusions

The objective of this study was to define identification and delimitation criteria for RS to recognize morphologic differentiation and compare them with delimitations obtained by criteria defined by the 2/2010 LUL through the interactive algorithm application. The criteria that LUL 2/2010 defines either pertain to the distance between buildings or to the type of buildings in order to calculate such distances, as well as the percentage of the RS land use consolidation in fixed values. Thus, the RS are inadequately delimited with no regard to their heterogeneity by function variations, shape and land use, reducing the criteria of functionality. The criteria that the study proposes as a result show numerically adjustable criteria by the differentiated uses of the distance, the main area and the surrounding area, as well as the type of building to be used, so that the criteria recognize and interpret the morphological differentiation of each RS.

The results obtained from the delimitations with the study criteria show more spatially balanced solutions than with LUL 2/2010 criteria, as well as a better spatial equity

supported by the algorithm. This is because LUL 2/2010 excludes buildings with spatial representation for their social function such as religious or housing buildings presenting a restrictive character such as delimitation, unlike the delimitations obtained according to defined criteria, which recognize the existence of these buildings, inserting them, as well as proposing expectant areas, according to the built dynamics of the RS.

Hence, the numerically defined criteria associated with a spatial operation permit the adaptation of morphological characteristics of any RS, as well as spatial equity by recognizing the differentiation of building structures and land use of each RS, as opposed to the LUL 2/2010 criteria. A further classification based on the design of these criteria may establish spatial differentiations contributing to a territorial planning of the rural space adapted to the essential characteristics of RS in terms of its social-cultural value. The aim of this study is to contribute to territorial design, particularly in rural areas because of the importance of building more reasonable and correct delimitation for each RS, as well as a more efficient land use management. The criteria defined by the study can be applied to the delimitation of RS and rural contexts elsewhere, since they define dimension characteristics and spatial functions associated with the built-up structure, as well as the spatial dimensions to which a design should respond in face of the social territorial needs.

As future lines of research, the possibilities of incorporating land uses and surrounding landscape can be highlighted, since these spatial data have characteristics and behaviors that can condition decision-making in rural planning.

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