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ELIZA SZCZEREK *, DAMIAN POKLEWSKI-KOZIEŁŁ**, MICHAŁ WIŚNIEWSKI***, DOROTA JĘDRUCH****, ADOLF SOTOCA*****, ARAITZ VILLALBA-RODET******

Evaluating Data Availability in the Development of Socio-Environmental Cartographies of Mass Housing Estates

Streszczenie

Artykuł analizuje możliwości wykorzystania cyfrowych danych przestrzennych w diagnostyce społeczno-środowiskowej powojennych zespołów mieszkaniowych oraz w rozwoju kartografii partycypacyjnej angażującej lokalne społeczności w proces mapowania. Głównym celem badania jest ocena dostępności, zakresu i jakości danych udostępnianych w otwartych zasobach Krakowa i Barcelony oraz określenie ich przydatności w opracowywaniu społeczno-środowiskowych kartografii powojennych osiedli mieszkaniowych. Analiza porównawcza ujawnia różnice w poziomie cyfryzacji, interoperacyjności i szczegółowości informacji oraz identyfikuje bariery utrudniające pełne wykorzystanie danych w diagnozach dotyczących zdrowia publicznego, efektywności energetycznej i jakości środowiska. Artykuł ukazuje znaczenie formalno-prawnych uwarunkowań udostępniania danych przestrzennych w kontekście polityki otwartych danych Unii Europejskiej. Wyniki podkreślają potencjał publicznych baz danych jako kluczowego narzędzia wspierającego planowanie partycypacyjne, procesy eksperckie i budowanie dialogu z mieszkańcami.

Abstract

This study analyses the potential use of digital spatial data in the socio-environmental diagnosis of post-war housing estates and in the development of participatory cartography that engages local communities in the mapping process. The main objective of the study is to assess the availability, scope, and quality of data provided through open-access resources in Krakow and Barcelona, as well as to determine their usefulness in developing socio-environmental maps of post-war housing complexes. The comparative analysis reveals differences in the level of digitization, interoperability, and detail of the information, and identifies barriers that hinder the full use of data in diagnostics related to public health, energy efficiency, and environmental quality. The article highlights the importance of formal and legal conditions governing the sharing of spatial data in the context of the European Union's open data policy. The findings emphasize the potential of public data repositories as a key tool supporting participatory planning, expert processes, and the building of dialogue with residents.

Słowa kluczowe: diagnoza społeczno-środowiskowa, dostępność danych, kartografia krytyczna, partycypacja społeczna.
Keywords: socio-environmental diagnosis, data availability, critical cartography, civic participation

1. INTRODUCTION

Cartography, once a field reserved exclusively for academic elites and state institutions, has undergone a significant transformation in recent decades – both epistemologically and practically. Today, maps no longer serve merely as objective representations of space. They have become dynamic and multi-dimensional tools for interpreting socio-spatial realities. These changes stem from technological progress, the democratization of access to knowledge, and the growing importance of civic participation. As a result, cartography is no longer the domain of specialized professionals alone – maps are increasingly produced collectively, involving diverse actors and local communities (Harley, 1989; Perkins, 2008). In the context of non-democratic states, critical and participatory cartography faces significant limitations

*Eliza SZCZEREK, PhD Arch., Faculty of Architecture, Cracow University of Technology, https://orcid.org/0000-0002-2787-7334, e-mail: eszczerek@pk.edu.pl

**Damian POKLEWSKI-KOZIEŁŁ, PhD Arch., Faculty of Architecture, Cracow University of Technology, https://orcid.org/0000-0002-2966-5036, e-mail: damian.poklewski-koziell@pk.edu.pl

***Michał WIŚNIEWSKI, , PhD, College of Economy and Public Administration, Cracow University of Economics, https://orcid.org/0000-0002-8006-4228, e-mail: wisniewm@uek.krakow.pl

****Dorota JĘDRUCH, PhD, Institute of Art History Jagiellonian University Cracow, https://orcid.org/0000-0003-2497-4574, e-mail: dorota.jedruch@uj.edu.pl

*****Adolf SOTOCA, Prof. PhD Arch., Departament d'Urbanisme, Territori i Paisatge, Universitat Politècnica de Catalunya – BarcelonaTECH, https://orcid.org/0000-0002-7948-0988, e-mail: adolf.sotoca@upc.edu

*****Araitz VILLALBA-RODET, M.Sc. Arch., Departament d'Urbanisme, Territori i Paisatge, Universitat Politècnica de Catalunya – BarcelonaTECH, https://orcid.org/0009-0006-9539-7152, e-mail: araitz.villalba@upc.edu

or cannot be implemented at all, due to the lack of institutional and political mechanisms that enable citizens to freely participate in mapping processes. As Kim (2015) points out, under such conditions, it is necessary to seek alternative methods of engaging society that can circumvent existing structural barriers and create space for grassroots forms of expression and social representation.

Traditionally, the map functioned as an instrument of power – created by experts who had access to data, tools, and technologies that were beyond the reach of ordinary citizens. As Harley notes, a map has never been a neutral reflection of reality. It has always conveyed a specific narrative, reflecting the interests of the institutions that created it (Harley, 2011). Cartographic power manifested itself both in the selection of data and how it was presented, as well as in the exclusion of alternative perspectives. In this context, Harley developed the idea of map deconstruction, interpreting maps as cultural texts that must be analysed in relation to a broader social and ideological context.

In the 1960s and 70s, cartographic research focused mainly on information transmission. The dominant paradigm emphasized effective, unambiguous, and precise spatial data representation. The map was seen as a communication tool, and the goal of research was to improve methods of graphically presenting geographic information (Perkins, 2008). This technocratic approach marginalized social, cultural, and political issues.

A breakthrough came in the 1980s and 90s with the development of digitization, Geographic Information Systems (GIS), and the Internet. Access to mapping tools significantly expanded. Morrison (1997) referred to this process as the democratization of cartography, pointing to the growing number of people involved in map creation. Cartography ceased to be the exclusive domain of experts and began to include grassroots, community, and activist initiatives. In this new landscape, the category of neo-cartographers emerged – individuals who, using available technologies and data, independently create maps as part of individual or collective actions.

As Perkins (2008) argues, the new approach to map-making was inspired by the theories of Brian Harley and Denis Wood, as well as the more critical perspectives of Crampton and Krygier (2006). Among other influential theories, he mentions Barthes' semiotics (Wood, 1992), the actor–network theory (Perkins, 2006), the Foucaultian concepts of power and knowledge (Joyce, 2003), post-colonialism (Sparke, 1998), hermeneutics (Pickles, 2004), affective geography (Kwan, 2007), and non-representational theory (Crouch, Matless, 1996). This broad spectrum indicates the interdisciplinary nature of contemporary cartography and its connections with social theory.

One of the most dynamic currents in contemporary cartography is social and participatory cartography. It involves the active engagement of residents in mapping the spaces they inhabit. Such maps not only depict physical features of the terrain but also reflect symbolic, emotional, and social meanings. As noted by Acserald and Coli (2008), as well as Little (2015), these maps illustrate which territories are shaped by traditional knowledge, popular culture, and embedded social practices. At the same time, critical voices emerge – Kim (2015) points out that participation is often superficial, and such maps may mask hidden power relations, particularly when projects depend on external funding sources.

The development of digital technologies – especially open-source tools, GIS systems, and mobile location-based applications – has led to an unprecedented proliferation of maps in everyday life. Mapping has become a widespread practice, embedded in complex relationships between knowledge, space, and power. In urban contexts, maps play an increasingly important role in planning processes, public consultations, and activist initiatives. Spatial visualizations now serve as tools for negotiating conflicts, expressing local community identities, and resisting dominant urban narratives. In the context of planning processes, maps – as urban plans that are accessible and comprehensible to all stakeholders – are crucial for effective communication, collaboration, and participation. These, in turn, are essential for the efficient management of the dynamic processes of developing cities, especially in the face of complex social, economic, and environmental challenges (Martyka, Przesmycka, 2024).

Access to spatial data is also gaining importance – their availability, quality, timeliness, and transparency are crucial for conducting reliable analyses and creating maps grounded in social realities. Questions arise about who controls the data and who has the right to interpret them. As Pickles (2004) emphasizes, mapping is not a neutral process – it is a form of "geo-coded power", the effects of which are felt in spatial and social structures. Contemporary cartography is thus situated at the intersection of science, technology, and politics. Creating maps requires not only technical skills but also ethical, cultural, and social awareness. This is especially true of participatory maps, which – though they hold emancipatory potential – can also reinforce inequalities and exclusions if they are not rooted in the local context and appropriately designed.

The issue of data accessibility, in all its forms, takes on particular importance in the 21st century – the age of the information society. The development of civilization can be seen as a time of opening up new, previously unavailable opportunities, while also serving as an impulse for changes and a field for experimentation (Stachura, Tufek-Memisevic, 2022). This phenomenon also poses challenges in the context of using and processing data, which represent one of the key resources of modern civilization. This raises the question of data overload. As Mikielewicz aptly observes, as a society we tend to hide behind computers capable of processing vast amounts of information, thus relying on technology at the expense of reflection on the meaning and values of our own actions (Mikielewicz, 2022). On the other hand, proper data management can become the foundation for a healthy dialogue. In the context of the residential environment – especially in today's unstable times – ensuring universal access to data about this environment, while simultaneously creating platforms for information exchange, collective decision-making, establishing democratic frameworks for cooperation, and implementing appropriate procedures, can support the shared management of living spaces, as well as help prevent conflicts and environmental degradation (Kwiatkowska, 2025).

In this way, data cease to be merely a technological resource. They become the foundation of responsible coexistence and dialogue in the complex world of today, and the issue of data accessibility – within the context of socio-environmental cartography of residential areas – takes on not only a technical but also a social and ethical dimension.

The main objective of this article is to assess the availability, scope, and quality of digital spatial data provided through open-access resources in two European cities – Krakow and Barcelona – and to determine their usefulness in developing socio-environmental cartographies of post-war housing estates. The purpose of this analysis is to examine the extent to which existing data resources can support the process of socio-environmental

diagnosis and the creation of participatory maps that serve not only as a source of expert knowledge but also as a foundation for dialogue with local communities.

Within this overarching goal, the article seeks to compare the availability and structure of spatial data in both cities, highlighting differences in terms of digitization, interoperability, and the level of detail of the information. An important aspect of the analysis is also the delineation of the formal and legal frameworks – at both the European Union and national levels – that define the obligations of public administrations in making spatial data available. This approach situates the study within the broader context of the European open data policy and helps to understand how these regulations influence local practices of data collection and dissemination.

The article also raises questions about the barriers and limitations associated with accessing the data necessary for a comprehensive diagnosis of residential environments, particularly in relation to issues of public health, energy efficiency, and environmental quality. This reflection aims to show how the lack of full data accessibility can hinder comparative research and limit the practical use of data in planning and social processes.

Ultimately, by juxtaposing the experiences of Krakow and Barcelona, the article aims to demonstrate the significance of available spatial data as a tool supporting the development of participatory cartography and the creation of a dialogue platform between experts and residents of post-war housing complexes.

2. MATERIALS AND METHODS

2.1. Methods and Research Context

This research and analysis concerning the accessibility and types of data available from open sources were performed within the framework of the WECARE project.[1] The project's main goal is to develop a replicable methodology that can support local communities in initiatives aimed at improving the quality of life within residential environments – particularly in housing estates built using large-panel construction technology in the 20th century – and protecting vital environmental resources. The project's philosophy is grounded in a paradigm shift from ecosystem services to ecosystem commons. This means that urban ecosystems are understood not only as services that enhance environmental quality but also, or primarily, as an urban common good managed and co-created by local communities. Consequently, the project also aims to strengthen social cohesion by raising ecological awareness among diverse groups.

The WECARE project is being implemented in three European cities. In each of them, the pilot study area is a selected residential estate from the second half of the 20th century, representing an example of contemporary socio-environmental conflicts. For the purposes of this article, reference is made to two of these cities and their respective housing estates: Złotego Wieku in Krakow (Poland) and El Besòs i el Maresme in Barcelona (Spain).[2]

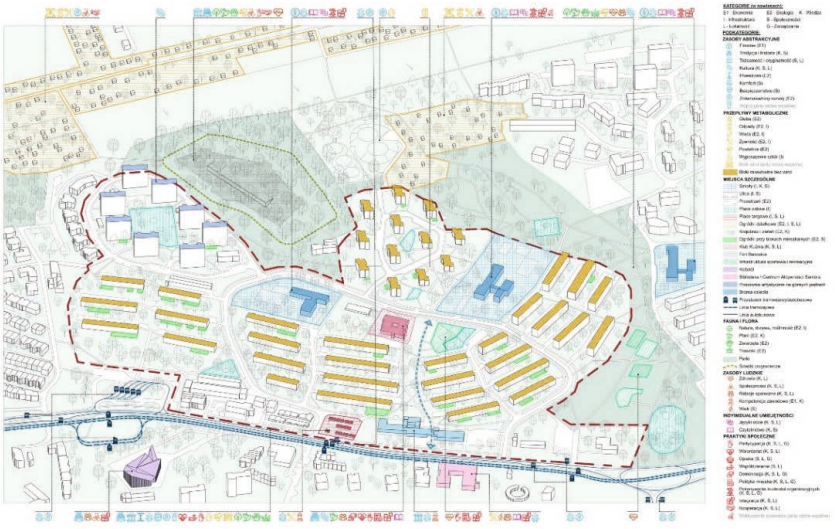
Collaboration with local communities from selected housing estates in the project's pilot resulted in the creation of a participatory socio-environmental diagnosis, including a participatory map graphically documenting key issues identified by the community (Ill. 1).

Its development was preceded by a socio-environmental analysis, intended not only to support the process of community engagement but also to create a platform for confronting expert knowledge – based on collected, objective environmental data – with the subjective experiences and perceptions of residents themselves.

The aforementioned socio-environmental analysis is based on ten shared thematic layers that together provide a comprehensive picture of the studied residential complexes. It relies on collected data grouped into the following categories: Case physicality, Socio-demography, Building stock, Public spaces and facilities, Health, Heritage, Heat, Land, Water, and Air. Describing the accessibility of these data formed the basis for defining the objectives presented in the previous section.

To provide a deeper understanding of the topic, the article also outlines the processes of data digitization in both selected cities, taking into account their institutional and technological contexts, and reviews the formal and legal regulations in force at both the European Union and national levels (in Poland and Spain) regarding the obligation to make digital spatial data publicly available.

Ill. 1. Participatory socio-environmental diagnosis map of the Złotego Wieku Housing Estate; material created within the framework of the EU WECARE project (CREA-CULT-2023-COOP), 2024. Source: Gyurkovich, M. [et al.]. WECARE Cracow. 2024.; available at: https://upcommons.upc.edu/entities/publication/8066dea4-6434-4928-8fe2-2b8910dc2cc0 (Accessed: 3 November 2025). Authors: members of the WECARE Project from the Cracow University of Technology.



A tabular comparison of available spatial data and their sources was created to highlight significant differences in the level of accessibility and detail of spatial information between the analysed cities (Krakow and Barcelona), which serve as case studies illustrating diverse approaches to the digitization of spatial information.

2.2. Formal and Legal Regulations on the Obligation to Provide Digital Spatial Data on National Level

The policy regarding the collection and sharing of data is reflected in documents at various levels. A key directive for European Union member states is the INSPIRE Directive 2007/2/EC of the European Parliament and the Council of March 14, 2007, (Directive INSPIRE, 2007). Its aim is to establish a coherent spatial information infrastructure within the EU to support environmental policy and other public activities that impact

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the environment. This infrastructure would facilitate, among other things, the exchange, sharing, access, and use of interoperable spatial data and services related to spatial data across different levels of public authorities and various sectors. These data are expected to be accessible through network services that allow them to be searched, viewed, downloaded, and altered. Thirty-four data categories have been identified in the directive for mandatory access, including transport, buildings, spatial planning, hydrography, geology, nature conservation, and demography. Reflecting on the experiences of Member States, the directive highlights the rationale for providing a minimal set of services freely accessible to the public. At a minimum, this includes search services and, under certain specific conditions, the viewing of spatial data sets.

Also noteworthy is Directive (EU) 2019/1024 of the European Parliament and of the Council of June 20, 2019 (Directive, 2019), which aims to facilitate the reuse of public data, including spatial data, by citizens and businesses. It is based on the assumption that public data and publicly funded data should be reused for commercial or non-commercial purposes. This approach is underpinned by the statement within the directive that "The evolution towards a data-based society, where data from different domains and activities are used, influences the life of every citizen in the Union, inter alia, by enabling them to gain new ways of accessing and acquiring knowledge".

The directive places particular emphasis on dynamic data, which are subject to frequent or real-time updates, especially due to their variability or rapid obsolescence, such as meteorological data, traffic data, satellite data, maps, etc. It is assumed that this information, including dynamic data made available in a widely used electronic format, will allow citizens and legal entities to discover new ways to utilize them and create new, innovative products and services. This is expected have a positive impact on society, and support economic development and innovation.

Regulations derived from the aforementioned EU directives have been reflected in formal and legal regulations in Poland. One key piece of legislation is the Act of March 4, 2010, on Spatial Information Infrastructure (Act, 2010), transposing Directive 2007/2/EC of the European Parliament and of the Council of March 14, 2007 (Directive INSPIRE, 2007). It imposes on public administration units the obligation to create, manage, and share spatial information infrastructure.

This is also evident in the context of spatial planning within the provisions of the Act of March 27, 2003, on Spatial Planning and Development (Act, 2003). This act, along with its subsequent amendments, mandates the integration of spatial planning systems with the national spatial information infrastructure, ensuring the interoperability and digitization of planning processes. It also addresses the need for sharing spatial data related to spatial planning and development.

Additionally, the Act of August 11, 2021, on Open Data and Reuse of Public Sector Information (Act, 2021) implements Directive (EU) 2019/1024 of the European Parliament and of the Council of June 20, 2019 (Directive, 2019).

The transposition of the European directives on public sector information was first implemented in Spain through Law 37/2007, which, although not specifically addressing geospatial data, promoted the fully reusable, interoperable, and open access of publicly funded research data. Only a year after Regulation (CE) 1205/2008 was approved, thus paving the way for the implementation of the INSPIRE Directive. The regulation established the details and the specifications for spatial information metadata, including access and use restrictions.

Yet, national-level legislation deemed to regulate geospatial information and its publication as open data was not enforced until two years later. Law 14/2010, on infrastructures and geographic information services in Spain (LISIGE) was approved on May 5, 2010. It transposed the INSPIRE Directive and established the specific regulatory framework for cartography. It mandated the standardization of metadata, data interoperability, and network services, ensuring that geographic data from multiple sources could be discovered, accessed, and used seamlessly. It also led to the creation of the Spanish Infrastructure for Spatial Information (IDEE), which serves as the national geoportal, offering public access to a wide range of geospatial datasets.

Regarding the implementation of viewers and datasets by public administrations, we can cite Law 19/2013 on transparency, access to public information, and good governance, which establishes that, as a principle of transparency, "structured information shall be provided on documents and information resources to facilitate the identification and search for information" (Art. 11.a). This principle is fundamental to the design of geospatial data viewers and catalogues.

Directive (EU) 2019/1024, known as the Open Data Directive, further reinforced public access by promoting the reuse of public sector information, including geospatial data. Spain transposed this directive through Royal Decree 1185/2020, amending existing regulations to align with the principles of open data. The decree emphasized the availability of high-value datasets (such as geospatial, environmental, and meteorological data) in machine-readable formats and under open licenses, facilitating innovation and economic reuse.

The entity that helps to implement the requirements and guidelines stemming from the mentioned EU directives is the Data Spaces Support Centre (DSSC),[3] established and funded by the European Commission within the Digital Europe program. Its objective is to support the creation of common European data spaces, thereby fostering the European economy and society. It emphasizes the benefits of a sovereign, interoperable, and trustworthy data exchange environment between businesses, public administration, and civil society.

The DSSC highlights three key factors maximizing the potential of shared data resources: discoverability, availability, and accessibility. Discoverability relates to the ease with which interested entities can locate data, thus fostering collaboration and innovation across sectors. Availability refers to the ability to obtain data when needed, enabling timely decision-making and efficient operations. Accessibility pertains to user interaction with data, emphasizing user-friendly interfaces and formats tailored to varying skill levels.

2.3. Spatial Data Digitization Process in Krakow and Barcelona

The digital data analysis provided for the WECARE project, dedicated to the Złotego Wieku housing estate in Krakow, was based on the open-access digital environment offered by the Municipality of Krakow.[4] The history of digital capacities and database development concerning land surveying information dates back to the early 1990s. In 1990, following political changes in Poland and the dissolution of the communist political system, a new system of municipal self-government was implemented. Rather than a vertical structure of power, Poland established a horizontal model of voivodeships (provinces), counties, and municipalities, each with their own responsibilities, resources, and share of taxation. This new situation played a crucial role in the further development of Krakow (Noga, Purchla, 2023).

One of the elements of the change concerned public access to statistical data presenting the economic, urban and social

conditions of the city. In 1991, the Municipality of Krakow presented its first annual report on the conditions of the city's development (Raport o stanie miasta, 1991). The significant challenge of this era was connected with the reconstruction and reestablishment of the land ownership system. In 1993, the Municipality of Krakow and the regional authorities of the Lesser Poland Voivodship initiated the development of Małopolski System Informacji Przestrzennej (the Lesser Poland System for Space Information). This system was designed to integrate information on infrastructure, planning, land ownership, and the environment. In 1994, the Municipality of Krakow began compiling its segment of the regional database in a digital format. By 1996, this system included approximately 155,000 parcels within the city limits of Krakow (an area of about 326.8 km²) and linked them to land ownership information. The system added new layers of information in the subsequent years.[5]

Currently, the municipal system of space information contains around 140 categories with 4,000 data layers organized to present information on 326.8 km² of area, covering approximately 165,000 parcels, 150,000 buildings, 2,950 streets, about 800,000 inhabitants, and around 300,000 students and other stakeholders who use the city's space on a permanent basis. Initially, access to the database relied on the computers of the Municipality of Krakow. Today, users can access the system online, and browse data on a map drawn to a scale of 1:500. In 2012, the Municipality of Krakow completed a project co-funded by the European Economic Area, titled Budowa i wdrożenie dedykowanego systemu informatycznego dla świadczenia nowoczesnych usług administracji samorządowej w Krakowie (construction and implementation of a dedicated IT system for the provision of modern local government administration services in Krakow). This project enabled the Municipality of Krakow to develop the Miejski System Informacji Przestrzennej (Municipal Spatial Information System) and provide permanent access to historic and contemporary spatial data. It is a JavaScript-based GIS system.[6] Today, it is accessible as an MSIP Obserwatorium (The Municipal System of Space Information Observatory)[7] through the Municipality of Krakow's website, Magiczny Kraków (The Magic Krakow: https://www.krakow.pl/).[8]

The database presents a multitude of data dedicated to each parcel as well as to larger entities. Regarding specific parcels, one can find details about their size, shape, history, urbanization, and underground infrastructure. The system also provides insights into the morphology of the area, including 3D models of buildings. For larger entities, such as one of the 18 neighbourhoods of Krakow or the entire city, users can access information related to, for example, environmental conditions, water bodies and flood projections, protected green resources, urban planning decisions and forecasts, safety and police intervention statistics, and average housing prices. The MSIP system is integrated with the national database system of Geoportal, which serves as the official cartographic and spatial information database for the Republic of Poland.[9] Between 2004 and 2008, a state project entitled the Geoportal.gov.pl was developed. The national database, offers today the online information on spatial data, cartography, and property. The system complies with the regulations of the INSPIRE Directive 2007/2/WE of the European Parliament and the Council of March 14, 2007 (Directive INSPIRE, 2007).

Between 1978 and 1987, the Barcelona City Council took decisive steps to modernize municipal services through digital cartography, particularly within the Urban Planning Unit. This shift was crucial, as the rapid urban expansion of the 1960s and 70s – driven by Spain's ***desarrollismo*** (development movement) – had rendered traditional hand-drawn maps obsolete. Outdated representations persisted, with empty fields still marked in areas like La Pau or Sudoest del Besòs, where residential complexes had already been built. To address this, the city combined existing cartographic sources, including the Martorell Plan (1:500) for central areas and the less precise but more up-to-date Galtier Parcel Plan for peripheral zones. By 1987, Barcelona had successfully developed a new digital cartographic model, a milestone that later influenced Spain's national Digital Cadastre in the 1990s.

The success of this digital transition was evident as Barcelona completed its full urban digital map by the late 1980s. The city further expanded its cartographic infrastructure by collaborating with six major public service providers – including FECSA, Telefónica, and Aigües de Barcelona – through data-sharing agreements between 1986 and 1990. The efficiency of the cartographic system was proved with the 1992 Olympic Games. The coordination allowed the updating of all these new development areas during the following three years, by 1995. To maintain accuracy, Barcelona implemented a system of periodic aerial surveys in partnership with the Cartographic and Geological Institute of Catalonia (ICGC), ensuring both quality control and the preservation of historical urban data in an easily archivable format.

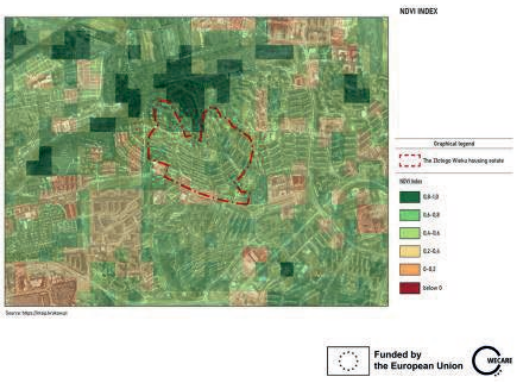
The institutional framework supporting these advancements also evolved significantly. The Institut Cartogràfic de Catalunya (ICC), established in 1982, played a pivotal role in standardizing Catalonia's cartographic data. In 2014, it merged with the Geological Institute of Catalonia to form the ICGC, which continues to oversee geospatial data management. Among its key contributions is Instamaps,[10] an intuitive online platform that allows users – both experts and non-experts – to create, customize, and share digital maps. Another notable tool is Hipermapa,[11] a public geographic information system launched in 2003 that provides access to socio-economic and territorial data from various government departments.

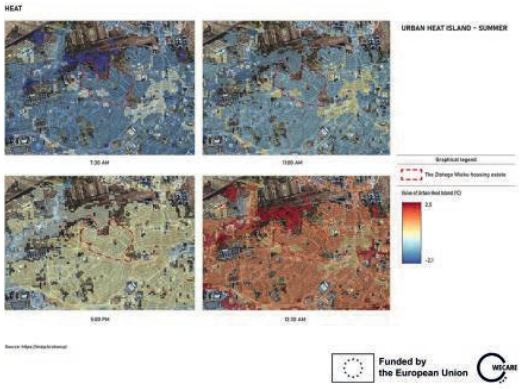
Parallel to these cartographic innovations, Barcelona also strengthened its data governance. The city's Statistics Department, founded in 1902, gradually expanded its role from maintaining population records to producing comprehensive municipal reports. Over time, it integrated with other key offices, including the Technical Programming Office – which handled urban planning and policy analysis – and the Studies and Evaluation Department, responsible for citizen perception surveys. In 2018, these efforts culminated in the establishment of the Municipal Data Office (OMD), a centralized body that oversees data transparency and accessibility. Another major milestone on this journey was the 2011 launch of Open Data BCN, a platform that publishes municipal datasets for public use, fostering innovation and accountability.

3. RESULTS ON DATA AVAILABILITY IN MUNICIPAL PUBLIC INFORMATION SYSTEMS

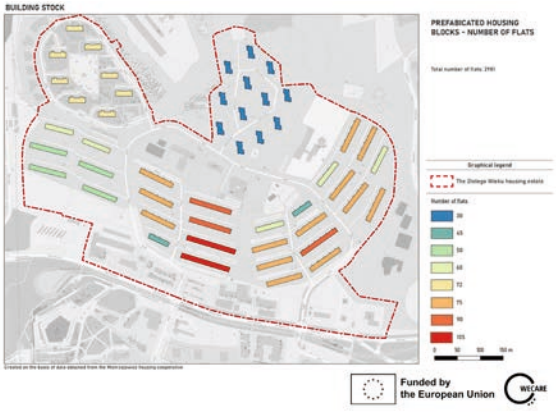
In the case of research conducted in Krakow, spatial data were obtained from various sources. Some of these were derived from publicly accessible digital resources (Ills. 2,3), such as the Municipal Spatial Information System (MSIP). However, accessing certain information required direct communication with relevant institutions and the submission of official data requests.

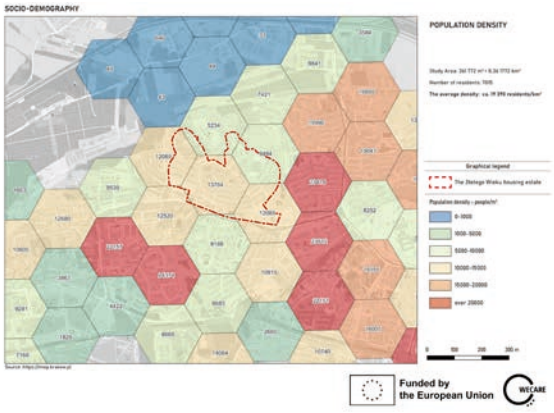
The acquired data were processed and analyzed using GIS software, applying to both materials obtained from public repositories and information received through cooperation with institutions. Such circumstances arose, for instance, concerning data on construction technologies of residential buildings, number of residential units or their periods of development (Ill. 4).





Ill. 2. (left) NDVI Index map, Ill. 3. (right) Urban heat island map; based on https://msip.krakow.pl/; materials created within the framework of the EU WECARE project (CREA-CULT-2023-COOP), 2024. Source: Mistrzejowice - The Złotego Wieku Housing Estate, Socio-environmental diagnosis, Work Package 2, April 2024, Cracow University of Technology; available at: https://wecare.upc.edu/index.php/studies/ (Accessed: 9 April 2025). Authors: members of the WECARE Project from the Cracow University of Technology





Ill. 4. (left) Building stock map, based on data obtain from Mistrzejowice housing cooperative; Ill. 5. (right) Socio-demography – population density map, based on https://msip.krakow.pl/; materials created within the framework of the EU WECARE project (CREA-CULT-2023-COOP), 2024. Source: Mistrzejowice - The Złotego Wieku Housing Estate, Socio-environmental diagnosis, Work Package 2, April 2024, Cracow University of Technology; available at: https://wecare.upc.edu/index.php/studies/ (Accessed: 9 April 2025). Authors: members of the WECARE Project from the Cracow University of Technology

It is noteworthy that, for more than one-third of the analyzed data categories, online data retrieval was not feasible. For 10 out of the 44 thematic layers examined, it was necessary to resort to alternative sources other than those provided by MSIP. This was due to two primary reasons: either the data were not digitally available, or their quality – particularly regarding spatial precision – was insufficient for reliable analysis.

The issue of data scalability posed a particular problem. In some cases, data were provided in large spatial units, such as sizable hexagons, preventing precise assignment of data to specific research areas (Ill. 5).

Another significant challenge was the complete absence of public health data – this was the only category for which no data could be obtained. Additionally, access to data on energy efficiency and consumption, critical for achieving sustainable development policy goals, was also severely limited.

The main spatial data sources for the analysis of the Besòs i el Maresme neighborhood in Barcelona were the National Institute of Statistics (Instituto Nacional de Estadística), LANDSAT, the Metropolitan Area of Barcelona, and the Cartographic and Geological Institute of Barcelona (Sotoca, 2025).

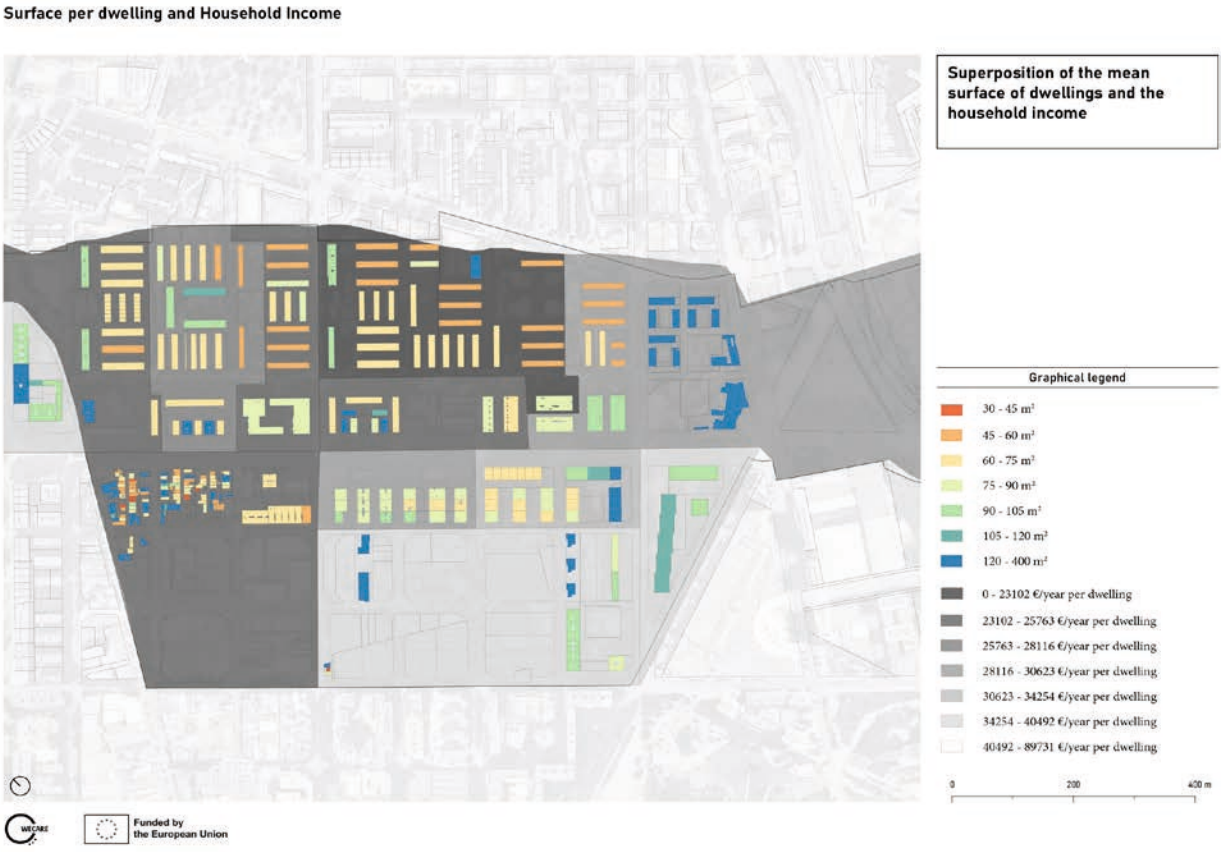
Similarly to what was done in Krakow, the information was processed with GIS software, integrating different bases of data to generate a comparative analysis that would show the relation between the mean surface and the household income of the dwellings of the neighborhood (Ill. 6).

Unlike the case of Krakow, Barcelona has extensive data available in the building and census sections. This fact allowed us to reproduce some analysis on a larger scale, situating the case and comparing it to the context of a larger part of the city. The territorial scale limits were defined by the Besòs River's Drainage basin. The studies in this scale included two main topics: economic and ecological factors. In greater detail, the analyzed data comprised (among others):

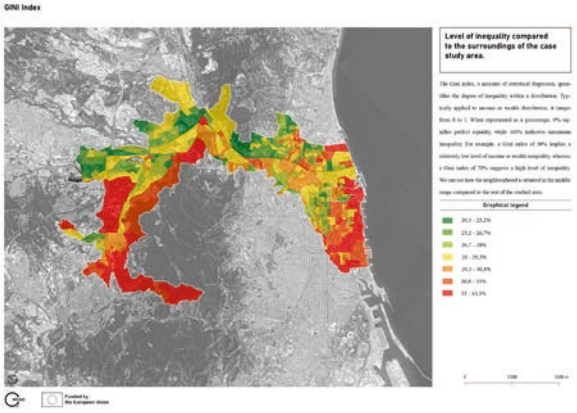
Household income and level of inequality. Elaborated with data from the National Institute of Statistics (Ill. 7);

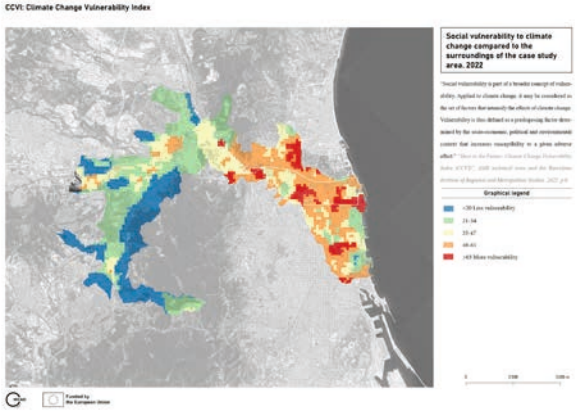
Quality of vegetation and Social vulnerability to climate change data elaborated with information from the NDVI index processed by the Metropolitan Area of Barcelona and available processed data concerning climate change vulnerability from the Metropolitan Area of Barcelona and the Barcelona Institute of Regional and Metropolitan Studies (Ill. 8).

Nevertheless, part of the recollected data was available only at the district or neighborhood scale of detail, which could only be used in this comparative state, but not in a deeper analysis. This was the case for the motorization index of the vehicle fleet (Ill. 9). Concerning the smaller scale, the air quality emissions were only available for the street axis and for a mean value (Ill. 10). The scarcity of detailed information in this field is still something to develop to create richer analysis for these topics, closely related to health conditions.

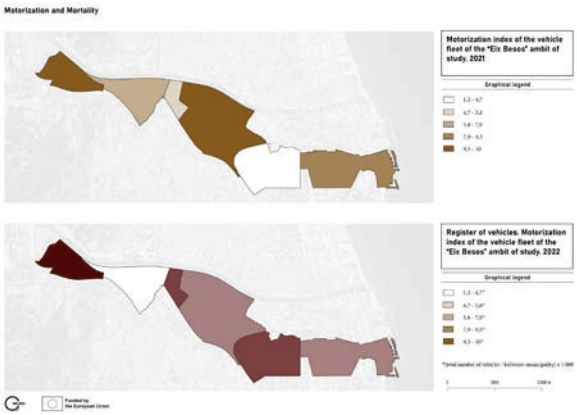


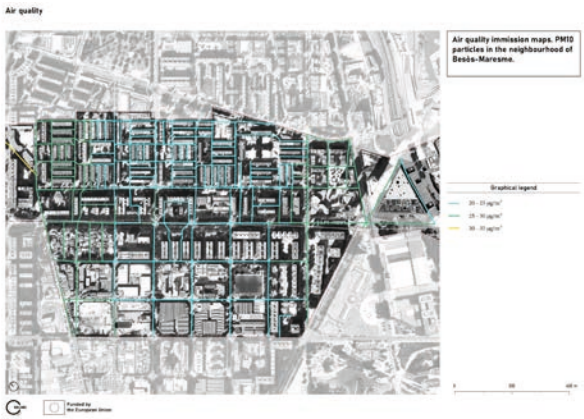
Ill. 6. Surface per dwelling and household Income map; material created within the framework of the EU WECARE project (CREA-CULT-2023-COOP), 2024. Source: Sudoest del Besos, Socio-environmental diagnosis, Work Package 2, April 2024, UPC – Barcelona Tech; available at: https://wecare.upc.edu/index.php/studies/ (Accessed: 9 April 2025). Authors: members of the WECARE Project from the Universitat Politècnica de Catalunya





Ill. 7. (left) GINI Index map; Ill. 8. (right) CCVI: Climate Change Vulnerability Index map; materials created within the framework of the EU WECARE project (CREA-CULT-2023-COOP), 2024. Source: Sudoest del Besos, Socio-environmental diagnosis, Work Package 2, April 2024, UPC – Barcelona Tech; available at: https://wecare.upc.edu/index.php/studies/ (Accessed: 9 April 2025). Authors: members of the WECARE Project from the Universitat Politècnica de Catalunya





Ill. 9. (left) Motorization and Mortality map; Ill. 10. (right) Air Quality map; materials created within the framework of the EU WECARE project (CREA-CULT-2023-COOP), 2024. Source: Sudoest del Besos, Socio-environmental diagnosis, Work Package 2, April 2024, UPC – Barcelona Tech; available at: https://wecare.upc.edu/index.php/studies/ (Accessed: 9 April 2025). Authors: members of the WECARE Project from the Universitat Politècnica de Catalunya

Table 1. Organizes information on the source and nature of the data obtained, authors: Szczerek, E., Poklewski-Kozieł, D.

	No.	Categories	Krakow / Source		Barcelona / Source	
			Open Access Digital Resources	Others	**Open Access Digital Resources**	Others
1.Case physicality	1.	Topographical Description	A		A	
	2.	Aerial Orthophoto (current)	A		A	
	3.	Aerial Orthophoto time series	A		A	
2. Socio-demography (unit of analysis: census track)	4.	Population density	B	A	A	
2. Socio-demography (unit of analysis: census track)	5.	Age	B	A	B	
	6.	Gender	B	A	B	
	7.	Place of birth (migration rate)		A Citizenship	A	
	8.	Income per household		A Purchasing power of money	A	
	9.	GINI Index			A	
	10.	Education level			B	
	11.	Motorization index (cars/1000 inhab)		A	B	
	12.	Energy poverty index			A	
	13.	Unemployment rate		A	B	
3. Building stock (unit of analysis: building)	14.	Age of Buildings		A	A	
	15.	Surface per dwelling		A	A	
	16.	Surface per inhabitant		A	A	
	17.	Energy consumption per household			A	
	18.	Energy performance per household			A	
	19.	Water consumption per household				
4. Public spaces and facilities	20	Public space per inhabitant (m2)		A	A	
	21.	Accessible streets (%)				
	22.	Public facilities	A		A	
5. Health	23.	Morbidity ratio				
	24.	Morbidity causes				
	25.	Index of socio-environmental vulnerability			A	
6. Heritage	26.	Built heritage	A			
	27.	Natural heritage	A			
7. Heat	28.	Land Surface Temperature	A heat Island		A	
	29.	Heat Accumulation Potential			A	
	30.	Albedo			A	
	31.	Sky View Factor				
	32.	Surface Materials				
8. Land	33.	NDVI	A		A	
	34.	Vegetation items	A		A	
	35.	Land Use (current)	A		A	
	36.	Land Use (time series)			A	
9. Water	37.	Surface water	A		A	
	38.	Underground water			A	
	39.	Caption of water	A			
	40.	Imperviousness of soil				
10. Air	41.	Air quality (immissions PM 2.5)	B		B	
	42.	Air quality (immissions PM 10)	B		B	
	43.	Air quality (immissions NO2)	B		B	
	44.	Noise pollution (day)			B	
	45.	Noise pollution (night)			B	

A – data for a specific area ; B – data without the possibility of assigning to a selected area

In that sense, the team was unable to locate georeferenced data related to health. This information could only be found in an aggregated format for large sectors. This is why it was discarded as a useful topic for mapping. Even though there are confirmed relations between health conditions and some studied factors, this could not be proved nor compared through this study.

4. CONCLUSIONS

Working on the WECARE project provided an opportunity to practically explore the potential of using available spatial data to support the development of a participatory social project. The aim of collecting, processing, and analyzing the data was to conduct an environmental diagnosis of the quality of life in selected housing estates. The multi-family housing complexes in Krakow and Barcelona, which were among the project's areas of focus, despite being located in different countries and developed under different political and economic conditions, share many common features: a similar period of construction, Modernist design, and building technologies. Across Europe, similar estates have been the subject of growing criticism and debate since the 1960s, particularly regarding the Modernist model of mass housing.

At the same time, apparent similarities between the housing estates are not necessarily reflected in current data on social and environmental conditions, which result from complex local factors. These housing estates are often accompanied by stereotypical – sometimes negative – perceptions about their resident communities and their quality of life, which can be verified through access to spatial data.

Gathering this type of information is crucial for further participatory activities. On one hand, it helps prepare for work with residents by offering insights into the community, identifying locations for targeted interventions, and developing appropriate tools. On the other hand, it provides a foundation of quantitative data that can be presented during participatory work and used to collect further qualitative data in collaboration with estate users. In the case of the WECARE project, participatory activities led to the development of participatory socio-environmental diagnosis maps – maps identifying places that play important roles in the daily life of housing estates, based on conversations with local community representatives.

A comparison of the experiences of the teams working in Krakow and Barcelona (Table 1) shows that, despite defining common research fields – such as topography, socio-demographic data, building characteristics, public spaces, public health, energy consumption, resources, and pollution – reliable comparison of both estates based on available data proved difficult. This is not solely due to restricted access to certain types of information (e.g., data related to resource consumption, public health, or residents' income), but also differing methodologies used for collecting statistical data. As a result, comparing specific housing estates would require dedicated research based on a unified methodology.

In both cases, certain challenges stemmed from the way territorial units were defined for data presentation. Existing information systems did not always allow for the development of profiles specific to a particular housing estate. Architectural environments or urban complexes, as defined by a team of architects and planners, rarely correspond to the units used by public administration bodies for data collection. Access to such data could, to some extent, support an assessment of the actual impact of the built environment on residents' quality of life – a question that frequently resurfaces in journalism and architectural criticism, particularly concerning Modernist projects.

Such diagnoses, which are extremely useful in participatory projects with residents or in estate revitalization efforts, cannot be precisely established using only publicly available data. They require dedicated research – both quantitative and qualitative – based on surveys and interviews with estate users.

The causes of the observed differences in data accessibility between Krakow and Barcelona would likely require more in-depth investigation. In both cases, the project was based on publicly available data, yet not all the desired information was accessible through open sources. Furthermore, in the case of Krakow, obtaining certain data required initiating additional formal procedures.

The democratization of access would likely require enabling the use of all public resources that authorities are legally obligated to make available. However, open access is not without its limitations, which include, for instance, the varying levels of user competence. Access alone may be insufficient if users are not provided with appropriate tools for data analysis and educational initiatives that enable them to use this information in an informed and critical manner.

Many environmental and spatial datasets can be used in public discourse, journalism, or for political and commercial purposes – for example, by comparing data on public health and air pollution, residents' income and apartment sizes, or the proportion of immigrant populations in a given estate. Linking precise quantitative data to specific addresses can reinforce mechanisms of exclusion or deepen social divides. Therefore, it seems that as important as data availability are its visualization, clear interpretation, and educational efforts. The WECARE project responds to these concerns by treating data as a crucial starting point for a dialogue with residents about their residential environment, ultimately aiming to support local communities in initiatives to improve quality of life in residential areas.

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Author Contributions:

Concept: Damian Poklewski-Koziełł, Eliza Szczerek,
Methodology: Damian Poklewski-Koziełł, Eliza Szczerek,
Writing: Damian Poklewski-Koziełł, Eliza Szczerek, Michał Wiśniewski, Dorota Jędruch, Araitz Villalba, Adolf Sotoca.
Funding aquisiton and project coordinator: Adolf Sotoca.

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PRZYPISY KOŃCOWE

1 Warding Ecosystem Commons through Action-Research & Education (WECARE) – a project funded by the European Education and Culture Executive Agency (EACEA) under the CREA-CULT-2023-COOP call, CREA Lump Sum Grants.
2 The third housing estate, which is not the subject of analysis in this article, is Crângași in Bucharest (Romania).
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4 https://msip.krakow.pl/ (accessed: 9 April 2025).
5 MSIP: Miejski System Informacji Przestrzennej, https://www.bip.krakow.pl/?dok_id=1932&lid=800102563&vReg=2 (accessed: 9 April 2025).
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