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Suburbanization in Metropolitan Barcelona: Contradictions Between Ideals, Ownership, and Sustainable Urbanism

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Abstract

Since the 1960s, the suburbanization of Barcelona Metropolitan Region has unfolded under ideals of an "American dream" transplanted into a Southern European context characterized by limited resources and a dispersed network of small urban settlements. This process has produced only a small number of true "garden cities," alongside a much larger share of scattered single-family housing developments, many of which still suffer from significant infrastructure deficits. This article examines the contradictions and tensions between residents' expectations and rights, and public policies and regulatory frameworks that have often adopted restrictive rather than constructive approaches. It develops a critical retrospective analysis at two complementary scales in the Barcelona Metropolitan Region. At a large scale, the extent of the urbanization phenomenon is presented through general data, outlining how urban policies over the past three decades have managed to "prevent" new developments of this type. At a more detailed scale, it presents and analyses two contrasting planning experiences co-led by the authors, aimed at upgrading suburban areas located less than 30 minutes from the city center. These case studies include diagnostic assessments, participatory processes, and planning proposals addressing micro-densification, mobility improvements, urban infrastructure upgrading, and the provision of basic services. Finally, the article discusses the need to contain further suburban expansion, including through the reassessment of developable land allocations, while also exploring the consolidation of existing suburban developments by defining urban strategies for their legalization, improving their services, and examining the potential for minimal densification that would enhance the sustainability of these areas.

Keywords

Barcelona; micro-densification; planning processes; suburban developments; urban upgrading

1. Introduction

The major cities of Southern Europe developed during the 20th century by combining compact growth models with extensive low-density suburban expansion. The American model of urban sprawl was not reproduced with identical forms. Instead, pre-existing settlements gave rise to distinct suburbanization patterns, which expanded significantly from the 1960s onwards with widespread automobile use. Territorial development patterns remained diverse, as noted since the 1980s through terms such as the "diffuse city" (Indovina & Istituto universitario di architettura di Venezia, 1990), the "explosion of the city" (Font-Arellano, 2007), and genuine "after sprawl" scenarios (De Geyter, 2002). In this way, shared or context-specific measures, densities, land occupations, and settlement patterns were parameterized, to qualify and characterize the European city–territory (Charmes, 2019; Charmes & Keil, 2015).

This article aims to contribute to the contemporary discussion on the relevance and future of this phenomenon in one of the major urban regions of the Western Mediterranean: the Barcelona Metropolitan Region (BMR). Since the 1960s, large low-density residential areas based on single-family housing plots have been offered as a housing solution for a significant share of the population in the BMR. Prices in these areas were initially lower than in traditional urban centers, and they offered access to lower-density environments closer to nature. Soon, suburbia evolved from a housing solution into an aspirational model, associated with second homes and higher environmental quality, suitable for weekends or holidays. In this way, suburbia shifted from a marginal position to a more privileged status of desirability.

What had been shaped by necessity and opportunity began to be reassessed by planning from the late 1980s onwards. This was due to the emergence of early principles of sustainable development, growing awareness of the need to contain land consumption, and recognition of the negative externalities of these low-density urban growth models, including a lack of planning, occupation of ecologically fragile areas, and deficiencies in the basic complements that should accompany housing, such as safe access, urbanization of roads and public spaces, and the provision of facilities and essential services, among others.

In this framework, the present research does not question whether this type of growth should be limited, since for years there has been a social and political consensus in the country that has led to restraint in territorial planning guidelines. Instead, it examines how contemporary planning can address a model that maintains a persistent appeal, especially given the post-pandemic (Covid-19) shift towards anti-urban preferences. In this context, suburban environments can be understood not only through their negative externalities or in opposition to the compact city model, but also as established territories requiring context-sensitive transformation strategies. Consequently, the research question is: How do sustainable development principles redefine the critical dimensions of planning interventions in established suburban territories?

From this perspective, the research engages with principles of sustainable and inclusive urban development (associated with SDG 11) through an integrated eco-social framework that encompasses environmental and social dimensions. This approach structures the analysis of the case studies around key planning dimensions including the containment of land consumption, the efficiency of infrastructure and mobility systems, the environmental preservation of surrounding landscapes, and their balanced integration with existing urban fabrics. Ecological continuity, accessibility, proximity, and public space quality are treated as key components

of urban sustainability. The research also examines how these spatial and environmental strategies interact with social objectives, including social diversity, access to housing and urban services, and the provision of collective spaces that support social interaction and cohesion. Through a comparative analysis of the two cases, the article explores how sustainability principles become operational, contested, and locally negotiated in the transformation of established suburban territories.

The analysis, conducted at two scales in the BMR, seeks to engage with broader debates that are commonly addressed in the scientific literature (Dunham-Jones et al., 2021; Rubiera-Morollón & Garrido-Yserte, 2020). Through an in-depth examination of local realities, including the local situated knowledge derived from planning practice in two specific suburban areas, the research aims to bridge the gap between a predominantly critical stance towards suburban growth in the literature and the perceptions, concerns, and everyday priorities of local residents, which are often centered on practical and regulatory issues. This approach highlights how universal insights are not reached through detachment, but rather through a deep, localized engagement with reality (Haraway, 1988). By embracing this situatedness, the study moves beyond a purely normative critique to provide a more robust and ethically grounded understanding of suburban transformation.

The article is structured as follows. It begins with a general overview compiling data and findings from various studies at the regional scale, highlighting specific impacts, forms, and spatial structures within a planning framework shaped by particular logics, regulations, and instruments. The third section presents an in-depth analysis of two representative case studies, grounding the broader discussion in specific contexts and incorporating both theoretical and regulatory perspectives, as well as input from local stakeholders. The fourth section organizes the discussion around five key issues: the legalization of existing buildings and plots, the need for urbanization upgrades, the provision of public facilities and open spaces, the controversies surrounding mobility improvements, and alternative approaches to micro-densification. The article concludes by summarizing the main findings and outlining potential directions for future research and policy.

2. Suburban Development in the BMR

The BMR is characterized by its historic polycentric structure, based on a constellation of towns surrounding the central city. The region covers a geographic area of 3,200 km² and comprises 164 municipalities belonging to seven *comarques* (administrative divisions). It is home to nearly 5 million inhabitants. In this territory, beyond the central city, which is compact, continuous, and diverse, numerous historical centers and their modern extensions are scattered, forming a fragmented structure interspersed with open spaces and strongly shaped by geographic features.

Barcelona's role as an economic hub in Catalonia and Spain has driven population growth, urban expansion, and metropolitan integration, including the proliferation of suburban residential areas around the central city, near intermediate towns and in more isolated locations (Figure 1). In this region, the phenomenon of these suburban developments (*urbanitzacions* in Catalan) proliferated spontaneously. They are generally unplanned, located on irregular terrains with steep slopes, and typically consisting of detached single-family homes on individual plots. Suburban developments have reached a massive scale throughout the metropolitan region, covering approximately 20,000 hectares or 6% of the region's total land (Barba &

Mercadé, 2006). They accommodate slightly over 3% of the total population of the BMR, as estimated from recent demographic data.

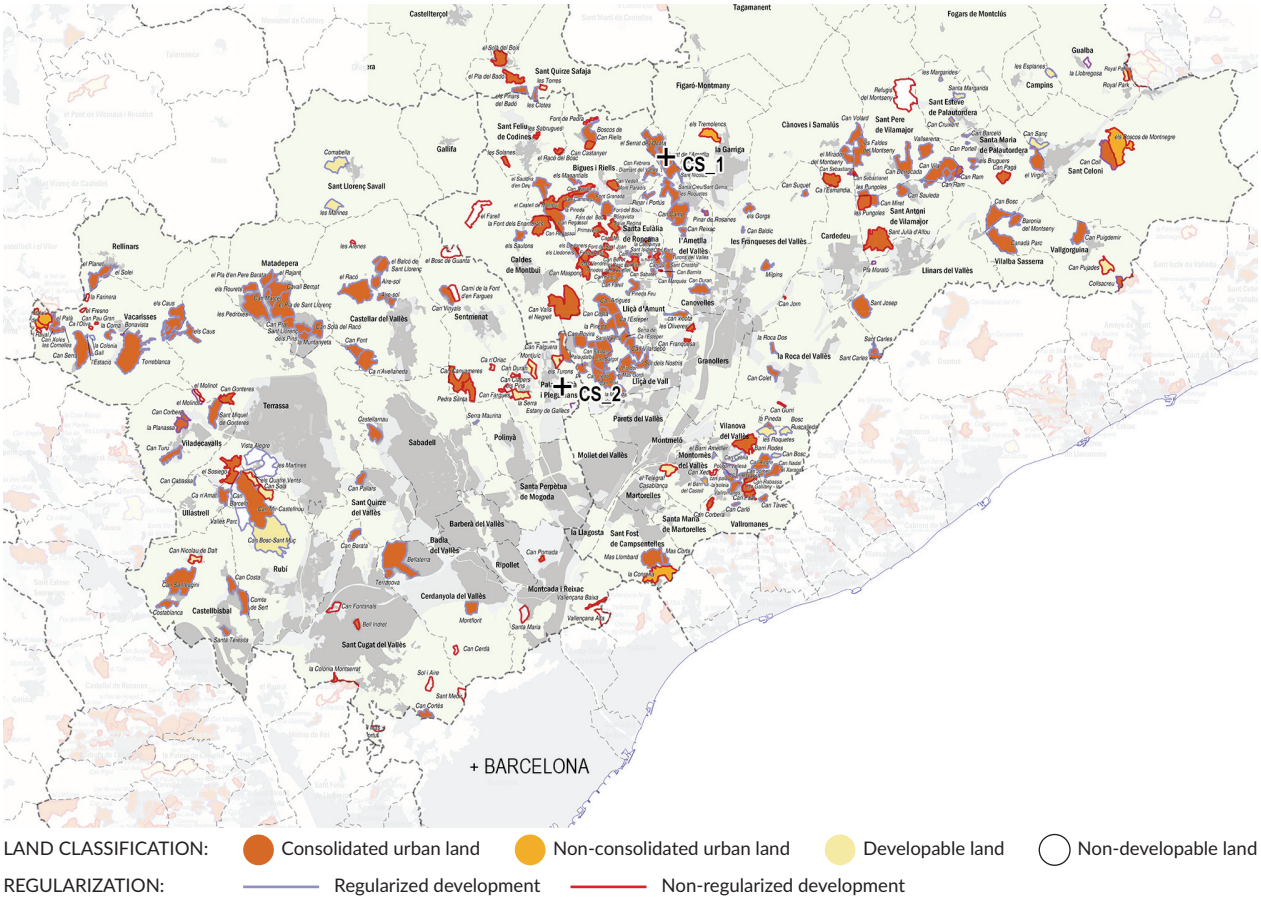

Figure 1. Suburban developments in the Eastern and Western Vallès districts. Distribution, land classification, and regularization status. Notes: CS_1 = Ametlla del Vallès; CS_2 = Palau-solità i Plegamans. Source: Compiled by the authors based on data from the Departament de Territori i Sostenibilitat (2016).

Due to their scale, these suburban and peri-urban developments have been a subject of study and a focus of policy for a range of actors, including academic institutes and public administrations such as the Àrea Metropolitana de Barcelona, the Diputació de Barcelona, and the Generalitat de Catalunya. Numerous studies have sought to precisely define the scope, distribution, and particularities of the process in the BMR (Barba & Àrea Metropolitana de Barcelona, 2018; Barba & Mercadé, 2006; Busquets, 1999; Font-Arellano et al., 1999; Indovina, 2007), while also considering it a local expression of broader global dynamics. Comparable patterns of dispersed suburban growth have been widely documented in international literature, as synthesized in recent reviews addressing the environmental, social, and economic implications of urban sprawl across diverse contexts (Rubiera-Morollón & Garrido-Yserte, 2020). In parallel, contemporary planning scholarship highlights the importance of context-sensitive interpretations, stressing how concepts and strategies related to dispersed urbanization evolve through their adaptation to specific territorial and institutional settings (Vicenzotti & Qvistrom, 2018).

The mid-20th-century urban revolution linked to the spread of the automobile disrupted previous balances in Barcelona. From the 1960s, the ideal of living close to nature, together with expanding road networks,

popularized second residences far from urban agglomerations, known among Catalan working classes as the culture of "la casa i l'hortet" (the house and the garden; Di Giacomo, 1987), revisiting earlier holiday models associated with the railway (Capel, 2011; Cayón et al., 2002). In addition, land competition in central cities and homeownership aspirations (Keil, 2018; Taricat, 2013), along with growing appreciation of coastal, rural, and mountain landscapes, stimulated scattered residential developments. In the BMR, these suburban developments emerged in the 1960s, became consolidated in the 1980s, were partially regularized by democratic municipalities, and between 1990 and 2000 shifted from seasonal to permanent use.

From the 2000s onwards, many scientific studies and public policies have agreed on the need to contain the spread of this type of territorial occupation, with a focus on improving residents' quality of life and metropolitan balance (Barba & Àrea Metropolitana de Barcelona, 2018). A shift from "containment to management" is needed (Muñoz, 2011), requiring legal, economic, social, urban, and architectural approaches. Research approaches range from developing transferable general guidelines (Muxí, 2013) to studies focused on specific projects adapted to the urban singularities of each development (Martín-Ramos et al., 2021; Vall-Casas et al., 2016). This also involves municipal planning processes, which address the management of suburban developments in their jurisdictions.

Data from the Generalitat de Catalunya and the Diputació de Barcelona indicate that nearly 600 suburban developments are located in the BMR, accounting for about 40% of all cases in Catalonia. Around half, in terms of both number and surface area, are regularized. The rest are still pending regularization. They are spread across 111 municipalities, meaning that just over two-thirds of municipalities contain at least one settlement. Overall distribution is relatively even, though some districts show stronger concentrations (Table 1).

In the Garraf district, all municipalities are affected and up to 10% of land is occupied. In Barcelonès, impact is minimal (0.4%) due to Barcelona's dominance. In Alt Penedès, the lower figure (2.6%) reflects the distance from the metropolitan core and agricultural specialization, especially viticulture. The Eastern and Western Vallès districts have the highest number and extent of developments, approaching 100 km², and have comparatively higher regularization rates (Figure 1).

The article analyses the challenges associated with suburbanisation in the BMR in-depth through two case studies, one from each Vallès district, selected for the authors' recent planning experience and their complementarity, which makes them representative of broader dynamics.

3. Research Design and Methods: Case Study Approach in Suburban Areas of El Vallès (BMR)

The two case studies are not presented as isolated planning experiences, but as analytical cases through which broader dynamics of suburbanization in the BMR can be examined. The research adopts a comparative case study approach to explore how legal and socio-spatial conditions shape the challenges and potential transformation pathways of consolidated suburban areas.

The selected cases correspond to residential developments that originated as urban subdivision projects on former agricultural or forested land (Figure 2). Initially conceived as peripheral neighborhoods offering improved environmental quality and housing conditions, these settlements have evolved over time into two

Table 1. Overview of residential suburban developments (SD) in the BMR.

District / *Comarca*	Municipal indicators			Suburban developments (SD)			Spatial extent indicators					
	Number of municipalities	No of municipalities with suburban developments	Share of municipalities with SD (%)	Number of SD in the district	No of regularized developments	No of non-regularized developments	District area (ha.)	Suburban developments area (ha.)	Regularized developments area (ha.)	Regularized area (% of total)	Non-regularized developments area (ha.)	Non-regularized area (% of total)
Alt Penedès	27	13	48.10%	35	12	23	59,270	1,522	397	26.10%	1,125	73.90%
Baix Llobregat	30	22	73.30%	103	54	49	48,600	4,035	1,906	47.20%	2,129	52.80%
Barcelonès	5	2	40.00%	4	0	4	14,580	63	0	0.00%	63	100.00%
Garraf	6	6	100.00%	65	19	46	18,510	1,878	899	47.90%	979	52.10%
Maresme	30	22	73.30%	132	64	68	39,850	3,318	1,693	51.00%	1,625	49.00%
Vallès Occidental	23	18	78.30%	98	54	44	58,310	3,885	2,917	75.10%	968	24.90%
Vallès Oriental	43	28	65.10%	161	98	63	85,100	4,768	2,962	62.10%	1,806	37.90%
TOTAL BMR	164	111	67.70%	598	301	297	324,220	19,469	10,774	55.30%	8,695	44.70%

Source: Compiled by the authors based on data from the Departament de Territori i Sostenibilitat (2016).

complementary models of suburban development, reflecting broader patterns of transformation between 1956 and the present day. Today, both areas face challenges that are representative of a significant share of suburban growth in the region, particularly in relation to socio-ecological performance and land-use legality.

Figure 2. Chronological timeline of urban evolution: 1956, 1970–1977, and 2025. Top: Case Study 1, El Serrat. Bottom: Case Study 2, El Castell. Source: Compiled by the authors based on data from the Institut Cartogràfic i Geològic de Catalunya (2024).

The rationale for the case selection is twofold. First, in terms of legal status, the cases represent the two contrasting situations identified in Section 2: "regularized" versus "non-regularized" developments. Second, from a socio-ecological perspective, both occupy an intermediate position. They are neither low-density areas with high transformation capacity linked to public transport accessibility, nor precarious settlements where de-urbanization might still be considered. Instead, both have a high degree of consolidation, making them particularly relevant for analyzing incremental improvement strategies.

From a comparative perspective, the two cases share several structural features, including: a similar distance from central Barcelona (25–35 km, or 30 minutes by car); subdivision processes initiated in the 1960s, with consolidation occurring in subsequent decades; proximity to small historical towns with populations of around 10,000 to 15,000 inhabitants; a high degree of built consolidation, with few plots remaining undeveloped; and a predominance of permanent residences.

At the same time, they differ in some aspects that enable a more nuanced understanding of the challenges associated with suburbanization in the BMR. These include: legal land-use status, which is consolidated urban land in the first case and non-consolidated land in the second; scale and spatial configuration; and degree of connectivity to and accessibility of surrounding urban centers. Together, these differences allow an examination of how distinct regulatory and spatial conditions influence planning responses in consolidated suburban environments.

Figure 2 illustrates the historical evolution of both case studies. The first (CS_1, El Serrat) is located in a forested area characterized by steep slopes and a relatively isolated spatial structure. The second (CS_2, El Castell) developed within an agricultural context, later becoming embedded in a more fragmented peri-urban mosaic. These differing environmental and spatial conditions have shaped both their initial formation and their subsequent trajectories.

3.1. Case Study 1 (CS_1): El Serrat Residential Area, Ametlla del Vallès (41.69750° N, 2.23735° E)

L'Ametlla del Vallès is located 35 km from Barcelona at the northern periphery of the metropolitan region. Geographically, it serves as a transitional zone between the Vallès plains and the pre-coastal range, situated at the Congost Pass adjacent to the Cingles de Bertí (Montseny) Natural Park. While its origins are medieval, the town emerged as a prominent seasonal retreat in the early 20th century. The main catalyst for modern expansion was the upgrading of the highway network connecting to Barcelona in the 1970s, which acted as a powerful stimulus for the development of 10 suburban residential areas. These now cover 325.95 hectares, representing 70% of the municipality's total urban land.

Drawn up in 1969, the original planning documents for El Serrat Residential Area emphasize the opportunity to repurpose land "with low agricultural yield" into a premium residential zone, given its "ideal residential characteristics." Features that are highlighted include panoramic views of the Vallès plain, surrounding forests, and optimal conditions for sun exposure and natural ventilation. The original plan provides for the development of a 31-hectare plot intended for approximately 140 dwellings, resulting in a very low density of fewer than five dwellings per hectare. Following this first development, adjacent large-scale rural estates underwent a similar urbanization process, with closely comparable morphology and density. This eventually formed a continuous urban fabric with other residential areas (La Miranda, La Fustera, and Sant Nicolau), which were formally recognized as consolidated urban land under the 1987 General Master Plan (Pla General d'Ordenació). The master plan is still in effect and currently under revision.

3.1.1. Data Collection and Mapping

An exhaustive data collection process, complemented by extensive fieldwork and subsequent data processing using GIS and CAD software, enables a precise analysis of the current state of these residential developments, through works commissioned by the administrations. For the first case study, the research was conducted as part of the ongoing revision of the municipal master plan (Preliminary Plan, 2020–2022, and Master Plan, 2024–present).

The suburban development under planning covers a total surface of 84.33 ha, which is three times the original rural plot. It is comprised of 467 detached single-family dwellings, 22 semi-detached units (Figure 3a), and

114 vacant plots or undeveloped units (Figure 3b), resulting in a current density lower than six dwellings/ha and a potential density of eight dwellings/ha (the maximum development capacity permitted under current land-use regulations).

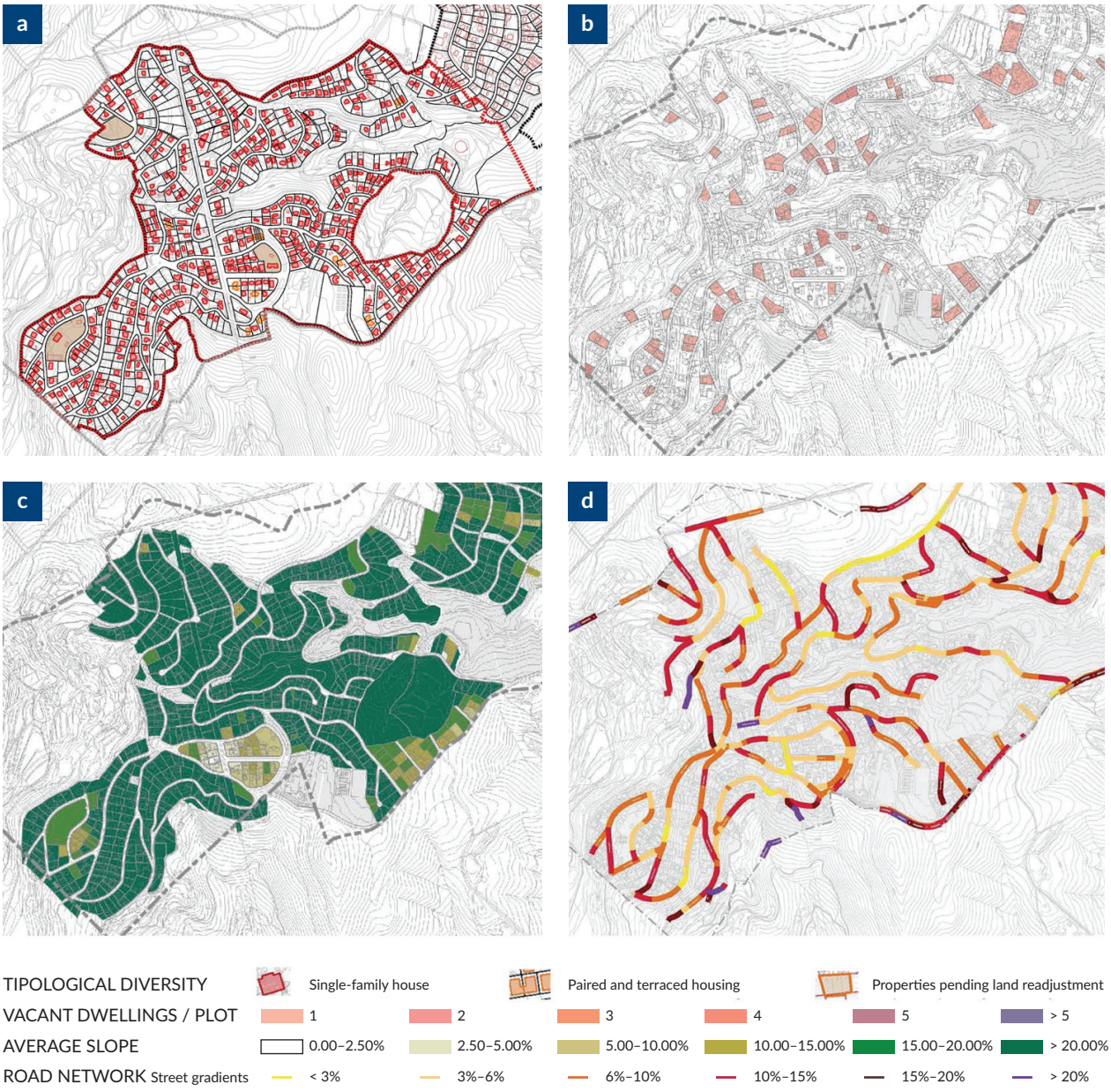

Figure 3. CS_1 mapping characterization: (a) typological diversity; (b) vacant dwellings; (c) average plot slope; (d) street gradients.

The urban analysis reveals a relatively uniform fabric. The construction of the dwellings was made compatible with the preservation of certain trees and permeable soil, providing environmental quality to the surroundings, despite the very basic level of street urbanization and a low sense of security due to the poor relationship between houses, gardens, and the street, as homes remain hidden behind opaque fences.

Due to the original ownership structure and the organic street layout, plot sizes show considerable variation, corresponding to the minimum plot regulations in each sector: 400 m² in some areas and 600 m² in others, while the largest plots are over 8,000 m².

Over 90% of plots in El Serrat exceed a 20% slope (Figure 3c), a condition now considered excessive for new developments but typical of earlier hillside suburban developments. This creates major technical and regulatory challenges for integrating buildings into the natural landscape. Accessibility and mobility are also constrained, as many streets have slopes exceeding 10, 15, and even 20% (Figure 3d), with significant access difficulties.

3.1.2. Participatory Processes

The urban planning for the improvement of these sectors is closely linked to the desires and difficulties expressed by their inhabitants. In general, these processes require a phase of guidance and clarification of technical and legal terms so that residents understand two key issues: first, the gap between the rights they perceive as owners and their actual legal status; and second, the equally significant distance between the comforts of their lifestyle model, associated with relatively low costs, and the actual cost of the low-density model in terms of public service demands, resource consumption (water, energy, and goods), and CO_2 emissions.

Citizen participation in this case was carried out as part of a broader discussion on the municipal master plan. The participatory process included three types of activities: thematic presentations and debates (three), participatory walks (two), and an open survey. Notably, the survey (June–August 2021) attracted 300 participants, 25% from the northern district where El Serrat is located. It comprised 42 questions structured around four pillars: the growth model, the social impact, the economic scope, and the urban and territorial framework.

The Diagnostic Results Memorandum indicates that residents value the low-density model primarily for its tranquility, convenience, and privacy, and often use the term “quality urbanism” to describe it. Conversely, it is recognized that this model exacerbates individualism and correlates with deficits in road safety and increased risks of residential burglary. A notable controversy exists on two specific issues: the opportunity to foster a more transparent and less restrictive relationship between the private homes and the public street, and the absence of dedicated spaces for community gatherings and social interaction. Both aspects reflect broader debates about how suburban residential areas can balance individual privacy with social cohesion and public accessibility.

Paradoxically, in these participatory processes, half of the respondents expressed that future growth should continue to favor the detached single-family house model. However, a smaller percentage (17%) advocated for maintaining the typology while permitting internal densification within the plots. An almost identical percentage emphasized the need to promote the construction of multi-family blocks for affordable housing. As other participatory experiences reveal, across all these issues, both supporters and opponents emerge, combining a collective view of the neighborhood with their own individual needs and preferences (Ruming et al., 2024).

3.2. Case Study 2 (CS_2): El Castell Residential Area, Palau-Solità i Plegamans (41.57983° N, 2.18469° E)

The second case study exemplifies a semi-consolidated, low-density suburban development. While the area is largely built and subdivided, persistent deficits in infrastructure, including paving, sewerage, and service supply networks, have prevented plots, long developed and occupied, from achieving legal urban land status. The El Castell sector began its subdivision process in the late 1960s through a largely unregulated parcellation model, originally applied to 14 rural plots for subsequent subdivision (Figure 4a). Although this produced a fully consolidated built environment, the area remains legally precarious, with numerous streets and green spaces still lacking essential infrastructure. With the arrival of democracy, municipal planning regulated sectors according to their degree of consolidation, either recognizing them as urban land or setting the conditions for attaining this status.

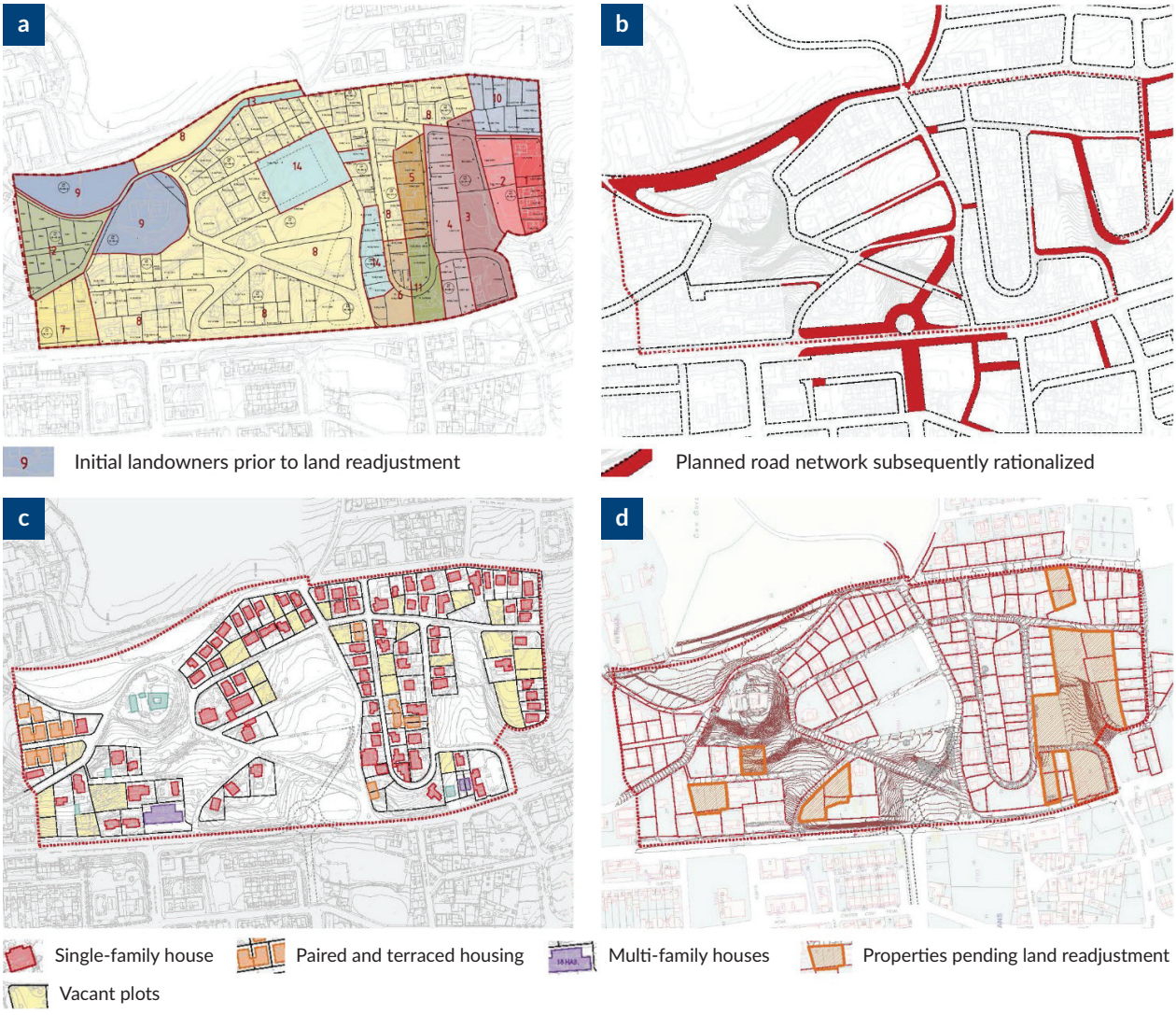

Figure 4. CS_2 mapping characterization: (a) ownership structure; (b) street-space deficits; (c) typological diversity; (d) vacant plots.

Successive planning efforts, including the 1978 General Plan (Pla General d'Ordenació de la comarca de Sabadell), followed by the drafting and approval of the 1984 Detailed Plan (Pla Parcial) and the corresponding 1986 Urbanization Project, attempted to legalize the sector through required land cessions and pending infrastructure works. However, legal disputes and disagreements among property owners ultimately led to the judicial annulment of the final parcellation process. The vicissitudes associated with this case are highly representative of the inherent complexity of urban planning processes in the Spanish legislative framework. This complexity stems from the intricate interrelationship between housing building permit approvals, land subdivision (parcellation), and urbanization projects, all of which must align with the protracted administrative procedures for detailed sector planning and municipal-scale master planning. The contradiction between licenses that are "legally" granted by municipal authorities and the nullity of the overall planning for the area leads to a legally ambiguous situation. Rather than strictly illegal, it should be considered "alegal" or existing in a legal vacuum, as it stems from conflicting layers of administrative validity.

Following the latest revision of the municipal master plan (Pla d'Ordenació Urbanística Municipal; Ajuntament de Palau-solità i Plegamans, 2015), the area was designated as a specific Urban Development Unit (Polígon d'Actuació Urbanística – PAU 09 El Castell). This designation has initiated a new phase of urban studies and community engagement seeking to provide definitive resolution to the sector's long-standing technical and legal challenges.

3.2.1. Data Collection and Mapping

The comprehensive assessment of the existing condition of this suburban development stems from a regional administrative commission established in 2022. The main features of the sector are as follows. First, it covers 15.93 ha, according to Pla d'Ordenació Urbanística Municipal sectorization, with 10.11 ha of private land and potential for 277 dwellings (223 free-market and 54 public housing). The maximum density is 17.38 dwellings/hectare, 0.39 floor area ratio, plus 1,248 m^2 allocated for non-residential use. Second, in total there are 144 plots, of which 103 are already built, representing a consolidation rate of 71.5%. Third, street analysis shows clear differences in hierarchy and levels of urbanization. These variations make a uniform, high-cost approach unnecessary and instead support tailored standards, especially for streets with significant deficits (marked in red in Figure 4b). Fourth, street parking frequently encroaches on pedestrian space. Future urbanization must determine whether on-street parking is essential (due to limited space on private plots) or whether street design should be adapted to prioritize off-street parking areas. Fifth, housing is primarily single-family (96 isolated, 17 semi-detached) with only two multi-family buildings (20 units), creating minimal diversity in terms of typologies (Figure 4c). There are 127 existing homes and 101 yet to be built (in the plots marked in orange in Figure 4d), totaling 228. This represents 82% of the planned capacity (277 units), a discrepancy that will be analyzed in the discussion section.

Following an initial phase focused on preliminary studies supported by the Diputació de Barcelona (January–October 2022), the process has now entered the executive stage. This current phase is centered on drafting a technical amendment to the master plan aimed at the area's full consolidation. By approving the necessary planning instruments, the legal status of the sector will be regularized, finally allowing for the development of vacant plots and the fulfilment of the original density and zoning goals.

3.2.2. Participatory Processes

In the second case study, participatory activities included a survey and an "active walk" (11 February 2023) to discuss initial planning efforts (Figure 5). Fifty residents joined a 1.5 km route highlighting key issues, providing oral and written feedback at designated stops. A total of 41 people completed the survey, most of whom were long-term residents with primary homes in the neighborhood.

The survey results show that over 95% of residents are satisfied with their home, and 52% are very satisfied with neighbor relations. Key positives in Castell are tranquility and low traffic (70%), followed by proximity to nature and green areas (40%), plus lower density and distance from industry. Residents stressed that street and public space design should not be uniform and suggested defining sub-areas with similar conditions. Some also proposed restricting access to residents only, though this was debated due to the public role of streets and access needs.

There was broad consensus that the planned fast peripheral road is unnecessary, as are new streets or the widening of existing ones. Instead, priorities included lowering speed limits, rationalizing the road network, and avoiding further loss of farmland. Residents also called for infrastructure upgrades, such as burying overhead cables and improving the sewerage system. Regarding green spaces, many residents supported concentrating the planned green areas into a single central park.

On densification, there was a general consensus against multi-family housing, except along the main artery (Avinguda Catalunya), where two- to four-story buildings were considered acceptable. Finally, most also favored keeping undeveloped plots as green areas.

Figure 5. Participatory process: urban walk, 11 February 2023, in Palau-solità i Plegamans.

4. Discussion

CS_1 and CS_2 illustrate typical scattered suburban developments in the BMR. They also reveal considerable differences in scale, density, and spatial conditions (Table 2). Although the two cases differ substantially in overall size (84.3 versus 15.9 ha) and number of dwellings (496 versus 127), they share relatively similar land distribution, with approximately 65% private land ("zones") and 35% public land ("systems"). Other parameters diverge more significantly. Maximum housing density in CS_2 is approximately twice that of CS_1, while the amount of private land per inhabitant remains considerably higher in the first case (436.19 versus 318.45 m^2/inhabitant). However, the most substantial contrast lies in topographic accessibility conditions, with average slopes of 14.71% in CS_1 and 2.93% in CS_2.

Table 2. Parametric comparison of the urban features and standards of both case studies.

	Case study 1: El Serrat			Case study 2: El Castell		
Urban development land area	Area [Ha.]		%	Area [Ha.]		%
Private land	54.10		64.10%	10.10		63.50%
Public land (streets)	12.60		14.90%	3.00		19.10%
Public land (parks and facilities)	17.70		21.00%	2.80		14.40%
Total	**84.40**		100.00%	**15.90**		**100%**
Plots and dwellings	No. of plots	No. of dwellings existing	No. of dwellings potential	No. of plots	No. of dwellings existing	No. of dwellings potential
Single-family units	467	467	467	98	98	133
Semi-detached units	5	22	22	18	11	37
Multi-family units				2	18	107
Large single-family units	7	7	75			
Empty plots	114	0	114	37		
Total	**593**	**496**	**678**	**155**	**127**	**277**
Urban standards	Existing		Potential	Existing		Potential
Density dwellings/hectare	5.88		8.04	7.98		17.41
Private land m^2/inhabitant	436.19		319.01	318.45		146.01
Estimated Population (2.5 inhabitant /unit)	1,240		1,695	318		693
Accessibility	Elevation max/min [m.]	Elevation difference / distance [m.]	Average slope	Elevation max/min [m.]	Elevation difference / distance [m.]	Average slope
Distance/elevation to the urban centre	565 / 315	250 / 1,700	14.71%	171 / 130	41 / 1,400	2.93%

The two case studies, based on the authors' planning experience, help identify key issues shaping the future development of similar suburban areas. These debates, which are common in technical, political, and civic spheres, are relevant to areas near small, consolidated settlements dominated by primary residences, as in both cases. This distinguishes them from larger suburban areas dominated by second homes that are weakly

connected to compact urban centers, which are also common in the BMR and along the Catalan coast. In these cases, diagnosis and improvement strategies would require additional, complementary approaches.

The discussion is framed from an urban-planning perspective, focusing on low-density areas that nonetheless require stronger territorial integration and more sustainable ways of living. Issues such as the energy efficiency of housing originally designed as seasonal residences, the per-dwelling impact of infrastructure networks, mobility patterns, and the provision of public space and facilities must be understood within broader territorial needs.

Based on the analysis of the two case studies, the research question can be addressed more explicitly by identifying the critical dimensions through which sustainable development principles become concrete, contested, and locally negotiated in established suburban territories. The discussion is therefore structured around five complementary dimensions. These are legalization, urbanization upgrades, public facilities and open spaces, mobility, and micro-densification. They are understood not as isolated planning problems or prescriptive guidelines, but as interconnected analytical lenses through which the challenges and opportunities of suburban transformation can be interpreted. Together, these dimensions reveal how environmental, social, legal, and spatial objectives must be continuously negotiated and balanced to support more sustainable forms of suburban development.

4.1. Legalization of Existing Buildings and Plots

The cases analyzed reveal the centrality of legal ambiguity as a structuring condition of suburban development in the BMR. Rather than exceptional situations, irregular or non-regularized developments emerge as a widespread outcome of fragmented planning processes and longstanding misalignments between legal frameworks and urbanization practices.

In this context, CS_2 illustrates how legalization is not a linear administrative procedure but a negotiated and technically mediated process, in which planning instruments must reconcile existing built realities with regulatory requirements. More broadly, these findings suggest that legalization should be understood not merely as a corrective action, but also as an integral dimension of suburban transformation.

The suburban lifestyle model centered on the single-family house and garden has frequently conflicted with planning legislation in Spain, resulting in deficiencies related to land classification, infrastructure provision, and building permits. As illustrated by CS_2, the regularization of these situations often depends on flexible planning mechanisms, including the redefinition of intervention areas and the adjustment of urbanization standards to reduce implementation costs. In this respect, the analysis highlights both the adaptability and the limits of existing regulatory frameworks when confronted with historically informal suburban development.

4.2. Urbanization Upgrades

The upgrading of street infrastructure emerges as a key entry point for the transformation of consolidated suburban areas. The cases show that existing urbanization patterns are largely based on outdated mobility paradigms that prioritize vehicular circulation over environmental performance and pedestrian use.

In this context, proposed changes need not entail increased costs and may even reduce infrastructure demands. The analysis highlights the potential of more flexible street design approaches, including permeable surfaces and shared-space streets with strict speed limits to enhance pedestrian safety. The cases also identify parking demand as a key constraint in reconfiguring street space, revealing a tension between existing mobility practices and alternative urbanization models. While part of this demand could be absorbed in private plots, some collective parking solutions would still be required.

In CS_2, the retrofitting proposal differentiates between streets primarily oriented towards vehicular circulation and others conceived as shared-space environments. In parallel, the CS_1 plan highlights the opportunity to improve pedestrian walkability through alternative paths running parallel to streams (Figure 6a), which are particularly suited to leisure and recreational uses.

Taken together, these findings suggest that street upgrading should be understood not only as a technical intervention, but as a reconfiguration of the spatial and functional logic underpinning suburban mobility.

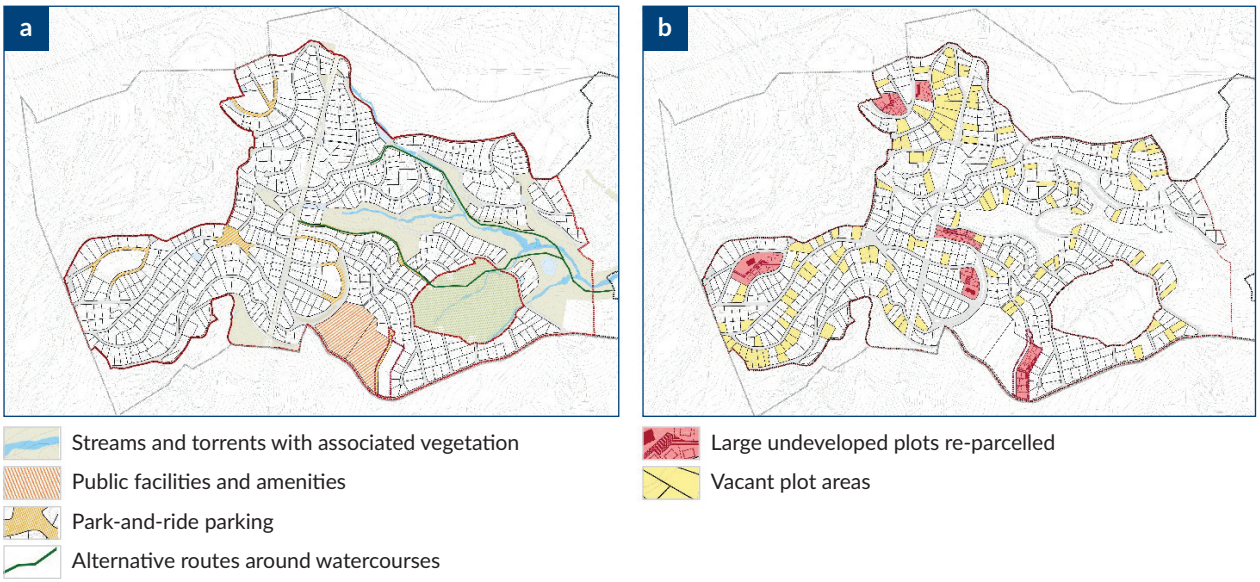

Figure 6. CS_1 urban strategies: (a) green spaces, ecosystemic services, and street pattern interventions; (b) micro-densification.

4.3. Provision of Public Facilities and Open Spaces

The provision of public facilities and open spaces highlights a fundamental ambiguity in the suburban model between individualized and collective forms of amenity. The cases show how early developments relied on private or semi-private facilities as substitutes for public infrastructure, shaping long-term patterns of service provision and social interaction.

As a direct import from the Anglo-Saxon model, many residential developments were originally organized around "social clubs" associated primarily with leisure activities rather than basic public services. Typically centered on swimming pools and sports facilities, these clubs functioned as shared amenities and informal social hubs fostering neighborhood interaction.

The CS_1 case illustrates how some of these collective functions have progressively shifted towards more individualized forms of use, particularly through the widespread incorporation of private pools. Furthermore, certain facilities such as sports clubs have adapted to changing recreational practices, maintaining their role as spaces of social interaction.

Determining which facilities these developments require today remains a central issue. The analysis suggests that this question is conditioned not only by changing demographic and social demands, but also by structural limitations including low density, spatial fragmentation, and limited integration with surrounding urban systems. While residents often demand additional services, many developments lack the critical mass required to sustain them.

Public space provision is similarly contested. Green areas designated in planning documents frequently respond to regulatory requirements rather than broader urban or social objectives, and are often poorly integrated into everyday use patterns. This raises questions regarding the viability of collective public space within residential environments where "green space" is already embedded in the private dwelling through gardens and pools.

In addition, the cases indicate that these spaces should not be understood solely in terms of social use, but also as components of broader ecological systems contributing to environmental quality and ecological connectivity (Figures 6a and 7a).

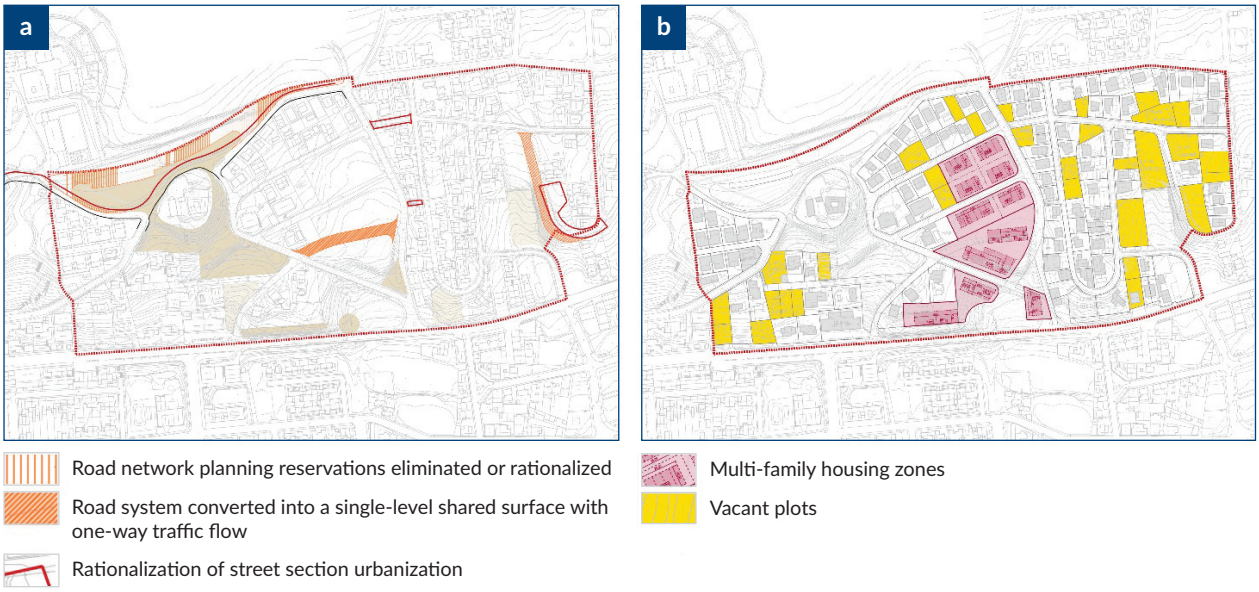

Figure 7. CS_2 urban strategies: (a) green spaces, ecosystemic services, and street pattern interventions; (b) micro-densification.

4.4. Mobility Improvements

The cases reinforce the well-documented dependency of low-density suburban environments on private vehicles, while also illustrating the structural constraints that limit the viability of conventional public

transport systems. Empirical evidence from both case studies confirms the predominance of car-based mobility, which reflects the combined effects of low density, spatial dispersion, and limited service provision.

In CS_1, mobility audits and participatory processes reveal a strong dependence on private vehicles and a very limited role of active or public transport modes in everyday practices. Similarly, surveys conducted in CS_2 indicate that most local journeys are made by car. They also reveal moderate openness among residents towards alternative mobility arrangements and changes in street configuration.

The analysis suggests that low-density suburban environments may require more flexible and hybrid mobility solutions than those provided by conventional public transport systems. Existing European and regional initiatives point towards alternatives such as demand-responsive transport, shared mobility systems, and the promotion of active mobility.

In this respect, while the predominance of private car use remains evident in both case studies, there is also a growing recognition that street space could be reconfigured to support more diversified mobility patterns.

Taken together, these findings suggest that mobility in low-density suburban areas should be understood not only as a technical or infrastructural issue, but also as a socio-spatial practice deeply embedded in the logic of the suburban model, and therefore resistant to rapid transformation.

4.5. Micro-Densification

The analysis of both case studies reveals what can be described as a "densification paradox," in which densification is simultaneously recognized as a necessary condition for improving the sustainability and long-term viability of low-density suburban areas, while also being perceived by many residents as a threat to the established suburban lifestyle. This resistance persists despite the progressive ageing of the original population and the growing difficulties faced by younger households in accessing these environments due to high housing costs and dependence on private vehicles, factors that reinforce social homogeneity.

Dwelling density should not be understood as a universal or infallible indicator of urban quality, since it only partially reflects the intensity and diversity of social life (Pafka, 2013). In this respect, the findings suggest that the retrofitting of suburban developments cannot be interpreted as a straightforward transition towards a conventional "compact city" model (Rice, 2010). Rather, the cases point towards more incremental and context-sensitive forms of intensification that can increase demographic diversity and improve the economic viability of services and infrastructures without radically transforming the existing urban fabric.

From this perspective, micro-densification emerges less as a singular planning solution than as a set of differentiated strategies conditioned by local spatial, legal, environmental, and social factors. The cases analyzed illustrate three complementary approaches that are currently under consideration.

4.5.1. Occupation of Vacant Land

The persistence of vacant plots in both case studies highlights the limits of interpreting available land reserves as immediately mobilizable resources for densification. Although both cases contain a significant number of

undeveloped parcels (114 plots in CS_1 and 37 plots in CS_2), their activation for urban development is highly constrained in practice.

The analysis suggests that the viability of this strategy is shaped less by physical availability than by the logic of fragmented private ownership and individual decision-making. Vacant plots often remain undeveloped due to diverse owner strategies, including the consolidation of larger garden areas, long-term land reservation, or speculative holding patterns.

These dynamics illustrate how property regimes can act as a structural constraint on densification processes, limiting the capacity of planning instruments to mobilize land in consolidated suburban environments.

4.5.2. Sector Densification via Horizontal Property Subdivision

Horizontal property subdivision illustrates a form of incremental densification that seeks to reconcile increased residential intensity with the preservation of the morphological identity of low-density fabrics.

The analysis explores the potential of this mechanism to increase the housing stock while maintaining the fine-grained character of suburban environments, without substantially increasing built volume. In the Spanish context, "división horizontal" is the legal mechanism that enables a single building to be subdivided into multiple independent units, combining individual ownership of dwellings with shared ownership of common elements. Beyond increasing density, this approach may also support greater social diversity through more varied housing typologies and tenure arrangements.

The cases also reveal considerable regulatory and spatial constraints. Densification processes remain tied to statutory requirements on public amenities and infrastructure provision, although current regulations establish some exceptions for affordable housing (Generalitat de Catalunya, 2012, Art. 100.2). Likewise, the adaptability of existing buildings to subdivision varies significantly depending on architectural configuration and accessibility conditions. In this respect, the strategy prioritizes the retrofitting of existing housing stock over more intensive redevelopment models, in line with broader concerns about carbon reduction and architectural renewal (Sauquet et al., 2019).

The applicability of this approach differs substantially between the two case studies. In CS_1, implementation is limited by environmental risks and accessibility constraints, whereas in CS_2 horizontal subdivision is considered a key mechanism for increasing residential intensity without altering the neighborhood's low-rise character. However, the viability of this strategy ultimately depends not only on regulatory flexibility, but also on the willingness of residents to renegotiate established forms of domestic space and property use.

4.5.3. Insertion of Small-Scale Multi-Family Developments on Vacant Plots

The insertion of small-scale multi-family developments is the most explicit form of intensification examined in the case studies, and consequently the one that generates the greatest tensions in terms of landscape character, accessibility, and neighborhood identity.

In the remaining undeveloped areas of these suburban fabrics, the cases indicate that coordinated planning may create opportunities for targeted intensification. This approach introduces a minimal density framework that seeks to improve environmental performance while supporting connections with adjacent green infrastructure. Rather than a purely quantitative increase in density, the strategy is associated with broader objectives related to mobility diversification, social interaction, and environmental resilience (Figures 6b and 7b).

The CS_1 case reflects a predominant resistance to the introduction of multi-family housing, justified by accessibility constraints and landscape considerations. Within this context, a specific initiative proposes the re-parceling of large vacant plots (Figure 6b), despite existing regulatory frameworks that limit changes to parcel structure. This proposal is framed as an attempt to reconcile housing provision with environmental and social objectives.

In contrast, CS_2 illustrates a more favorable planning context, where multi-family housing was already envisaged in the original plan, particularly in central areas and along main access corridors (Figure 7b). Current studies focus on defining appropriate building envelopes to ensure compatibility with the existing urban fabric.

The contrasting reception of this strategy across the two cases highlights how the social and political acceptability of densification is strongly conditioned by local spatial configurations and collective perceptions of urban change.

5. Conclusions

This article, within the broader framework of the thematic issue on suburban development and city extensions, addresses the urban planning challenges associated with suburban growth in a Southern European metropolis throughout the case of BMR. To this end, it adopts a dual approach based on two contrasting scales. Firstly, it provides a general contextualization of the phenomenon at the regional scale, drawing on previous studies. Secondly, it develops a more novel, fine-grained perspective through a practice-based approach bridging research and professional practice. While intermediate scales were considered throughout this process, the scope of this article did not allow their explicit inclusion. Nevertheless, this dual approach, combining general data with in-depth, case-based knowledge, is particularly valuable for advancing discussion on the topic. Its relevance extends beyond the specific geographical context and may be transferable to other suburban growth contexts, such as smaller metropolitan regions without a dominant central city, or to other European and international settings.

The study reveals notable differences between professional and resident perspectives. Commonly accepted assumptions in academia or professional practice do not always align with residents' own assessments of the shortcomings in the suburban development model they inhabit. This observation calls for careful reflection: On the one hand, there is a need to better communicate the technical perspective to residents; on the other, the insights and experiences of residents should be incorporated into academic and professional deliberations. In both case studies, the Participatory Processes sections, complementing the Data Collection and Mapping analysis, highlight the role of participatory approaches as a means of accessing situated local knowledge. Through a combination of methods (including workshops, site walks, and surveys), these

processes also allow citizens to become familiar with the technical rationales behind the unsustainability of certain urban forms and the legal ambiguity of specific situations. This is particularly relevant in contexts where divergent perceptions between residents and planning professionals shape both the interpretation of existing conditions and the scope of potential interventions.

More broadly, the research suggests that the transformation of established suburban territories cannot rely exclusively on standardized sustainability frameworks or rigid planning regulations originally conceived for different urban conditions. While the maintenance of fundamental legal and environmental principles remains essential, the case studies highlight the importance of context-sensitive and adaptive approaches to urbanization standards, densities, public space provision, and certain building regulations. The challenge is not only technical, but also cultural and institutional: how to progressively reconcile residents' lived perceptions and expectations with planning frameworks often shaped by highly normative assumptions, to make the sustainable transformation and territorial integration of these suburban areas realistically achievable.

Further research could build on this framework in two complementary directions. First, it could develop comparative analyses across regions and contexts, at both scales, to identify patterns of similarity and difference. Second, future research could deepen the practice-based dimension of the approach by incorporating additional case studies derived from professional planning work, to further test, refine, and expand the methodological and conceptual insights proposed here. In this respect, the article emphasizes how diagnosis emerges from context-sensitive analysis, in which situated knowledge plays a central role.

The findings are not intended to be directly generalized, as they stem from highly specific local conditions and from the planning framework of the BMR. Nonetheless, the case studies provide broader lessons for debates on suburban transformation. In particular, they highlight the importance of combining containment and regeneration strategies, the central role of legal regularization and resident acceptance, and the need for incremental, negotiated, and context-sensitive interventions rather than large-scale or purely normative retrofitting models. More broadly, the cases also suggest that future demographic transformations may create opportunities for redefining the long-term viability and social composition of established suburban territories. These contributions are synthesized in four main insights:

- The Imperative for Containment and Regeneration: In the BMR, a consolidated planning consensus has emerged centered on the strict containment of the low-density model. This paradigm shift is robust enough to support the active deprogramming of developable land previously zoned for such development. However, given the sheer scale of the existing suburban footprint, containment alone is insufficient. Proactive management of these areas is also required. In this context, the analysis underscores the relevance of emerging planning instruments and experimental interventions aimed at addressing the systemic inefficiencies of these areas.
- A Combinatorial Approach to Heterogeneity: The structural heterogeneity of the suburban developments renders one-size-fits-all solutions ineffective. A combinatorial strategy, tailoring interventions to local needs, is therefore recommended. In some cases, priority should be given to urgent administrative resolutions, such as legalizing land tenure regimes. In others, the focus should shift to short-to-medium-term qualitative improvements, such as street urbanization and the provision of public facilities, which are generally well received by residents. These "soft" interventions contrast with the more controversial, yet essential, structural reforms associated with densification.

- The Densification Paradox: Densification is a central challenge and a cornerstone strategy for transitioning low-density suburbs towards a sustainable economic and environmental model. Although there is broad technical consensus on its efficiency, implementation faces significant barriers and is often perceived by residents as a threat to their established lifestyle in the case studies analyzed here. This perception is consistent with findings reported in other international contexts (Ruming et al., 2024). Case studies testing strategies such as infill development on vacant plots, horizontal subdivision of existing dwellings, and micro-densification reveal a clear tension between planning objectives and community acceptance. Effective deployment of these strategies therefore requires robust regulatory and fiscal incentives to mitigate resistance.
- Demographic Evolution as a Catalyst for Change: Ultimately, the intersection of the current housing emergency and the progressive aging of the population in low-density areas may create opportunities to overcome this impasse. Even small, targeted adjustments to existing development patterns, limited in scale but capable of triggering meaningful change, could support greater social diversity and more efficient service provision. Taken together, these shifts suggest pathways to enhance the resilience of these areas and improve their functional integration in the broader urban and social system.

Taken together, these insights contribute to a more nuanced understanding of suburban transformation processes in contexts characterized by regulatory ambiguity, socio-spatial heterogeneity, and competing planning rationalities.

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Conflict of Interests

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