

A Methodology to Define Urban Areas in Intermediate Cities. A Case Study on Inland Spanish Cities (Castilla-La Mancha)



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Abstract Recent decades have witnessed dramatic transformations in urban structures, which are reflected in intermediate cities. Tapping sources of information other than those traditionally used to analyse urbanised and built-up areas helps understand the patterns of spatial reformulation in cities. The cadastre developed by the Spanish Government is a source that can be used for these purposes. This study presents a methodology to analyse the transformation of cities, focusing particularly on the processes of urban sprawl. As the subject of study, we have selected the five provincial capitals of the Autonomous Community of Castilla-La Mancha (Spain) and their respective urban areas to examine the spatial scope and differences in the impact of sprawl, drawing on an analysis of the evolution of the population and housing between 2000 and 2016.

Keywords Urban area · Urban sprawl · Intermediate cities · Castilla-La Mancha Spain

Introduction

The changes associated with the process of globalisation and the reorganisation of capitalism have engendered new political, economic, social and/or cultural scenarios, which have shaped the relationships between society and space. These processes of adaptation and transformation have affected urban structures. Castells explained this by drawing on the foundations of the *Social Theory of Space*, in which space is the support for social practices. These foundations were then amended complemented

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by the principles of the *Theory of Space of Flows*. This latter theory holds that the flows of capital, information, technology and organisational interaction are home to practices, processes, images and symbols that determine the economic, political and social framework within which today's society operates.

Castells refers to this as “a new form of space typical of the social practices that dominate and shape the network society: the space of flows... Which is the material organisation of social practices” (Castells 2000: p. 488). These changes generate a new form of spatial organisation, where mobility is one of the key elements in understanding urban sprawl in Europe (Castells 2006).

The recent stages of urban development in Western Europe, defined and characterised by a temporally sequenced logic that can be summed up in the consecutive phases of urbanisation, suburbanisation, urbanisation and re-urbanisation, have had substantial spatial impacts, especially in the increase in urban encroachment. Urban sprawl has been most prominent in the second and third of these stages. The antecedents of this process lie in events in the United States since the 1950s, with the onset of a new model of city, typified by low building and demographic density and an increase in daily movement (Garreau 1994). All this has given rise to an intense academic and institutional debate, the aim of which is to understand the processes and analyse the effects, without, however, solutions always being found to correct the impacts.

The concept of urban sprawl itself is one of the issues that has been the focus of much attention. According to Galster, “it explains everything and nothing” (Galster et al. 2001: p. 681). Despite the underlying conceptual complexity, this author ventured a definition of the concept based on eight complementary dimensions: density, continuity, concentration, clustering, centrality, nuclearity, mixed uses and proximity. The combination of all these factors (albeit with different weights according to the areas under study) allows categories of urban sprawl to be established. The dominant features can be summarised in the separation of land uses—residential, commercial, leisure and production; peripheral urban developments dispersed across space; the fragmentation of government responsibility, the decentralisation of employment, and the dependence on private cars, among others.

These spaces of urban sprawl form part of the organic structure of a city, functioning as entities with a life of their own, adapting to the changing circumstances of each period (Hasse and Lathrop 2003). However, the separation between urban and rural tends not to be framed in physical and functional terms, as these have apparently become obsolete, although this approach continues to hold true from a social and/or administrative perspective. From a spatial viewpoint, this process goes beyond concrete settings and has become widespread, affecting varying sociocultural contexts. Western Europe and Spain, therefore, are no exception.

The European Environment Agency has elaborated a conceptual framework under which to understand and address a phenomenon whose primary characteristic is uncontrolled urban expansion in the face of a trend towards falling rates of demographic growth (EEA 2006). Across Europe, the examples of landscape fragmentation are abundant, a consequence of the uncontrollable growth of “urban concrete” (EEA 2018). These landscapes are the opposite of those of compact cities, in which

the urban centre is clearly defined and serves to articulate social relationships. In this context, urban peripheries are growing rapidly, to the detriment of historic centres, which are losing their traditionally characteristic dynamism. (Couch et al. 2008). Forms of urbanisation are emerging because of the combination of global and local logics (Brenner and Schmid 2015). The causes are multiple, and the outcomes vary according to the sociocultural contexts. In the middle of the twentieth century, in Europe, a progressive expansion of urban areas around larger cities began, due to growth by agglutination, gradually annexing nearby centres of population. At the end of the century, centreless cities were common. While, as a result of the rapid advance of industrialisation, Great Britain was at the forefront of these processes (Ferrán 2007), and Poland, for example, was slower to embrace these urbanisation dynamics (Czerny 2013). Since the 1980s, urban sprawl dynamics have progressively enveloped intermediate cities in Europe.

The structural reasons for this change of city model can be explained by the very logic of expansive neoliberal capitalism (Soja 2008), which is based around three lynchpins: global market integration, immediacy and self-regulation (Pollin 2013). These economic and ideological foundations have been laid in the context of an expansive economic scenario ongoing since the end of the twentieth century. These processes have come to fruition in the form of a change of mentality in relation to housing, which has gone from being seen as an asset for use to being one with which to speculate (de Taifa 2008). In most European countries, in a context of abundant and cheap land, there has been an increase in demand for housing, with individual ownership increasing (Borsdorf and Zembri 2004). Preferences have shifted towards larger single-family homes with more green space. Increased mobility is another factor that has fuelled the processes of urban sprawl. Added to this is the increased purchasing power of the middle class, which has made it possible to cover greater distances and to resolve the availability of private means of transport (the principles of economic profitability for public transport are not guaranteed in peri-urban areas). The result is a considerable movement of population, housing and functions towards the peripheries, in a process organised to avoid the traditional problems of the compact city (congestion, noise, pollution...).

The nomenclature that has emerged in a bid to explain this reality is diverse, and somewhat conceptually confused: diffuse, disperse, fragmented, scattered, deconcentrated, compartmentalised ... Attempts have also been made to define the processes: counter-urbanisation, rural urbanisation, suburbanisation, peri-urbanisation, diffuse urbanisation and urbanisation (Cebrián Abellán 2020). The associated collective image is that of growth and/or the extensive spread of urban sprawl towards remote peripheries, with the result being the blurring of urban edges, with a lack of clear separation between urban and rural worlds. There has been a sharp increase in mineralised land, generally given over to one-family dwellings and with a rise in the density of road infrastructures. The visible outcome is that the essence of the characteristic city/country binomial has disappeared.

The above considerations are necessary to understand the reality of the processes and the case study presented in this chapter. Morphological, functional and social processes have been triggered by the spread of urban sprawl in Spain since the end

of the 1990s. Between 1987 and 2005, there was a 50% increase in the amount of artificial area (in urban development and infrastructures), which has undoubtedly brought about a change in the new Spanish urban landscapes, which have largely been developed under the model of diffuse urbanisation. Different economic situations have affected the dynamics of the construction and housing sector. Different sub-periods can be identified. There was a decade of unprecedented urban growth from the late 1990s to 2008. This period has been variously referred to as “expansive urbanisation” (Burriel de Orueta 2008), “urbanising tsunami” (Gaja i Díaz 2008) and “spatial misgovernment” (Romero 2010). It was followed by a period of deep depression. From the first period, however, there remains a significant spatial footprint in the periphery, and a city model that differs from that bequeathed by the so-called urban urbanisation (Bellet Sanfeliú and Cebrián Abellán 2022), which has left us with more extensive, more disperse and less dense urban areas. One of the problems is that of its definition.

Different proposals have sought to define the limits of urban areas. There is some consensus on the use of statistical data at municipal level, combining their use with the implementation of statistical and cartographic techniques. From the institutional viewpoint, the most outstanding proposals are those made by *Urban Audit* and by the Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA, in its Spanish acronym). Since the 1990s Eurostat (the Statistical Office of the European Union) has been developing the Urban Audit project, the aim of which is to analyse certain aspects of European cities. Based on the Local Administrative Unit (LAU), the project defines the level of urbanisation (cities; towns and suburbs; rural areas), while the FUAs (Functional Urban Areas) refer to cities and their commuting zones, among others. Urban areas are conceptualised according to functional aspects, with the daily movement between municipalities for employment reasons being particularly important. A city is considered to be an LAU with more than fifty thousand inhabitants, and its FUA includes the municipalities in which at least 15% of the employed residents work in the city. The MITMA, meanwhile, has produced the Statistical Atlas of Urban Areas (*Atlas Estadístico de las Áreas Urbanas*), the aim of which is to define urban areas in Spain. The latest editions, from 2018 and 2021, establish differences between large areas (which have a municipality of at least 50,000 inhabitants and include municipalities of at least 1000), small areas and non-urban areas. Three groups of variables are used to establish these categories (Group 1: population statistics; Group 2: housing statistics; Group 3: spatial structure and observed urban dynamics) (Fig. 1).

The methodologies and indicators used to define urban areas at institutional level yield heterogeneous results, which vary according to the aim of the study, the scale, the sources available and the variables used in each case. The findings show highly diverse and unbalanced spatial models of cities in terms of the territorial scope included in each case. Urban Audit generates urban areas that appear oversized, as it incorporates a number of municipalities and urban areas that, on occasions, exceed a radius of 30 km. Meanwhile, MITMA does not always reflect the dynamics of the first decade of the twenty-first century, and the proposed definitions are, in some cases, undersized, which also conditions the results. The proposals for the delimitation of

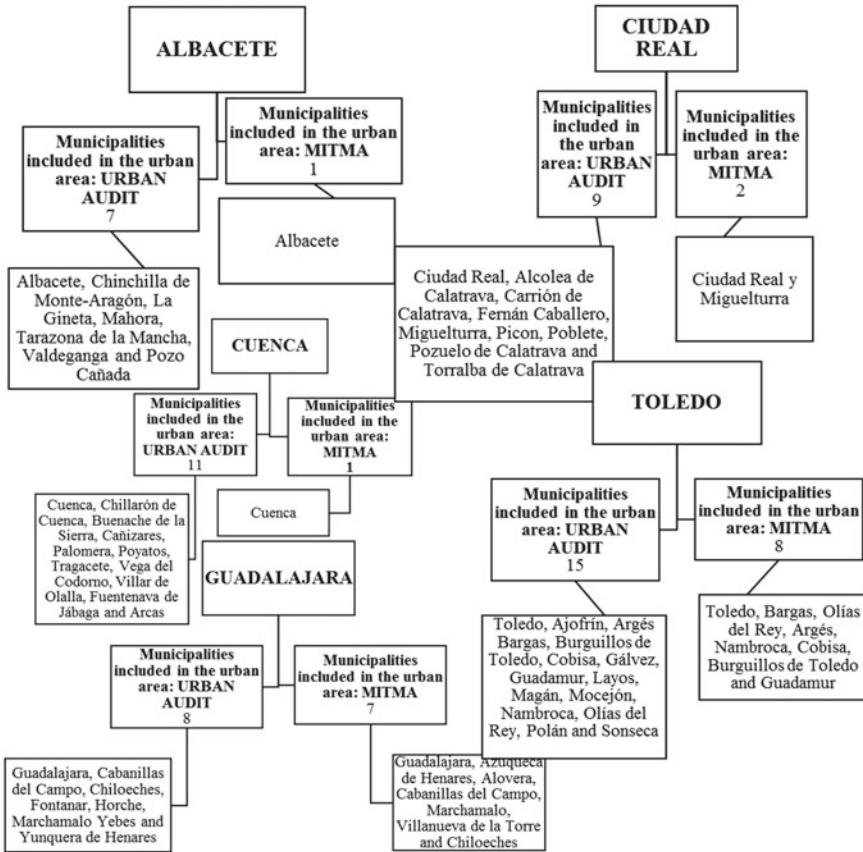


Fig. 1 Urban audit and MITMA classifications. Own preparation

urban areas drawn up at institutional level render very heterogeneous results (Fig. 1), which is mainly due to the use of different variables and methods.

Methodology

The methodology proposed in this chapter thus aims to enrich the debate. It uses complementary statistical and cartographic sources, as well as other methodologies to establish the scope and typologies. The aim is to understand the spatial structure of urban areas. In our case, a series of population and housing data was taken as a reference. Using these, indicators were established and processed using statistical analysis tools. This has allowed for an interpretation of the behaviour of the municipalities. Urbanisation dynamics are assumed to be a good indicator of the processes

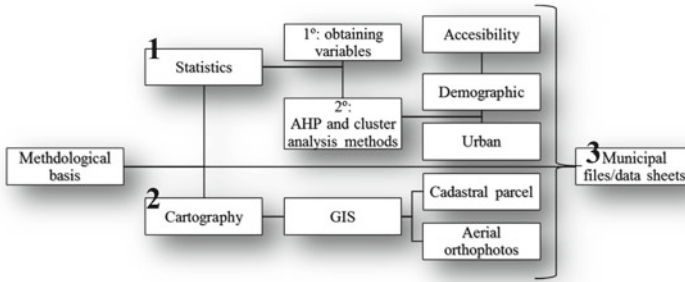


Fig. 2 Methodological proposal. Own preparation

of integration of the municipalities in the respective urban areas. The proposal is methodologically underpinned by various elements (Fig. 2):

The spatial context chosen for the case studies is that of five cities in the Autonomous Region of Castilla-La Mancha (Spain): Albacete, Ciudad Real, Cuenca, Guadalajara and Toledo. They all have the same administrative status (provincial capitals) and are considered to be intermediate inland cities (their populations range from 50,000–20,000 inhabitants. They have also all undergone processes of urban dispersion (Sánchez Ondoño 2020). Nevertheless, they are contrasting examples, with different intensities and manifestations of the processes depending on the case. In order to identify the scope of the urban areas and establish a typology of municipalities included in each one, the municipalities included within a radius of 30 kms around each city were analysed, assuming that the actual spatial scope of urban dispersion is less than this reference threshold. The study universe comprises 202 municipalities: 12 in Albacete; 24 in Ciudad Real, 30 in Cuenca, 71 in Guadalajara and 60 in Toledo (Fig. 3).

The time frame used for the study extends from 2000 to 2016, divided into two sub-periods: 2000–2008 and 2008–2016. The first corresponds to the period of maximum urban expansion. The second corresponds to the economic crisis and subsequent recovery, which generated an abrupt change in dynamics, the most evident effects of which were the general stagnation of the economy and a severe blow to the health of construction sector.

Sources Used

As shown in Fig. 2, part of the method involves selecting sources and obtaining data. In this case, the variables used are essentially demographic and urban. A further two were included that focus on accessibility (distance in kilometres and time in minutes from each municipality to the central city, following the shortest route by road) (Source: Via Michelin). Absolute or relative values were used.

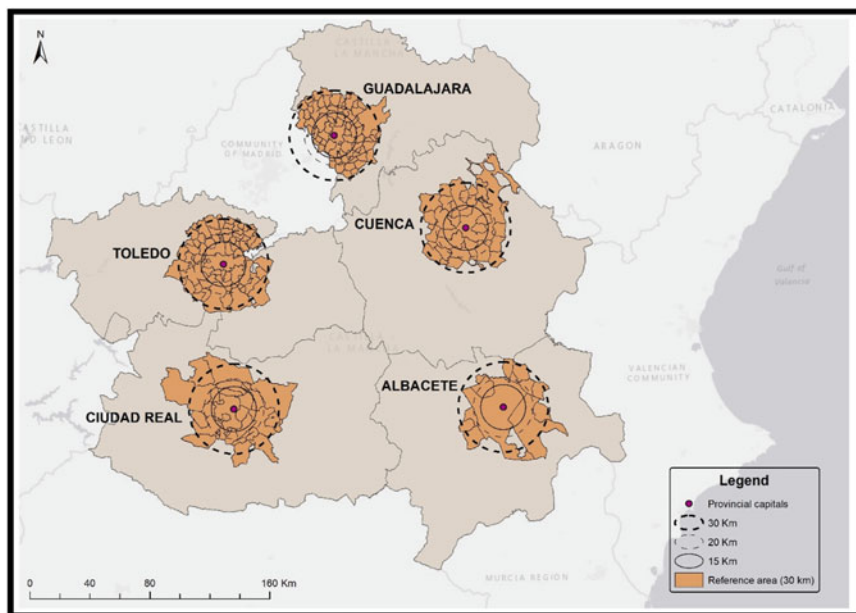


Fig. 3 Reference areas of the provincial capitals of Castilla-La Mancha. Own preparation

Data at municipal level for 2000, 2008 and 2016 were used. The population variables were downloaded from the webpage of the Spanish National Statistics Institute (INE, in its Spanish acronym) using “the official population figures from Spanish municipalities: revision of the Municipal Register” (INEbase/Lista completa de operaciones). For each municipality, this provided us with the total population, its composition by age group and nationality. To generate the urban variables, we used the *Portal of the Directorate General of the Cadastre* (<https://www.catastro.meh.es/>). From this institution, we downloaded the number (in units) and the surface area (in hectares) of the total and disaggregated land parcels according to building status (built or unbuilt). As a second source for analysing the transformation of the housing stock, we used the Cadastre Website (<https://www.sedecatastro.gob.es/>), from which we extracted the housing data (CAT files): number of dwellings per municipality, age and building type.

The use of data from the latter source for urban analysis research purposes requires complex processing. The CAT files (open access) are “Security Catalogue Type” files without line format. Each file (one per municipality) contains a wide variety of interrelated information (Table 1). The data obtained from the original source are structured such that it is necessary to convert them because the basic information (Table 1) appears in a format that prevents its use for the analysis of real property on a municipal scale (Fig. 4). To solve this problem, a specific method for the transformation of the information was created.

Table 1 Information available on the CAT files. Computerized cadastre remit file (urban, rural, and special status real estate). Own preparation

Type	Name
01	Header record
11	Land record
13	Record of constructed unit
14	Record of construction
15	Record of property
16	Record of distribution of common elements
17	Record of agricultural parcels
90	Trailer record

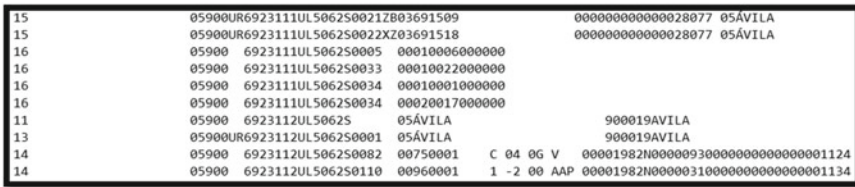


Fig. 4 Image of a CAT file

Method used to obtain housing variables

The process of transforming cadastral information necessarily starts with understanding the structure of the data shown in Table 1. Once identified, a method was generated to systematise and convert the information from plain text into a relational database. This allows the required housing variables to be obtained, targeted queries to be carried out and thematic mapping at cadastral parcel level to be generated.

To implement the methodology, we created a data management platform that permits cadastral data to be processed. The data management tool, initially created in Access, using Visual Basic programming language, in accordance with the information on the computer file on changes in cadastre (urban property, rustic property and property with special characteristics), allows plain text files to be converted into files in relational database format, with eight distinct tables, one for each type of record shown in Table 1. Once ordered, the information can be consulted (Sánchez Ondoño et al. 2021).

However, in none of the eight tables obtained with this process is there a specific field for the variables required. Additionally, the complexity of elaborating queries by cross-referencing information from registers and the processing time makes its advisable to develop a more user-friendly Web application specifically designed for the study of urban dynamics (Sánchez Ondoño and Cebrián Abellán 2022). This tool works with PHP programming language and MySQL as the relational database system, based on an entity-relationship model, determining the main table, identifying the interactions between the different elements and the expected outcome.

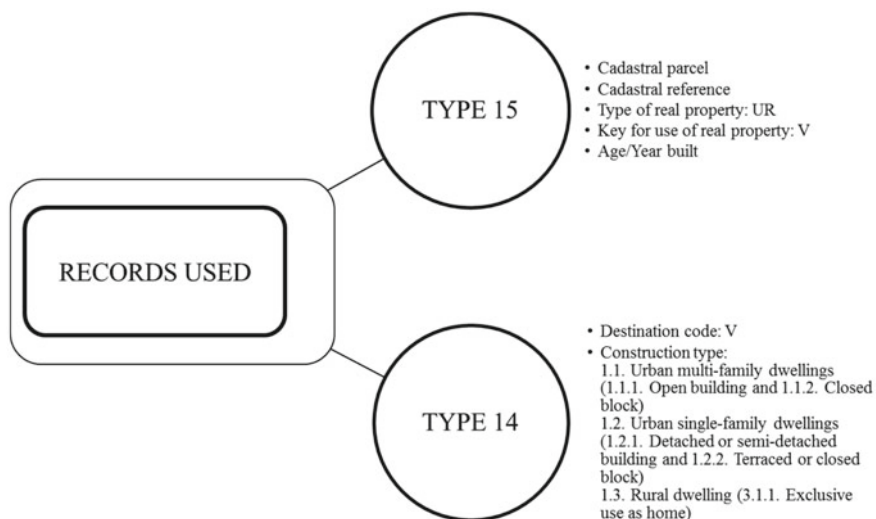


Fig. 5 Filtering for housing study in the web application. Own preparation

Although the official data are provided at municipal level, our application allows for working at more detailed levels. The information can be filtered by province, municipality and/or smaller entity. There is also the possibility of working by periods according to the age of the property. In this case, the information contained in records 14 and 15 was used (Fig. 5).

Methods of Analysis

Once the information had been generated, two complementary data processing methodologies were used (Fig. 2): the analytic hierarchy process (AHP), which made it possible to delimit the scope of the urban areas, and cluster analysis, which was used to classify the municipalities, searching for homogeneous patterns of behaviour.

The main advantage of AHP lies in its ability to model the problem graphically and simply, using a hierarchical structure. Its three basic functions are to “structure complexity, measure on a scale and synthesise” (Osorio and Orejuela 2008: p. 248). Broadly speaking, the process is as follows: calculating the paired comparison matrices, normalising the matrix, calculating the average vector and the consistency ratio (Saaty 2008). In the research, municipalities were assigned a value according to each of the four criteria used in this case (rates of change in population, number of urban parcels, area in hectares and homes built during the period 2000–2016), taking the preferences scale into account (Saaty 1990). This makes it possible to compare the dynamics of the municipalities and to rank them according to their behaviour.

Cluster analysis enables the identification of elements (municipalities in this case) with similar behaviour, establishing homogeneous clusters. The fifty-six variables generated were grouped into four categories: population, urban land, housing and accessibility (for 2000, 2008 and 2016). Unlike AHP, the data used here are absolute, and the variables are disaggregated into more groups (population by age and nationality, built and unbuilt parcels—units and hectares—and housing by type of construction—mainly multi-family and single-family).

Once the urban areas had been defined and the municipalities classified, the results obtained from the AHP and the cluster analysis were mapped. Additionally, explanatory municipal data sheets were created, which provide information in the form of a data table (with absolute values), a graph (representing the evolution of relative data) and a cartography of the location of the municipality and the population centre. The cadastral cartography (obtained from the Cadastre Web site) was used as the basis, in which the cadastral parcels, their construction type, the year of construction of the dwellings and the number of real estate properties in each one of them is represented. This was done by means of two different maps: one with the dwellings by year of construction and their construction type; the other with the number of properties per cadastral parcel. To contextualise the dynamics of urban change, we used the orthophotos from the National Plan of Aerial Orthophotos of 1956, 1997, 2009 and 2018 have been used. In the latter case, these are WMS resources provided by the Cartographic Centre of Castilla-La Mancha.

Results

Delimitation of Urban Areas

Drawing on the rankings generated according to the average AHP vector, the group of municipalities in each urban area was found to present more dynamic behaviour than the central city in which it is integrated. The methodology allows preference scales to be assigned by means of the four criteria used. The variable that uses housing as the dominant criterion was chosen in this case (Sánchez Ondoño and Cebrián Abellán 2021), being the most dynamic in all the areas analysed during the reference period (2000–2016) (Table 3). This finding yields a substantially lower number of municipalities than previously considered in the reference areas (30 kms) (Table 2 and Fig. 6).

On applying the methodology to the three units of analysis used (central city, urban areas—AHP—and reference areas—30 km), municipalities that showed negative growth in some of the selected variables or that had lower dynamics than those of their reference city were excluded from the condition of municipalities affected by processes of urban sprawl.

The differing behaviour of the variables in the various urban AHP areas is striking (Table 3). In Albacete, the dynamics of the urban land variables are significantly

Table 2 Number of municipalities included in the reference and urban areas. Own preparation

Central city	Number of municipalities in the reference area (30 km)	Number of municipalities obtained using AHP
Albacete	12	6
Ciudad real	24	6
Cuenca	30	6
Guadalajara	71	30
Toledo	60	32

Table 3 Values for the areas of reference (30 km) and urban areas (AHP). Own preparation

Spatial context	Rate of population change (2000–2016) (%)	Rate of change in number of urban parcels (2000–2016) (%)	Rate of change of surface area in hectares (2000–2016) (%)	Overall rate of change in housing (2000–2016) (%)
Albacete	15	13	62	32
Area of reference	7	28	84	41
AHP area	16	38	93	56
Ciudad Real	23	12	6	46
Area of reference	11	30	47	42
AHP area	27	56	64	64
Cuenca	21	20	64	38
Area of reference	4	14	49	34
AHP area	56	35	97	85
Guadalajara	27	43	73	43
Area of reference	137	57	100	89
AHP area	166	87	126	114
Toledo	22	27	107	43
Area of reference	30	34	-37	53
AHP area	75	84	44	106

higher than those of the population: the surface area of parcels grew by 93%, housing by 56% and the number of urban parcels by 38%. Meanwhile, the population increased by 16%. This situation is replicated in Ciudad Real, where surface area and housing maintain the same rate (64%), followed by parcels (56%) and population (27%). In Cuenca, surface area and housing are also the two most dynamic variables

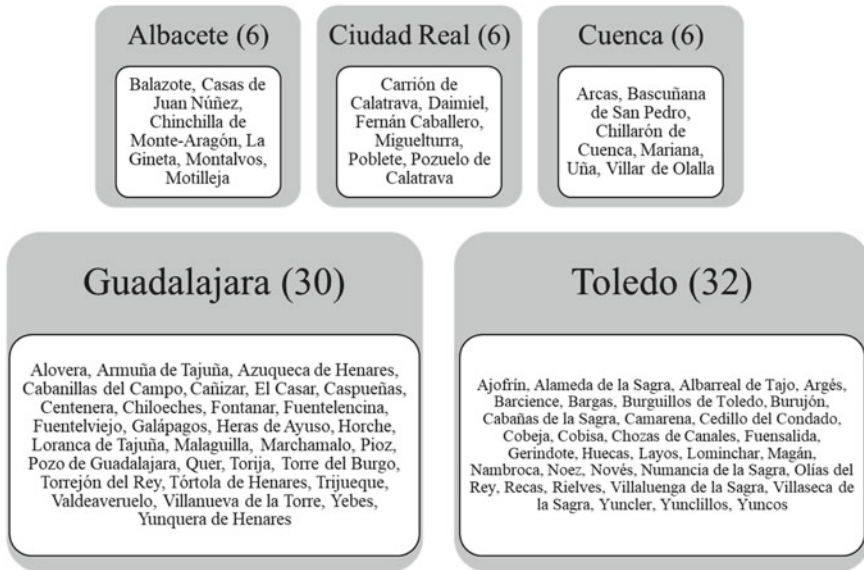


Fig. 6 List of municipalities included in the AHP urban areas. Own preparation

(97% and 85%, respectively), while population (56%) shows a higher growth rate than urban parcels (35%).

Most noteworthy are the urban areas of Guadalajara and Toledo. The former, unlike those previously mentioned, shows a greater dynamism of change in population (166%), a higher increase than that in the surface area of parcels (126%), housing (114%) and number of urban parcels (87%). Both surface area and housing more than doubled over the period analysed, while the population tripled. Finally, the highest growth in Toledo was that in housing (106%), followed by the number of urban plots (84%), population (75%) and surface area in hectares (44%). Nonetheless, in balance, the general trend shows a significantly more pronounced behaviour in the variables of urban fabric (parcels and dwellings) than in the demographic variables.

Classification of Municipalities Integrated into the Urban Areas

Cluster analysis was used to establish a typology of the municipalities included in the urban area. Due to the characteristics of such analysis (it does not require dependent variables and, despite seeking the greatest similarities between the groups established, the heterogeneity of the data is maintained), it is a flexible technique that is well suited to the data used in this research (Ocaña Peinado 2019). The results obtained from each group using the cluster method were completed with a critical

examination derived from fieldwork. This enabled us to generate a final proposal for urban area and typology of municipalities (Figs. 9 and 10), which was the result of adjusting the first proposal obtained after applying the AHP methodology (Figs. 7 and 8).

Figure 8 shows the main characteristics of the groups of municipalities included in each cluster (Fig. 7). This was obtained using, as critical variables, demographic size, time or average distance from each municipality to its central city, and the predominant variables, including the dominant housing typologies in each case. All data were calculated based on the average of each group.

The proposed definition and classification of the respective urban areas (Figs. 9 and 10), which is the result of the combination of AHP, the cluster analysis and the critical review, is structured based on municipalities with demographic and urbanisation behaviours that exceed those of their parent city. From the spatial point of view, the main defining feature is the scope, which is situated at the threshold of 20 kms around the central city (Figs. 9 and 10).

The urban area of Albacete is organised around five municipalities from the fourth group and one from the first group (Fig. 9).

- Group 1: Chinchilla de Monte-Aragón.
- Group 4: Balazote, Casas de Juan Núñez, La Gineta, Montalvos and Motilleja.

The centres of population of Chinchilla de Monte-Aragón and La Gineta are less than 20 km from the city of Albacete. The rest are slightly above this threshold. In

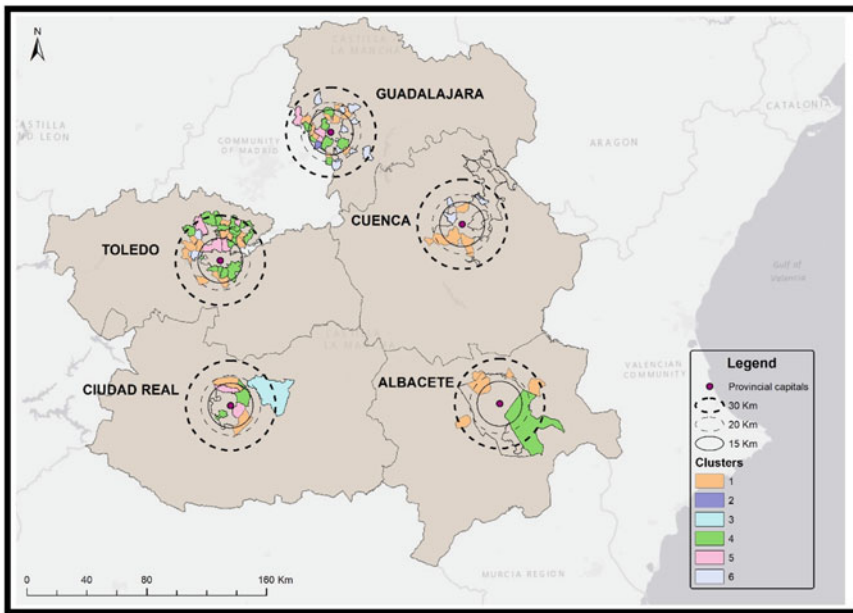


Fig. 7 First proposal for a typology of urban area. Own preparation

GROUP 1 (32 MUNICIPALITIES) "RURAL MUNICIPALITIES CHARACTERISED BY NOTABLE PROCESSES OF URBAN LAND ARTIFICIALISATION"	<ul style="list-style-type: none">• Inhabitants < 2000 Time and distance: 25 minutes and 24 km• Predominance: land and housing variables Single-family dwellings
GROUP 2 (1 MUNICIPALITY) "SMALL TOWNS"	<ul style="list-style-type: none">• Inhabitants > 10.000 Time and distance: 14 minutes and 13 km• Predominance: housing and population variables Multi-family housing
GROUP 3 (1 MUNICIPALITY) "SMALL TOWNS"	<ul style="list-style-type: none">• Inhabitants > 10.000 Time and distance: 27 minutes and 33 km• Predominance: urban land variables multi-family/single-family housing
GROUP 4 (24 MUNICIPALITIES) "SMALL SEMI-URBAN MUNICIPALITIES, CLOSELY ASSOCIATED WITH SPATIAL RECONFIGURATION OF THE CENTRAL CITY"	<ul style="list-style-type: none">• Inhabitants 2.000 – 5.000 Time and distance= 22 minutes and 10 km.• Predominance: housing variables Single-family dwellings
GROUP 5 (14 MUNICIPALITIES) "URBAN MUNICIPALITIES HIGHLY INTEGRATED INTO THE PROVINCIAL CAPITALS"	<ul style="list-style-type: none">• Inhabitants > 10.000 Time and distance: 20 minutes and 18 km• Predominance: housing and population variables Single-family dwellings
GROUP 6 (14 MUNICIPALITIES) "RURAL MUNICIPALITIES WITH NO CHARACTERISTICS OF REVITALISATION DUE TO THEIR PROXIMITY TO THE CENTRAL CITY"	<ul style="list-style-type: none">• Inhabitants < 1.000 Time and distance: 32 minutes and 28km• No particular outstanding dynamic Single-family dwellings

Fig. 8 Main characteristics of the cluster analysis. Own preparation

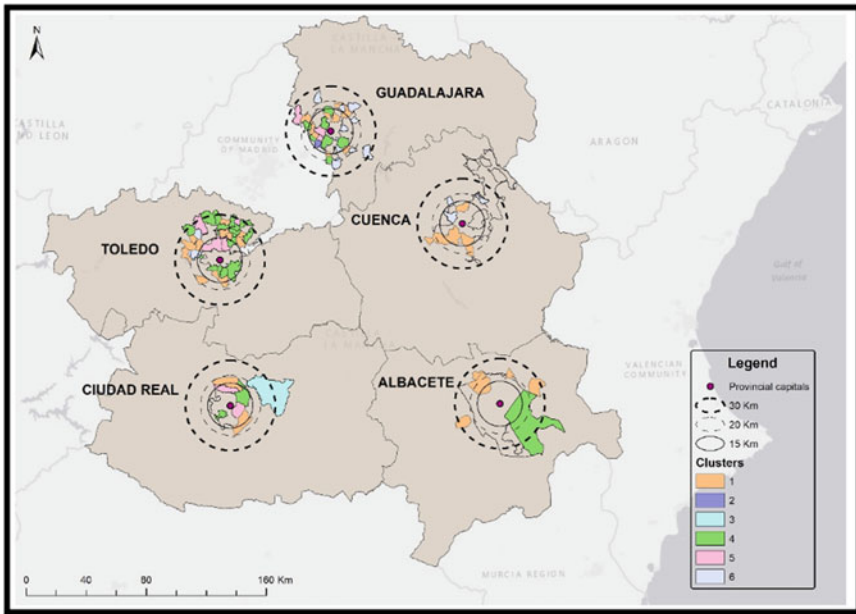


Fig. 9 Final proposal for a typology of urban area. Own preparation

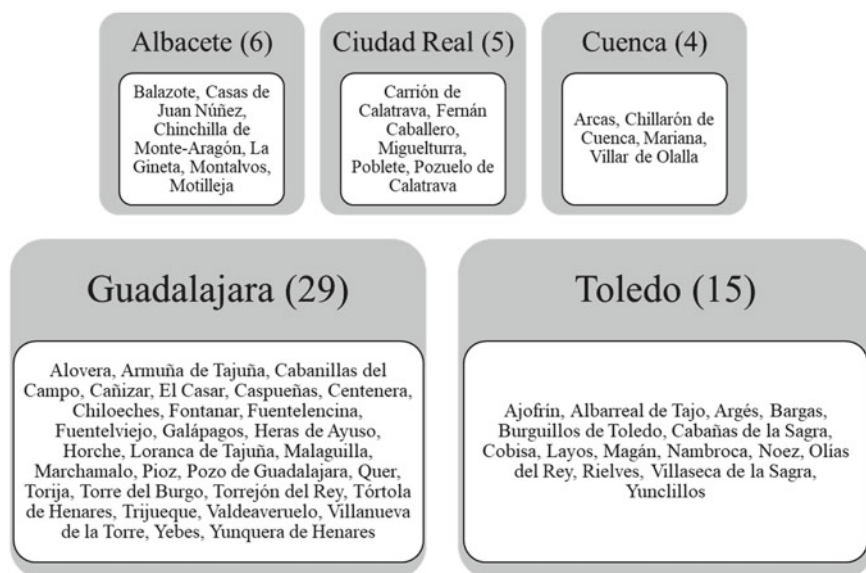


Fig. 10 Final proposal for a typology of urban area. Own preparation

the urban area of Albacete, the number of hectares of undeveloped urban land is striking.

The same situation occurs, albeit more clearly, in the case of Ciudad Real. The urban area is made up of six municipalities divided into three categories:

- Group 1: Pozuelo de Calatrava and Fernán Caballero (substantial production of urban land).
- Group 4: Carrión de Calatrava and Poblete (both bordering the capital of the province).
- Group 5: Miguelturra (part of outskirts of Ciudad Real).

All the centres of population are included within the 20-km radius, except for Daimiel, which was excluded—Group 3, Fig. 9. The latter is located more than 30 km from the central city—Ciudad Real—and its functionality and demographic size (agro-city with a certain degree of industrial activity) make it a regional centre.

In Cuenca, four municipalities are located within the urban area. They are divided between categories one and six:

- Group 1: Arcas, Mariana and Villar de Olalla.
- Group 6: Chillarón de Cuenca.

In this case, Bascuñana de San Pedro and Uña were excluded, as neither their demographic size nor their (scant) dynamics were significant in the process analysed. However, compared to the previously described provincial capitals, Cuenca is the urban area that shows the most sluggish growth.

The last two areas are the most complex because of their proximity to Madrid, the national capital (especially as regards the urban area of Guadalajara). In this case, the municipalities within a radius of 20 kms from the city of Guadalajara were included, with those distributed along the Henares Corridor being the most dynamic. The only one excluded was Azuqueca de Henares (Group 2), which has been considered part of the urban area of Madrid. The urban area is organised into 29 municipalities (Fig. 9):

- Group 1: Armuña de Tajuna, Fontanar, Galápagos, Heras de Ayuso, Pozo de Guadalajara, Quer, Torija, Torre del Burgo, Tórtola de Henares and Valdeaveruelo.
- Group 4: Chiloeches, Horche, Marchamalo, Pioz, Torrejón del Rey, Villanueva de la Torre and Yunquera de Henares.
- Grupo 5: Alovera, Cabanillas del Campo and El casar.
- Grupo 6: Cañizar, Caspueñas, Centenera, Fuentelencina, Fuentelviejo, Loranca de Tajuña, Malaguilla, Trijueque and Yebes.

Finally, in the proposal for the urban area of Toledo, our AHP yielded a total of 32 municipalities. Of this group, 17 were eliminated, those most to the north, as they form part of the polynuclear metropolitan area of Madrid along the la Sagra Corridor (being the cases of Camarena, Chozas de Canales, Cedillo del Condado, Cobeja, Huecas, Lominchar, Recas, Yuncos, Yuncler, Numancia de la Sagra, Villaluenga de la Sagra, Alameda de la Sagra, Gerindote, Burujón, Barcience, Novés and Fuensalida). In this way, the 20-km radius also proves appropriate. The distribution, according to cluster group, of the 15 municipalities that make up the urban area, is as follows (Fig. 9):

- Group 1: Ajofrín, Cabañas de la Sagra, Noez, Layos, Rielves, Villaseca de la Sagra and Yuncillos.
- Group 4: Argés, Burguillos de Toledo, Cobisa, Magán, and Nambroca.
- Group 5: Bargas and Olías del Rey.
- Group 6: Albarreal de Tajo.

Example of Cartographic Data Sheet

Municipal level data sheets were generated (combining statistical and cartographic information as tool to explain the processes operated at the scale of the population nucleus.). Their use allows for a detailed understanding of the process of transformation at urban level. Only the example of Yebes is presented here (for reasons of space). It is unique both for its unusual dynamics and the differences between the trend it presents and those of the other municipalities.

Yebes is included in Cluster 6 of the urban area of Guadalajara. The municipality has experienced abnormally high growth in all the variables used during the period 2000–2016, reproducing the pattern of changes in urbanisation dynamics being more significant than those at demographic level. The data sheet (Figs. 11, 12, 13, 14, 15, 16 and 17) helps understand the transformation process in the two sub-periods for each of the variables. The change in undeveloped urban area, which increased by 9050%

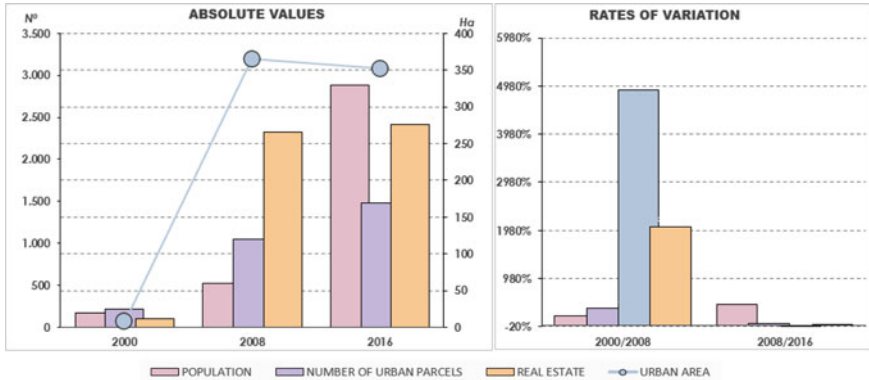


Fig. 11 Example of municipal data sheet for Yebe. Own preparation

between 2000 and 2008, is striking. The built-up area also showed notable changes during this period (rising by 1450%), although the housing production has been even more extraordinary (2051%). The number of urban parcels increased exponentially, especially the number of undeveloped plots (1115%). The least dynamic element is the rate of population change, although it did grow by 214% between 2000 and 2008. Looking at what occurred in the two sub-periods, the unique feature of the demographic variable is that the changes occurred in both the first (2008–2016) and the second (2000–2008) periods, especially since this change is more marked in the latter period (which, paradoxically, was that of the economic crisis). Another striking feature is that the dynamic was more intense in the construction type of housing blocks (1838 open building and perimeter block multi-family dwellings, for the same period), departing from the logic of urban dispersion, which is related in the rest of the cases to the production of single-family dwellings (464 detached and semi-detached buildings over the 2000–2016 period), which were dominant in these two sub-periods in the rest of the municipalities.

In Yebe is Ciudad Valdeluz (Figs. 15, 16, and 17), considered “a symbol of the crisis only 67 kms from the Puerta del Sol in Madrid [...]. Surrounded by concrete skeletons, a handful of neighbours who had bought homes of the highest quality in the middle of nowhere despaired” (Villarino 2015). This urban development created an ex-novo city that failed to meet the expectations of the (few) inhabitants who decided to settle there (Sanz Abad 2014). The special urbanisation dynamics and its characteristics are motivated by the proximity and accessibility to Madrid, the difference in land and housing prices, and the local authorities’ support for unbridled urban development (Martínez Navarro and Vázquez Varela 2018).



Fig. 12 Number of dwellings and construction types (Yebes). Own preparation

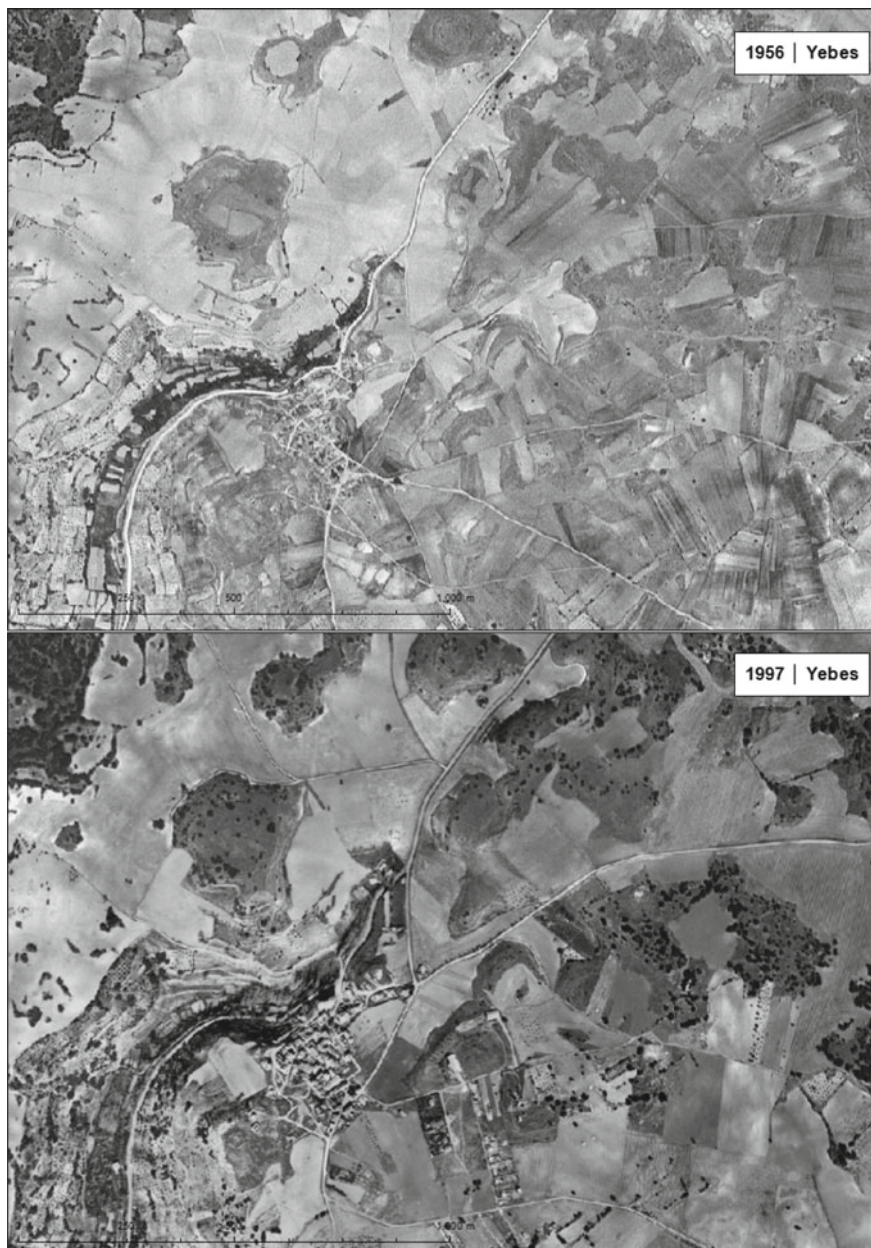


Fig. 13 Orthophotos from the National Plan of Aerial Orthophotos of 1956–1997: Yebes. Own preparation



Fig. 14 Orthophotos from the National Plan of Aerial Orthophotos of 2009–2018: Yebes. Own preparation



Fig. 15 Number of dwellings and construction types (Valdeluz). Own preparation



Fig. 16 Orthophotos from the National Plan of Aerial Orthophotos of 1956–1997: Valdeluz. Own preparation. Own preparation



Fig. 17 Orthophotos from the National Plan of Aerial Orthophotos of 2009–2018: Valdeluz. Own preparation

Conclusions

The processes of urban sprawl form part of the debate on the characteristics and dynamics of the transformation of cities. It is a widespread phenomenon, which has been replicated in the European sociocultural context, and, consequently, in Spain.

The progressive functional, morphological and social transformation of cities has given rise to less dense and more fragmented structures. These structures are also found in intermediate cities. In this case, the analysis of the processes undergone in the last two decades is addressed, using an alternative and complementary methodology to that employed by national and European institutions, based on the use of housing and population variables.

The cadastre in Europe can be a highly useful tool, although it is little tapped and its structure makes it complicated to use. The development of computer tools and instruments for urban studies has proven to be a useful option. In this case, an application was developed that allows massive downloads cadastral of housing information. Designing this application was necessary given that such data are not commonly used for the analysis of urbanisation dynamics.

Using these sources in AHP and cluster analysis methodology reveals a considerable difference between the results obtained and the proposals for definition suggested by Urban Audit (EU) and MITMA (Spanish Government). In this case, the urban areas are apparently better dimensioned and are organised in a 20-km radius around the cities that serve as their reference. The municipalities included are those that are more dynamic than their respective central cities. In addition, using these sources allow a typology of municipalities to be established, according to the processes observed. In this way, the intensity of the processes, territorial scope and municipal typology are features that enhance the use of this combination of methodologies.

The collection of municipal records makes it possible to use an inductive method to recognise how urban sprawl has expanded. It allows us to analyse in detail, case by case, the development of the process on an urban scale. Atypical examples appear (especially in the municipalities in Cluster 1) in which the growth of the urban area has taken place outside the main nucleus of population (Yebes, Ciudad de Valdeluz or Chinchilla de Monte-Aragón).

Finally, it is worth noting that when the dynamics of the central city and the urban areas are compared, it can be observed that growth has been significantly higher in the latter (except for Toledo—the central city—where there is a substantial re-zoned area) and that it has been especially intense in urbanised surface area and housing (much higher than that observed in demographic change).

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