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Methodological proposal for the inclusion of citizen participation in the management and planning of urban public spaces

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A R T I C L E I N F O

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A B S T R A C T

The appropriate planning of Areas of Public Space and Meeting (APSM) plays a pivotal role in enhancing the quality of life for citizens, particularly in developing countries where socio-economic disparities impact social and territorial cohesion. Engaging the local population in decision-making processes through public participation is crucial. This research endeavours to design and implement two geoinformatics tools aimed at streamlining data collection processes, thereby contributing to the democratization of urban planning and management. These tools, known as Field Geoform (FG) and Crowdsourcing Geoform (CG), have been successfully deployed in Comunne #9 of Monteria, Colombia.

The collected data is presented systematically and in real-time through a web-based data visualization platform. FG offers a practical and efficient means of characterizing and assessing the physical and conservation status of APSM. On the other hand, CG empowers users of these areas to actively contribute valuable data. The trial to evaluate the functionality of CG confirms that the use of digital crowdsourcing tools, accessible to the community, gathers pertinent data regarding APSM. This mechanism greatly facilitates the efforts of those responsible for the restoration and maintenance of these infrastructures, as well as decision-makers within the realm of urban management.

1. Introduction

Areas of Public Space and Meeting (APSM), as known in Colombia, encompass spaces like parks, green areas, squares, plazas, water features, and sports arenas, providing environmental and social benefits that significantly influence urban life quality. These spaces are considered fundamental city components (Restrepo Carvajal, 2017; Shen et al., 2017; Wojnarowska, 2016) and essential to sustainable urban systems. Urban sprawl, population density growth, and service concentration have strained primary connections and eroded life quality (Chiesura, 2004; Cohen, 2018; Dziekonsky et al., 2015; Mehta, 2013; Romero, 2016; Salas-Zapata et al., 2015; Terraza et al., 2016).

In developing countries, grappling with poverty, inequality, marginalization, and social exclusion, APSMs offer an opportunity to employ planning as a tool to address socioeconomic disparities and promote social cohesion (Gutiérrez-López et al., 2019). Paradoxically, these spaces can sometimes be viewed as threats to public safety and tranquillity, fostering detachment and a preference for private alternatives (Segovia & Jordán Fuchs, 2005).

Public participation is widely recognized as the most effective means to mitigate these challenges and contribute to the development and enhancement of functional urban spaces (Shuib et al., 2015; Syukron, 2022; Terán et al., 2012). Involving citizens in participatory processes is critical as they possess firsthand knowledge of their daily needs and are directly impacted by environmental changes (Dejtiar, 2022; ONU-Habitat, 2021; Schubert et al., 2019; Sosa, 2018).

Active citizen participation plays a pivotal role in fortifying urban planning and democratizing the process by decentralizing political decision-making to citizens (Giraldo Gutiérrez et al., 2023). This democratization endeavour aims to strike a balance in participation and

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ensure equal conditions for all in critical decision-making processes, especially in cities marked by spatial segregation and inequalities (Leeds et al., 2008). The planning approach for APSM aligns with the concept of 'specially enabled societies', fostering collaboration among communities, institutions, and companies to reshape territories with territorial intelligence (Bozzano, 2018). Within this framework, the 'crowdsourcing' approach also emerges, harnessing the collective capability of many individuals to contribute data, ideas, or solutions, often through online platforms (Estellés-Arolas & González-Ladrón-De-Guevara, 2012; Hammon & Hippner, 2012; Khan et al., 2023). Empowering communities with access to spatial data is instrumental in their ability to plan and manage their environment (Ioniţă et al., 2015). Community participation in urban public space is essential for fostering a more inclusive and adaptable urban design, influencing residential satisfaction, place attachment, and social interaction (Foth, 2017; Jupp, 2007; Björgvinsson et al., 2012; Zhang et al., 2018).

Community participation is key in the development of smart cities, an emerging conceptual approach, promoted by the advantages and potential of information and communication technologies (Man & Manaf, 2022; Zalloom, 2022). A smart city aims to enhance the efficiency of urban services, reduce costs and consumption, and improve the connection between citizens and government. By integrating technology with citizen and governmental collaboration, specific challenges of sustainability, efficiency, and quality of life can be effectively addressed, especially in marginalized urban environments (Maia Ribeiro & Medina Macaya, 2022; Supriyanto et al., 2022). The importance of participatory and inclusive processes within smart cities facilitates the co-creation of policies and projects (Jung & Kang, 2023).

Active citizen involvement in APSM planning and management promotes the formulation of urban models rooted in the principles of urban sustainability (Nour, 2011; Raut & Raut, 2013; UN-HABITAT, 2019), ensuring their ongoing functionality (Caballero-Calvo & Serrano-Montes, 2020; Caquimbo Salazar et al., 2017; Espinoza Durán et al., 2017; Flores-Xolocotzi et al., 2007; Ismail & Said, 2015). This approach aligns seamlessly with the global imperative for increased inclusive and sustainable urbanization, exemplified by Global Development Goal No. 11.3 (Guzmán and Cisneros, 2019) and supported by the Latin American Landscape Initiative and European Landscape Convention. Both initiatives advocate for collaborative design practices that integrate nature and culture in the planning of urban public spaces (Council of Europe, 2000; LALI - The Latin American Landscape Initiative, 2012).

Despite the significance and potential impact of democratizing urban planning, its implementation faces challenges. Community participation often falls short, resulting in project solutions thant stem from decisions made by groups unaware of the real challenges faced in these spaces (Adjei Mensah et al., 2016; Cuartas & Valencia, 2021; Ismail & Said, 2015; Muñoz-Vanegas et al., 2019; Murcia-Daza, 2020; Pérez-Arévalo & Caballero-Calvo, 2021; ONU-Habitat, 2021). The efficacy of participation in the democratic process has been hindered by the manipulation of planning issues and the selective composition of participants. This has, at times, cast the democratization approach to urban planning as more of an illusion than a tangible reality (Alfasi, 2004).

Effective APSM planning and management necessitate robust data collection processes, encompassing relevant variables and elements of analysis for thorough and accurate urban environment assessments (Jiménez-Caldera et al., 2022; Wolch et al., 2014). Yet, geoinformatics tools designed to achieve these goals are scarce in scientific literature, particularly in Latin American urban areas.

Data collection in the context of community participation processes can take various forms, such as public meetings, community workshops, focus groups, interviews, or surveys (ANPR México, 2020; Cárdenas O'Byrne, 2017; Castelao et al., 2019; Espinoza Durán et al., 2017; Heal Cities Campaign & ChangeLab Solutions, 2016; Li et al., 2020; Madrid, 2010). Geographic Information Systems (GIS) and programming tools have emerged as valuable technologies, promoting mass collaboration in various contexts (Kuorum.org, n.d.; Brabham, 2009; Certomà et al., 2015; Colom, 2015; Ranulfo & Aragón, 2012).

Conceptual approaches tied to the democratization of urban planning and management, such as the mentioned "spatially enabled society" and "crowdsourcing", have surfaced due to the continual evolution of geotechnology, heightened accessibility, enhance processing capabilities of spatial data, and a growing emphasis on urban sustainability issues (Roche, 2014; Vidal-Filho et al., 2013; Williamson et al., 2010). Even, the term "smart city" is used comumente to refer to urban areas where advanced technologies are used to benefit the community (Horák & Ivan, 2020; Man & Manaf, 2022). Geospatial technologies prove to be crucial in the development of smart cities as they enable the creation, management, analysis, and visualization of spatial data. These technologies facilitate the digital transformation of urban infrastructures in sectors such as transport, health, energy, and education. The implementation of smart city concepts in various countries seeks solutions to resource shortages, congestion, and environmental issues through innovative technologies like open data, interconnected systems, the internet of things, artificial intelligence, cloud computing, big data, and geospatial intelligence. These tools offer solutions to urban challenges, improving quality of life and promoting sustainable urban development (Liu et al., 2023; Sharma et al., 2021; Turek & Stępniak, 2021).

These approaches find application not only in city analysis (Agunbiade, 2012; Borges et al., 2015; Chenal et al., 2022; Crooks et al., 2015; Gómez et al., 2015; Hadj Kaddour et al., 2022; Ioniţă et al., 2015; Karadimitriou et al., 2022; Liao et al., 2019) but also specifically in identifying and resolving issues related to urban public space. In this domain, mobile applications and platforms have been deployed, providing users real-time access to view and modify digital representations of these urban spaces. Innovative platforms feature interactive three-dimensional models, mixed reality technologies, and dedicated mobile or passive social media applications (Konomi et al., 2013; UN-HABITAT, 2019; Karadimitriou et al., 2022; Schrammeijer et al., 2021; D'Silva, 2017: Jiménez-Caldera & Durango, 2021).

In the Latin American context, crowdsourcing has been applied to urban public spaces in countries like Colombia. In Bogota, it was used to analyze public space encroachments (Castrillon Osorio, 2015) and to gauge citizen perception of these spaces (Bernal, 2018). In Cucuta, a geoinformatics mechanism facilitated public participation in public lighting, mobility, infrastructure, and cleanliness (Herrera-Cáceres, 2017). While crowdsourcing is increasingly used in analyzing and managing public spaces, combining this approach with GIS tools at the local level remains underexplored.

This research hypothesis posits that developing an innovative method utilizing Geographic Information Technologies (GIT) for constant APSM conservation status monitoring, as well as user perception, satisfaction, and aspirations, is crucial for effective APSM management and planning and achieving urban sustainability goals. Consequently, the objective is to design and implement geoinformatics mechanisms that facilitate and optimize data collection and processing within the framework of APSM planning and management democratization. This method seeks to support the conceptual model developed by Jiménez-Caldera et al. (2022), which outlines key variables and elements for comprehensive urban diagnostics and effective APSM management. It is grounded in the three fundamental tenets of urban sustainability: environmental conservation and preservation, socio-spatial justice, and community participation.

The modelling advocates for the ongoing monitoring of APSM functionality by adopting a cohesive and interconnected analysis of its constituent elements. This underscores the imperative need for recurrent data collection, ensuring a requisite level of detail. For APSM planning and management, this compilation must align with urban dynamics and citizens' continuous demands (Muñoz-Vanegas et al., 2019; Páramo et al., 2018), requiring periodic and systematic data collection processes (Jiménez-Caldera & Durango, 2021).

The study area selected for tool implementation and testing is Comune #9 in Montería, Colombia. Both the conceptual model and the proposed method serve as the theoretical and methodological foundations for a future urban public space observatory aiming to monitor conditions determining APSM functionality in Colombian Caribbean cities, fostering information exchange, collaboration, and knowledge sharing online.

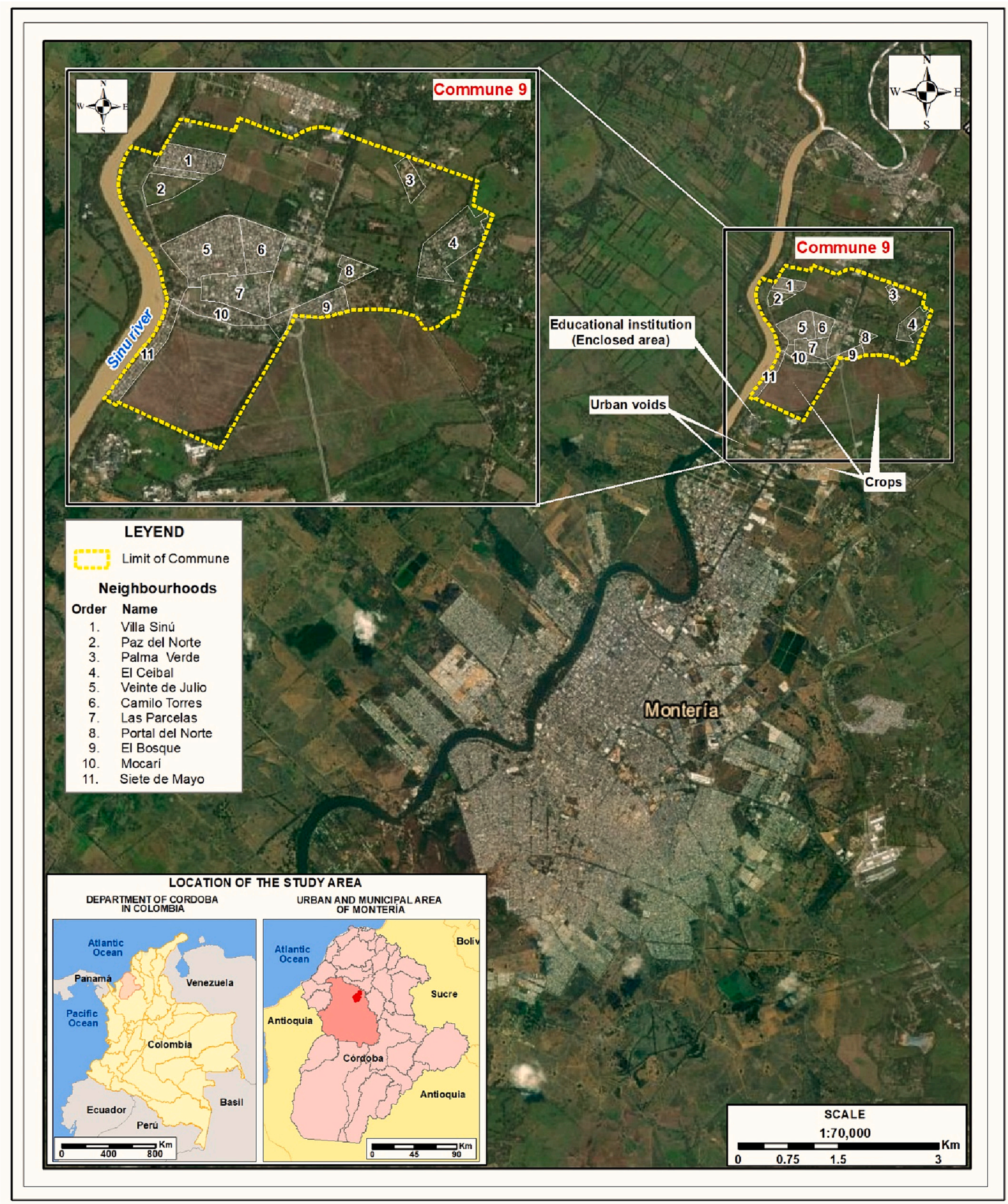

Fig. 1. Area of study based on the information of the Land Management Plan (2019–2033).

2. Methodology

2.1. Study area

Monteria, located in northwestern Colombia within the Colombian Caribbean, serves as the capital of the Córdoba department. It is classified as an intermediate city (Torres & Caicedo, 2015) and boasts a population of 402,223 inhabitants as of 2022 (DANE, 2022). According to the current Territorial Planning (2021–2033), the city is divided into nine communes, with Commune #9 offering distinctive geographical features that render it an intriguing case study.

Commune #9 is characterized by its spatial isolation from the rest of the city, situated on the opposite bank of the Sinu River and surrounded by significant urban voids. These voids represent areas in the process of urban consolidation and large agricultural expanses (see Fig. 1). The eleven neighborhoods within Commune #9 primarily fall within socioeconomic strata 1 and 2, the lowest strata within Colombia's six-level stratification system. Recent data indicates a population of 14,815 residents (DANE, 2022). Within its boundaries, certain sectors face extreme housing precariousness. These unique conditions underscore the vital role of APSMs as essential urban structural elements contributing to the overall urban life quality in this area.

Moreover, social determinants such as security and inequality (Caquimbo Salazar et al., 2017) and environmental factors like vegetation, insolation, and temperature (Pérez-Arévalo et al., 2023) demand special attention in the planning process.

2.2. Relevant data for APSM planning and management

In Colombia, the Territorial Planning regulations address certain elements of analysis on public spaces; However, when contrasted with the principles of urban sustainability, these elements are inadequate to achieve the necessary breadth. The model of Jiménez-Caldera et al. (2022) for APSM planning and management addresses this gap, focusing on key variables and three sustainability principles: environmental conservation, socio-spatial equity, and public participation.

This model recommends structuring the data collection process based on four fundamental requirements:

a. Identification and mapping of existing APSMs.
b. Characterization of the APSM, delving into specific attributes of the APSM, employing a conceptual modelling approach that incorporates two strategic typological classifications:

i. Internal composition and social role: analyzing the design of the APSM based on scenarios like children's, bio-healthy, sports, or residential. This approach investigates the overall satisfaction levels concerning the preferences and interests of the population, considering various options for active or passive recreation or leisure (Garnica & Jiménez Caldera, 2014; Jiménez-Caldera et al., 2022).
ii. Scale or Area of Influence: determining the representativeness and particularity of the APSM, identifying spaces potentially attracting users from distant areas (Jiménez-Caldera & Durango, 2021) or based on size or surface. This helps identify spaces suitable for repowering processes, ensuring typological diversification and ecological contributions (DADEP - Departamento Administrativo de La Defensoría Del Espacio Público, 2020).

c. Evaluation of the Conservation Status of the APSM: this phase utilizes the methodology proposed by Jiménez-Caldera and Garnica (2016), focusing on estimating the qualitative deficit of public space. This indicator is mandatory in the study area (Colombia) and reflects the physical state of the infrastructure and its availability for use. The deficit is assessed on a seven-point scale, ranging from zero to total, considering the unique characteristics of each APSM based on strategic typological classifications.
d. Citizen involvement: The objective is continuous monitoring of the APSM's conservation status and gaining insights into factors influencing their use and appropriation, Such as satisfaction levels and perceptions of insecurity. Sociodemographic profiling of APSM users iscrucial for this analysis encompassing basic data like age, gender, occupation, place of origin and motivation for utilizing the visited infrastructures (Cedeño Pérez, 2006; Mehta, 2007; Garnica & Jiménez Caldera, 2014).

2.3. Design of geoinformatics mechanisms for data collection

To address these data collection requirements, georeferenced web forms, commonly known as web geoforms, were employed. These tools are practical and functional, enabling interactive and large-scale data capture through smart devices, even in the absence of an internet connection (ESRI INC, 2022). The Survey123 Connect tool was used to create surveys or forms linked to geographical entities. Survey123 Connect, version 3.3.12.232, was utilized to design the geoforms. These forms were structured using the open standard XLSForm, which simplifies form creation through Excel, utilizing special syntax based on conditional logic for calculations or response automation, and codes to load response option data from external sources such as web maps hosted on the ArcGIS Online cloud.

The data collection process within the framework of georeferenced web forms (ArcGIS Survey123) is structured in three phases: (i) Design and Publication: Creation and publishing of the forms; (ii) Data Collection: Actual data collection; (iii) Visualization and Analysis: Examination of the collected data.

Addressing diverse data collection needs, two distinct web geoforms were meticulously designed and deployed, incorporating the methodologies and approaches detailed in the 2.2 section:

a. Field Geoform (FG):

- Target users: Urban planners and managers.
- Language and structure: Crafted in a technical and scientific language, aligning with the conceptual modelling governing the data collection process.
- Specific purpose: Geared towards facilitating and optimizing the data collection process. It focuses on the inventory and detailed characterization of APMS, along with evaluating their conservation status.

b. Crowdsourcing Geoform (CG):

- Target users: Common citizens.
- Purpose: Emphasizes community participation, aligning with the democratization of APSM planning and management. Recognizes citizens as valuable contributors, drawing on their firsthand experiences during recreational visits.
- User engagement: Encourages direct, active, and recurring participation in urban management planning processes. Enables citizens to contribute to essential tasks like monitoring APSM functionality and expressing their needs, concerns, and affections.

Both FG and CG showcase intelligence and complexity, featuring integrated logic that supports default values, omission logic, calculations, and branching questions (ESRI INC, 2017). Below, it is outlined the detailed structure of each geoform, tailored to their distinct purposes.

2.3.1. The structure of the Field Geoform (FG)

The Field Geoform (FG) is structured into four sections, with each section serving a specific purpose and containing a series of questionnaires and questions. The sections are described as follows:

1. Introduction: This section serves as an application introduction and contains guidance information, including the tool's name, an iconic reference image, and explanatory text explaining its purpose and content.
2. User Data: This section enables users to input data, such as the date and time of data collection, which is automatically recorded.
3. Geographical Contextualization: This section focuses on geographical contextualization of APSM and includes:

a. Contextualization of APSM: This includes questions regarding the political-urban administrative division. Users are asked to input the name of the commune and neighbourhood where the APSM is located.
b. APSM Spatialization: Displays a geoviewer with a base map (high resolution satellite image), complemented with vector information and reference labels. Users can spatialize the APSMs in the polygon vector format on the base map or by plotting using the geolocation provided by the device's GPS receiver.

4. Characterization and assessment of APSM: This section involves the identification and characterization of APSM and includes

a. Identification of APSM: To record the official names.
b. Characterization of APSM: To determine the unique attributes of the infrastructures, based on two critical strategic typological classifications outlined in the 2.2 section.

5. Evaluation of the State of Conservation of the APSM: The final section of the FG integrates a methodology for estimating the Individualized Qualitative Deficit (IQD) of public spaces, as described in the 2.2 section. It comprises four questionnaires, each associated with one of the four types of spaces (children's, stay, biohealth and sports), following the typological classification criteria based on the internal composition and social role of the APSM (2.2). The activation and visualization of these questionnaires depend on the previous indication of the APSM type during its characterization in section four. The questions in these questionnaires are organized into groups, and the number and type of questions vary based on the APSM typology (Fig. 2).

Sports scenarios have a more complex and variable structure (Fig. 3), with 13 questionnaire models designed to evaluate different sports. Each sport selected presents a unique questionnaire with questions tailored to that specific sport (Fig. 4).

Appendix 1 provides a detailed display of the questions and response options for each section within the FG, as viewed on a smartmobile phone. Notably, in sports scenarios, the quantity and nature of questions related to the evaluation of furniture and internal components may vary, contingent upon the specific type of sport.

Fig. 4 provides a visual representation of the operational flow of the data collection process facilitated by the FG. This figure presents a clear depiction of the sequential and logical order in which questions are implemented and the distribution of these questions within the structured framework of the application.

2.3.2. *The structure of the Crowdsourcing Geoform (CG)*

The CG serves as a catalyst for democratizing APSM planning and management, employing a language accessible to individuals beyond the urban planning realm. While maintaining some structural parallels with the FG, its functionality diverges during the geographical contextualization and APSM identification, a pivotal step for implementing the qualitative deficit indicator, empowering citizens to assess the conservation status of public spaces. To circumvent the necessity for specialized mapping and characterization methods (beyond the scope of citizens), the CG automatically imports preloaded data from a virtual thematic layer linked to the FG in the ArGIS Online cloud, utilizing geolocation synced with APSM locations provided by GPS.

Comprising ten sections, six of these correspond to additional subforms or questionnaires exclusive to the CG, gathering data uniquely contributable by the community. This includes information for sociodemographic profiling (age, gender, occupation), place of origin, modes of transport, motivation to use, levels of satisfaction, and perceptions of insecurity. The illustrative workflow outlining the sequence of CG questions and their distribution across sections is depected in Fig. 4. For

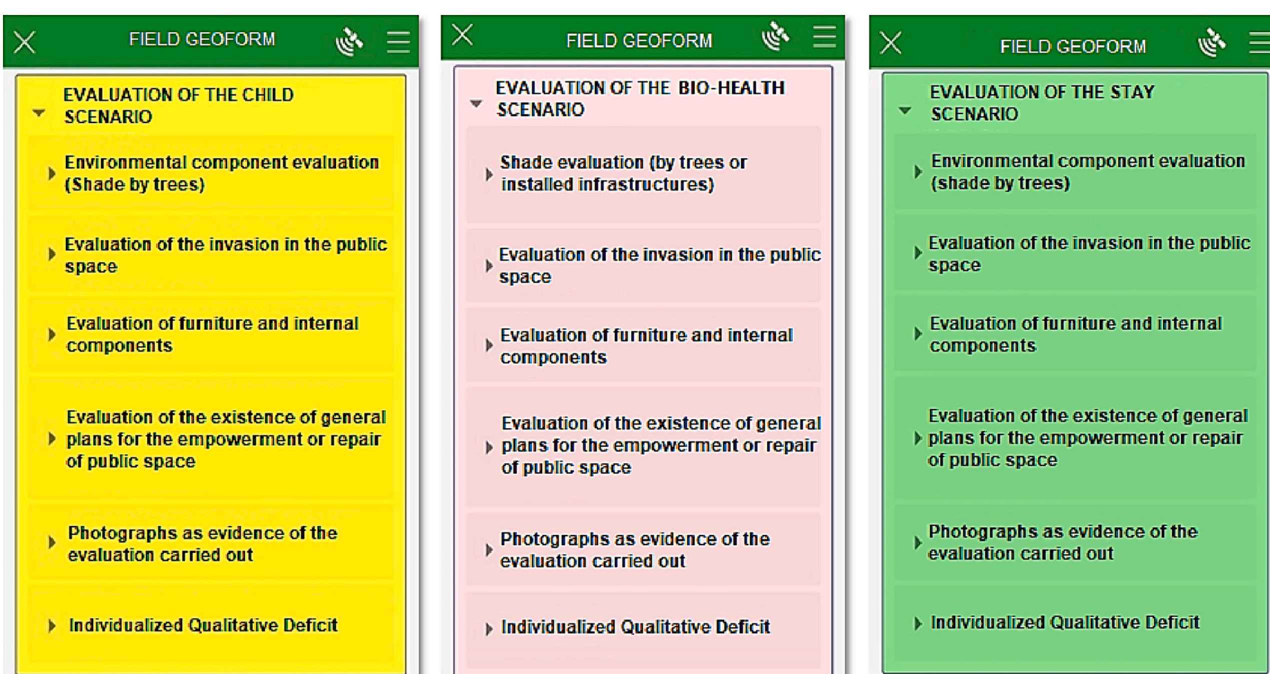

Fig. 2. Fifth section of the Field Geoform structure: groups of questions for questionnaires associated with child, stay, and bio-health scenarios.
Note: view from a mobile phone device.

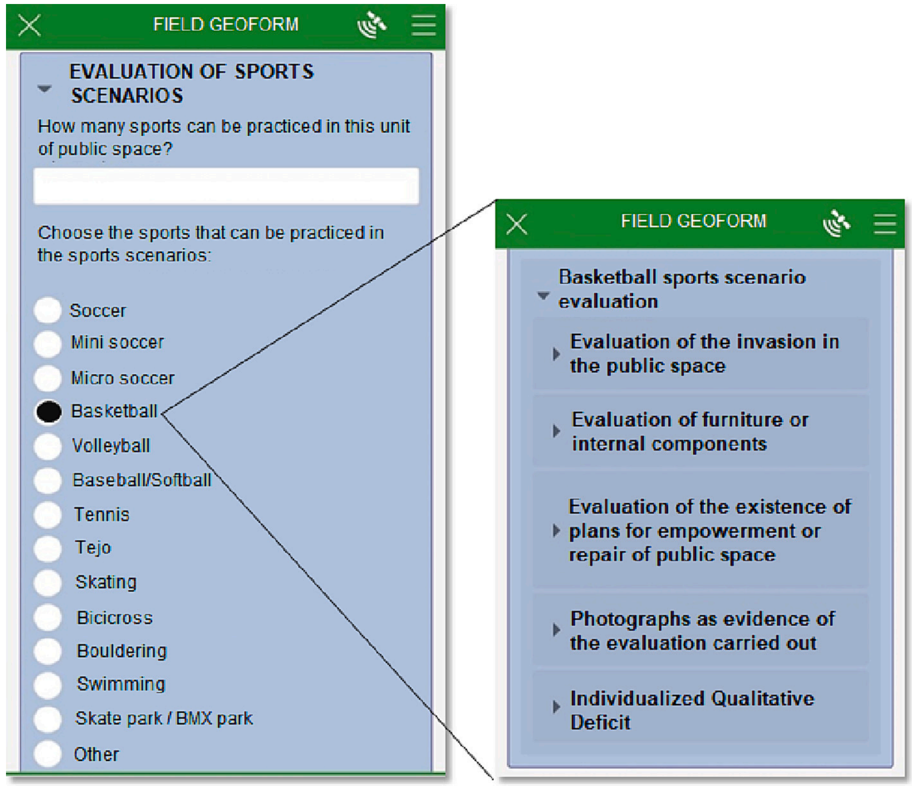

Fig. 3. Fifth section of the Field Geoform structure: groups of questions for questionnaires associated with sports scenarios.
Notes: view from a mobile phone device. Each sport in the list displays a unique questionnaire with questions associated with the selected sport.

a detailed view of the questions and response options in each section displayed on a smart mobile phone, refer to Appendix 2 (Fig. 5).

2.4. *Test of geoforms operation: data collection*

The two geoforms, with restricted access, were implemented in Commune #9 in January 2023. The FG was used to conduct an inventory and characterization of APSM by a professional well-versed in technological equipment and thoroughly acquainted with the conceptual model by Jiménez-Caldera et al. (2022). Data collection using the FG occurred through the Survey 123 Connect application, which can be installed on mobile devices, facilitating field data capture in both online and offline modes. During offline collection, data is temporarily stored on the device and synchronized with the ArcGIS Online geospatial cloud once an internet connection is available.

The CG underwent a pilot test to validate its functionality, selecting three APSMs renowned for their potential to cater to diverse interests and recreational needs (with the presence of sports, stays, children's and bio-health scenarios), thereby encouraging increased visitor traffic. The test occurred during the hours with the most favourable thermal conditions, typically in the late afternoon.

Contrary to statistical sampling, the test's participants count was not predetermined due to specific reasons: (i) a defined timeframe for the test's execution; (ii) a criterion that participants must be individuals visiting APSM to fulfil their recreational needs; and (iii) a voluntary participation approach. Consequently, the number of participants varied across the three selected APSM. The urban context's reality might introduce unforeseen factors, such as a sense of insecurity (Rengert, 1980; Páramo and Burbano-Arroyo, 2013; Cárdenas O'Byrne, 2017) or dissatisfaction with the space' design and recreational offerings (Cárdenas O'Byrne, 2017; Espinoza Durán et al., 2017). Thus, a non-probabilistic convenience sampling method was employed, as described by Otzen and Manterola (2017:230), "allows us to select those accessible cases that agree to be included. Thus, based on the convenient accessibility and proximity of the subjects for the researcher". This sampling type facilitates self-selection, where samples are crafted based on accessibility and the willingness of individuals to be included.

The process took an average of 10 min per participating user. To ensure inclusivity and avoid digital disparities, mobile devices with internet access were provided to participants during CG implementation. This was done to mitigate potential accessibility issues among certain social groups, such as children, the elderly, or individuals with lower incomes, who may face limitations in accessing suitable devices and the Internet (Karadimitriou et al., 2022).

2.5. *Calibration of geoinformatics tools*

During the pilot test of the geoforms in a real-world setting, efforts were made to identify any irregularities or anomalies that could signal technical or operational failures affecting the tools' functionality. Both FG and CG underwent scrutiny to verify the proper loading and display of questions and answer options within the application, ensuring logical consistency and thematic accuracy concerning the conceptual model by Jiménez-Caldera et al. (2022).

For the CG, additional criteria were applied during tool calibration and adjustment, given its intended user base of ordinary citizens utilizing public spaces. The wording of questions and answer options was examined for potential confusion or unintelligibility. Patterns of common or repetitive responses not included in predetermined response lists were identified. Feedback from data contributors was gathered through an open-ended question at the end of the CG questionnaires, assessing the application's relevance and user experience.

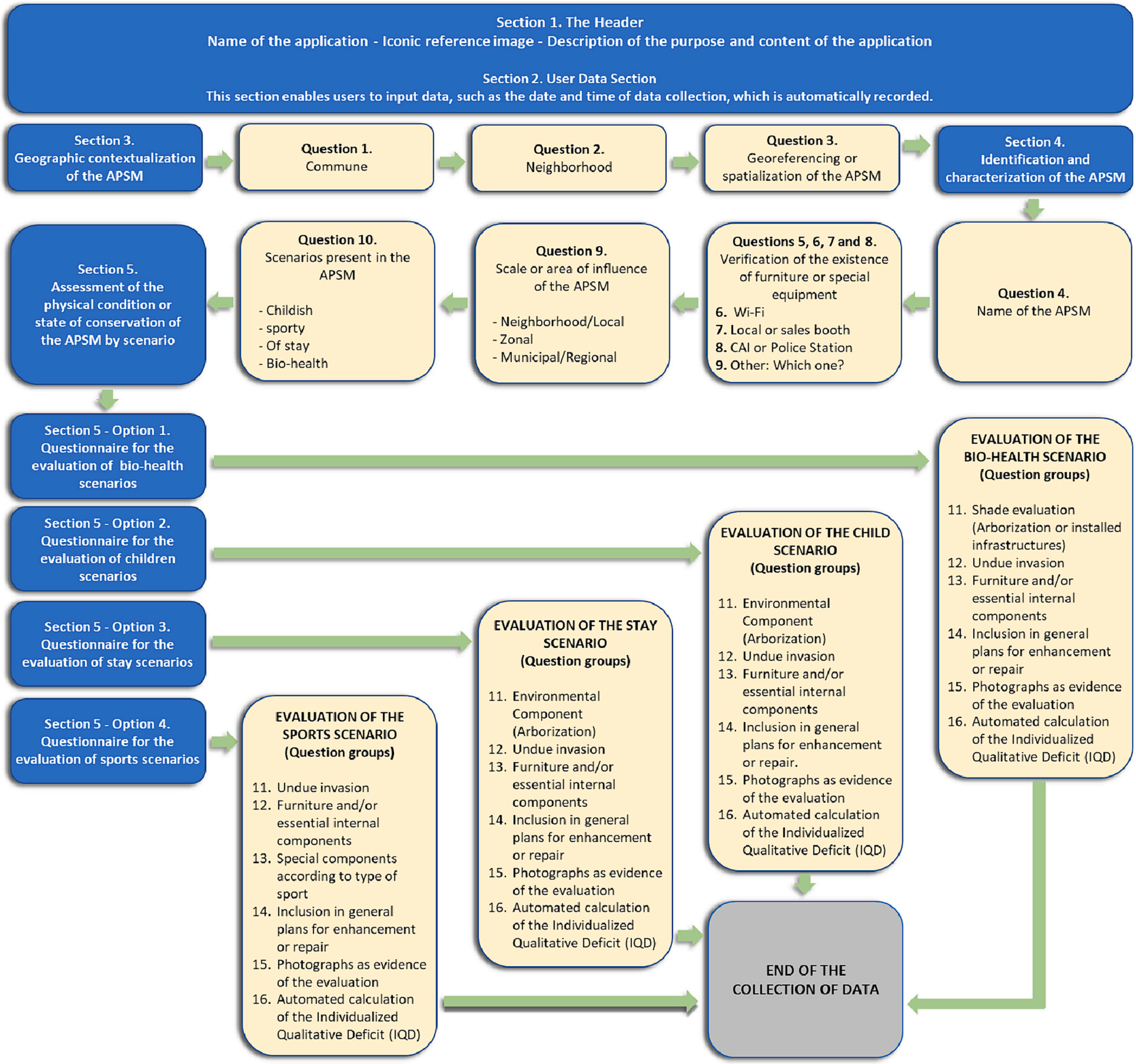

Fig. 4. Workflow for data collection with the Field Geoform.
Note: Section 1 of the geoform corresponds to the header that only shows guidance information.

2.6. Presentation and visualization of collected data: tool implementation test

Data collected through the implemented geoforms were automatically stored in a virtual cloud, enabling real-time monitoring during the collection process. This storage system efficiently provides data analysis services, including the creation of summaries in the form of graphs and tables to identify trends. It also facilitates data downloads in various formats for use with geospatial analysis and modelling software (ESRI INC, 2023b). Additionally, data can be exported individually or in bulk to report templates for final presentations (ESRI INC, 2023a).

To streamline the decision-making process, two ArcGIS dashboards were created. These dashboards are directly linked to the geoforms and enable the visual representation of geodata in web browsers. They allow for the dynamic and real-time presentation of data, simplifying the display of various types of values and variables. Dashboards present organized and synthesized data, transforming it into useful information that can be compared to the content of lengthy documents and reports (Soporta., 2021).

3. Results

3.1. Testing the operation of geoforms: data collection

3.1.1. Using the Field Geoform (FG)

A comprehensive survey of Commune #9 in Monteria revealed the presence of 12 APSM distributed across 7 out of the 11 neighborhoods. At each APSM location, a meticulous on-site inspection was conducted for the FG, focusing on data collection related to APSM identification, characterization, and conservation assessment. Table 1 summarizes the implementation of the FG, encompassing an inventory of existing APSM and their characterization based on established typological

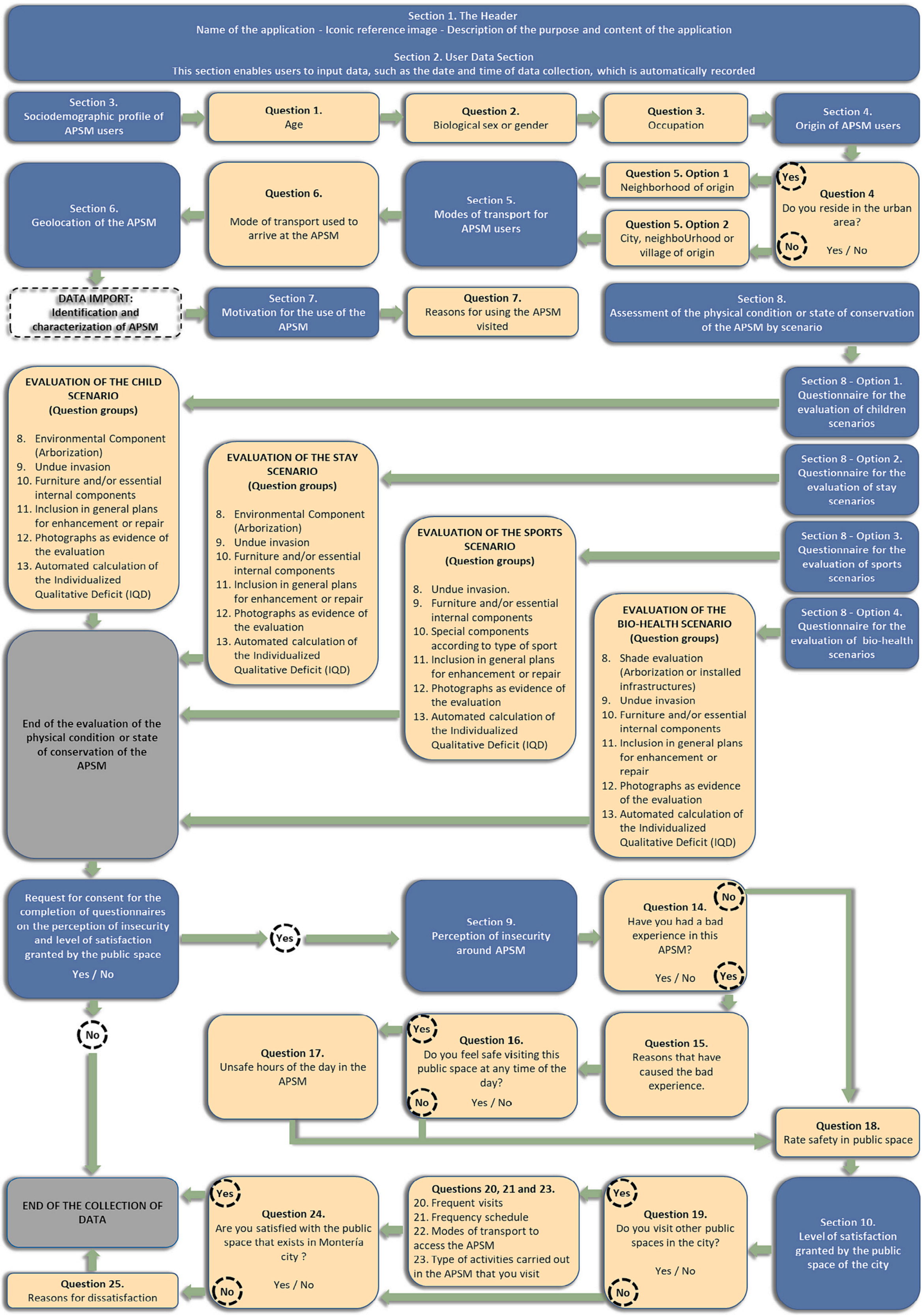

Fig. 5. Workflow for data collection using the Crowdsourcing Geoform.

Table 1
Inventory and characterization of the APSM of Commune #9.

Identification of the APSM	District of the location of the APSM	Strategic typologies				
		Internal composition: Type of scenarios present				Scale or area of influence
		Childish	Stay	Sporty	Bio-health	
Cancha Siete de Mayo	Siete de Mayo	✗	✗	✓	✗	Neighbourhood
Parque Mocarí	Mocarí	✗	✓	✗	✗	Neighbourhood
Parque de la Iglesia Mocarí	Mocarí	✗	✓	✗	✗	Neighbourhood
Parque Cancha El Bosque	El Bosque	✓	✓	✓	✓	Zonal
Parque El Bosque	El Bosque	✗	✓	✗	✗	Neighbourhood
Parque Cancha de Fútbol Mocarí	Veinte de Julio	✓	✓	✓	✗	Zonal
Parque Veinte de Julio	Veinte de Julio	✓	✓	✓	✓	Zonal
Parque Paz del Norte (Papayal)	Vila Sinú	✓	✗	✗	✗	Neighbourhood
Cancha Paz del Norte (Papayal)	Villa Sinú	✗	✗	✓	✗	Neighbourhood
Parque El Ceibal	El ceibal	✓	✓	✓	✗	Neighbourhood
Cancha El Ceibal	El ceibal	✗	✗	✓	✗	Neighbourhood
Cancha Camilo Torres	Camilo Torres	✗	✗	✓	✗	Neighbourhood

Note: typological characterization of APSM by field operator expert.
Source: Data extracted from the Field Geoform.

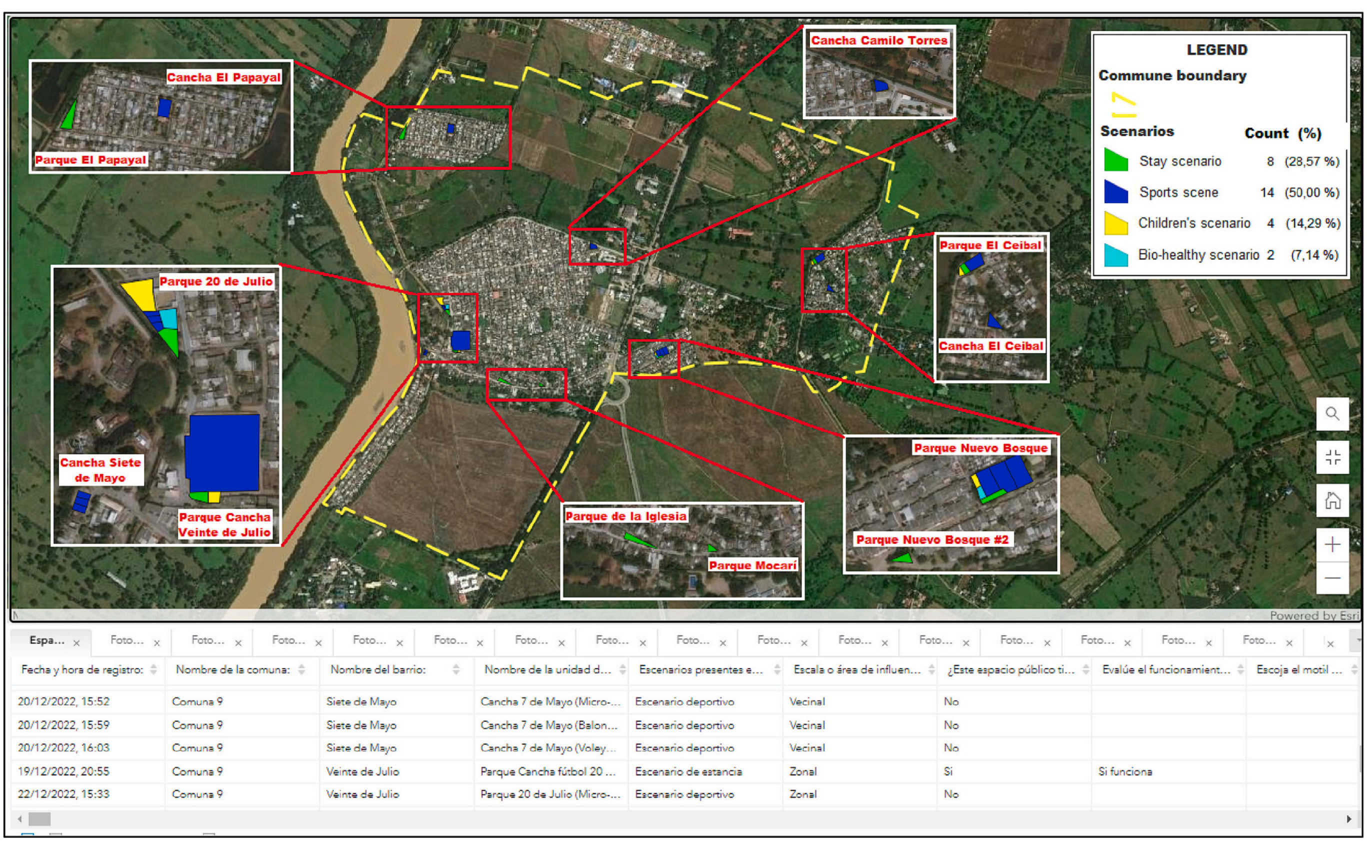

Fig. 6. Cartographic layer of field geoform - ArcGIS Online Map Viewer.
Note: The depicted mapping was conducted utilizing the Field Geoform through a mobile device. The thematic representation on the map aligns with the typological classification based on the composition and social role of the APSM.

classifications.

The information detailed in Table 1 originates from the base cartographic layer integrated into the FG and stored in ArcGIS Online geospatial cloud by ESRI. This layer encompasses the spatial representation of each infrastructure, along with additional attributes crucial for conservation status assessment (Fig. 6).

The layer, integral to the FG, is seamlessly connected with the CG to function as a primary data source during the automated import process. This process facilitates the extraction of pertinent information required for the identification and characterization of APSM, specifically catered to the expertise of field operators well-versed in APSM planning and management. Furthermore, this layer serves as a foundational component in the CG, enabling the automated importation of essential data-information typically beyond the scope of the general public's contribution. The seamless transfer of data from the GF to the CG acts as a catalyst for the activation of tailored questionnaires within the CG. These questionnaires empower citizens to assess and evaluate the conservation status of APSM during their visit, fostering a collaborative and informed approach to urban space management.

3.1.2. *Using the crowdsourcing geoform*

In a week-long initiative, the CG focused on three APSM locations in Commune #9, Montería. Community volunteers assessed APSM conservation, sharing sociodemographic details, motivation for use, security perceptions, and satisfaction. The pilot involved 226 locals at Parque-Cancha El Bosque, Parque Veinte de Julio, and Cancha Siete de Mayo. Table 2 highlights sociodemographics of 102 users in El Bosque, 80 in Veinte de Julio, and 44 in Siete de Mayo.

Data from the CG reveals a participant age range of 12 to 60, predominantly falling with 27 to 59 years. The majority were male, constituting 61.5 %, compared to 38.5 % female participants. This gender disproportion is particularly pronounced among users of Cancha 7 de Mayo, and APSM exclusively featuring sports scenarios (micro-soccer, basketball, and volleyball).

3.2. *Calibration and adjustment of geoinformatics tools*

During the pilot testing of the geoforms, no irregularities or operational issues were encountered that could affect the proper functioning of the FG. The mobile application performed consistently both in offline and online modes. Consequently, the inventory, characterization, and conservation assessment of APSM proceeded smoothly. This exercise confirmed the logical consistency and thematic accuracy between the observed realities on the ground and the conceptual model used for APSM planning and management, ensuring that all observations could be accurately recorded in the geoform without ambiguities.

The logical consistency and thematic accuracy were also observed positively during the operational test of the CG. However, some technical and operational issues emerged, notably the occasional slowdown in the deployment of certain questions within the activated questionnaires due to fluctuations in internet connection speed during the test.

Table 2
Sociodemographic profile of users.

Age	Park Cancha El Bosque		Park Cancha Veinte de Julio		Cancha 7 de Mayo	
	# persons	%	# persons	%	# persons	%
0–5	0	0.00	0	0.00	0	0.00
6–11	0	0.00	1	1.25	0	0.00
12–18	15	14.71	20	25.00	14	31.82
19–26	19	18.63	15	18.75	16	36.36
27–59	65	63.73	44	55.00	13	29.55
> 60	3	2.94	0	0.00	1	2.27
Males	59	57.84	46	57.50	34	77.27
Females	43	42,16	34	42.50	10	22.73
Total	102	45.13	80	35.40	44	19.47
Average	30		28		25	
Minimum	13		10		14	
Maximum	67		55		70	
Mode	33		15		18	

Source: demographic insights from Crowdsourcing Geoform data.

Out of the 266 citizens who participated in the CG test, 35 voluntarily provided open comments regarding the application's relevance and their experience in using it. All respondents expressed a positive opinion about the application. However, 14.3 % (5 users) included some negative comments, as outlined below:

- Comment 1: “Although it takes a bit long to complete, I believe it is necessary.”
- Comment 2: “It's good. They should improve the Wi-Fi to enable smoother questionnaire completion.”
- Comment 3: “It's good. I don't have a cellphone, but those who do can fill it out.”
- Comment 4: “I think it's great that something like this exists… For those with a cellphone, it's very useful.”
- Comment 5: “Very practical and necessary, although quite lengthy.”

From these opinions, two noteworthy conclusions arise that could enhance the overall data collection process:

Firstly, a portion of users (those without smartphones) may face exclusion from the data collection process, despite their willingness to participate. Implementing an assisted data collection process could address this issue.

Secondly, the length of the questionnaires could be a factor affecting completion rates. However, the CG is designed to allow users to selectively activate question groups based on their interest, thus reducing the number of questions they need to answer.

3.3. *Presentation and visualization of collected data*

The data collected through the geoforms were integrated into operating dashboards that provide a comprehensive and organized view within a web-based platform. The dashboard associated with the FG consists of a header and a main section comprising multiple tabs. These tabs offer a detailed presentation of the inventory, characterization, and conservation assessment of the APSM (Fig. 7). The data presentation method adds significant value through spatial representation. The dashboard incorporates three web maps, with two highlighting strategic typological classifications used for APSM characterization. The third map represents the Individualized Qualitative Deficit (IQD) of the public space, providing a comprehensive view of the urban landscape (Fig. 8). The data specific to sports scenarios are displayed as integrated content within this dashboard due to the volume of data associated with various sports.

The dashboard aligned with CG mirrors FG's structure but introduces two key distinctions: (i) additional tabs showcasing sociodemographic profiles, motivation for APSM use, user origin, transportation modes, perception of insecurity, and satisfaction levels. Integrated content on the IQD variable is consolidated for easy consultation (Fig. 9). (ii) This dashboard omits tabs displaying spatial variables associated with APSM mapping and characterization, given its non-citizen functionality. However, each CG participant generates a point geometry object in the anchored layer, denoting their GPS-marked location with accompanying attributive data accessible through online tools in the ESRI geospatial cloud (Fig. 10). The data presentation within these dashboards is dynamic, meaning that the summary of each variable may change as new data is collected through the geoforms.

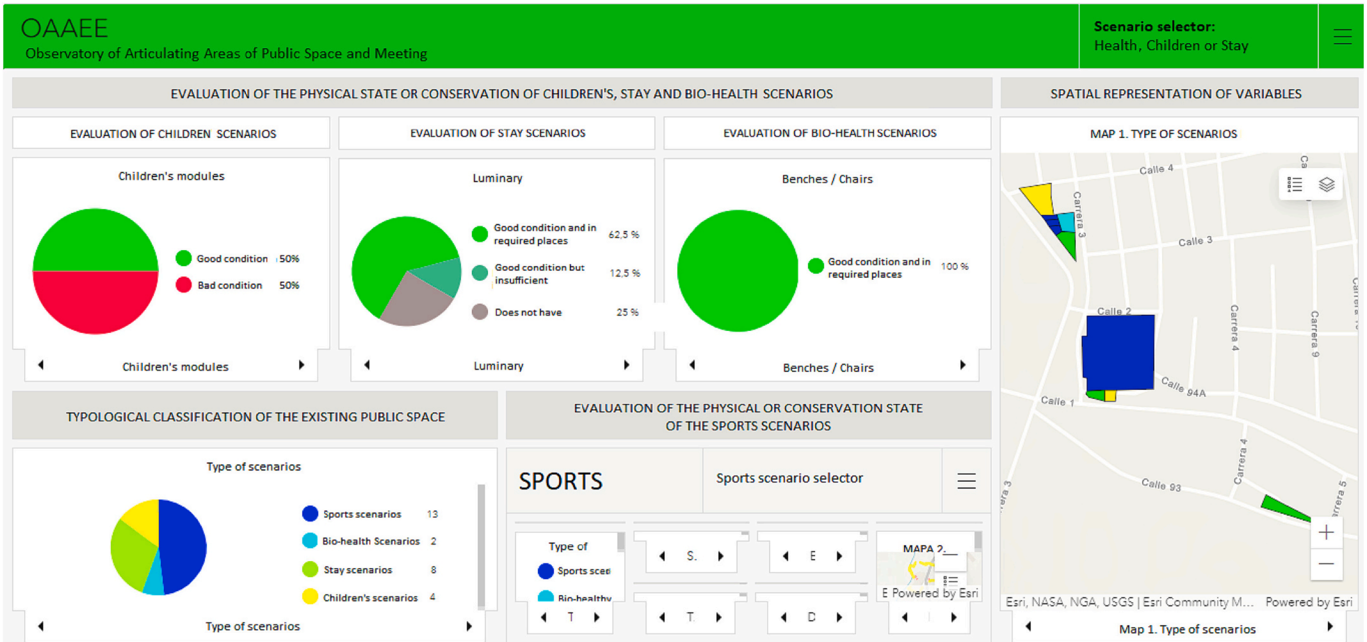

Fig. 7. Example of a dashboard for the presentation and visualization of the data collected with the Field Geoform.

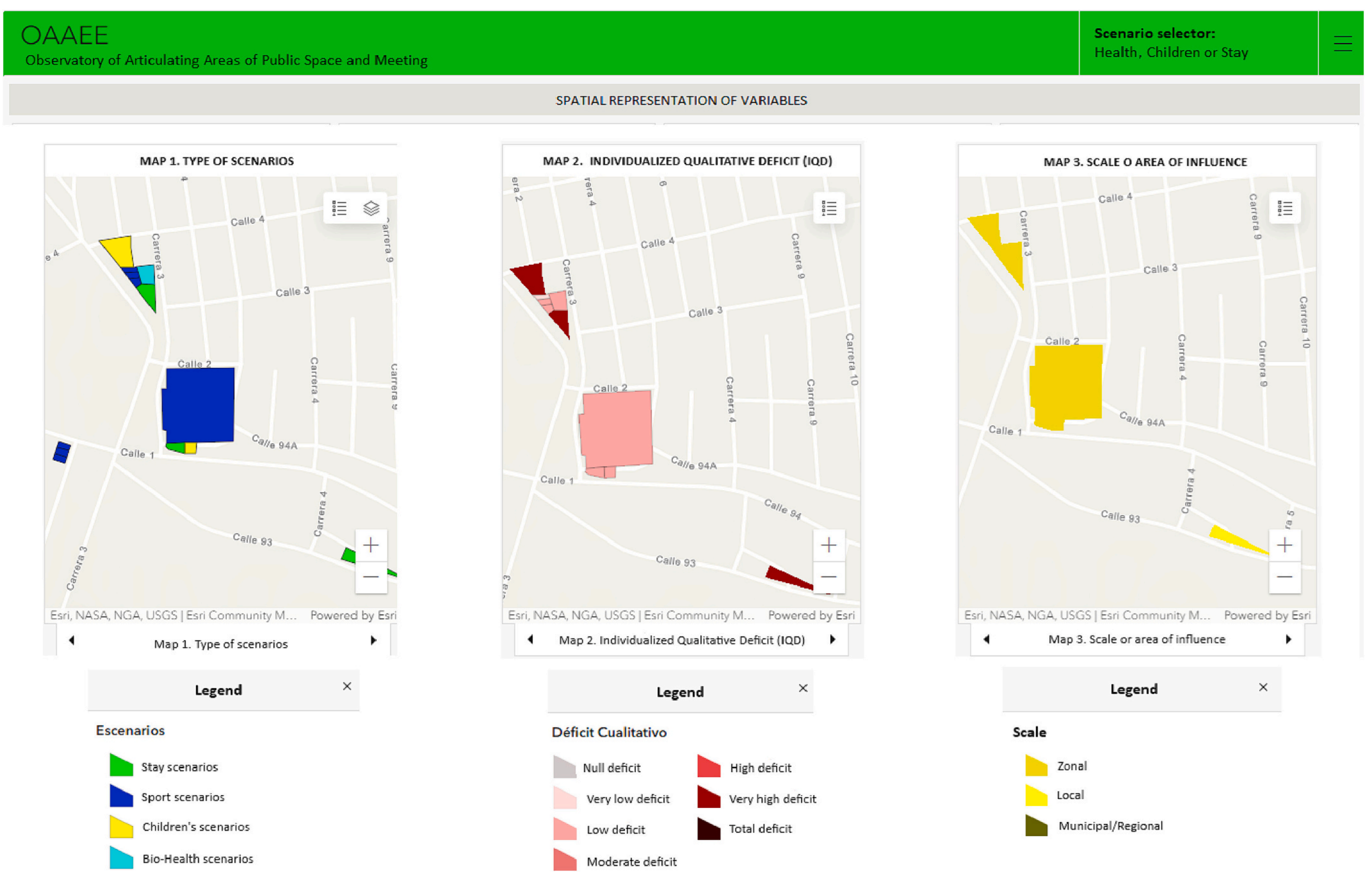

Fig. 8. Web maps incorporated into the dashboard for the presentation and visualization of the data collected with the Field Geoform.

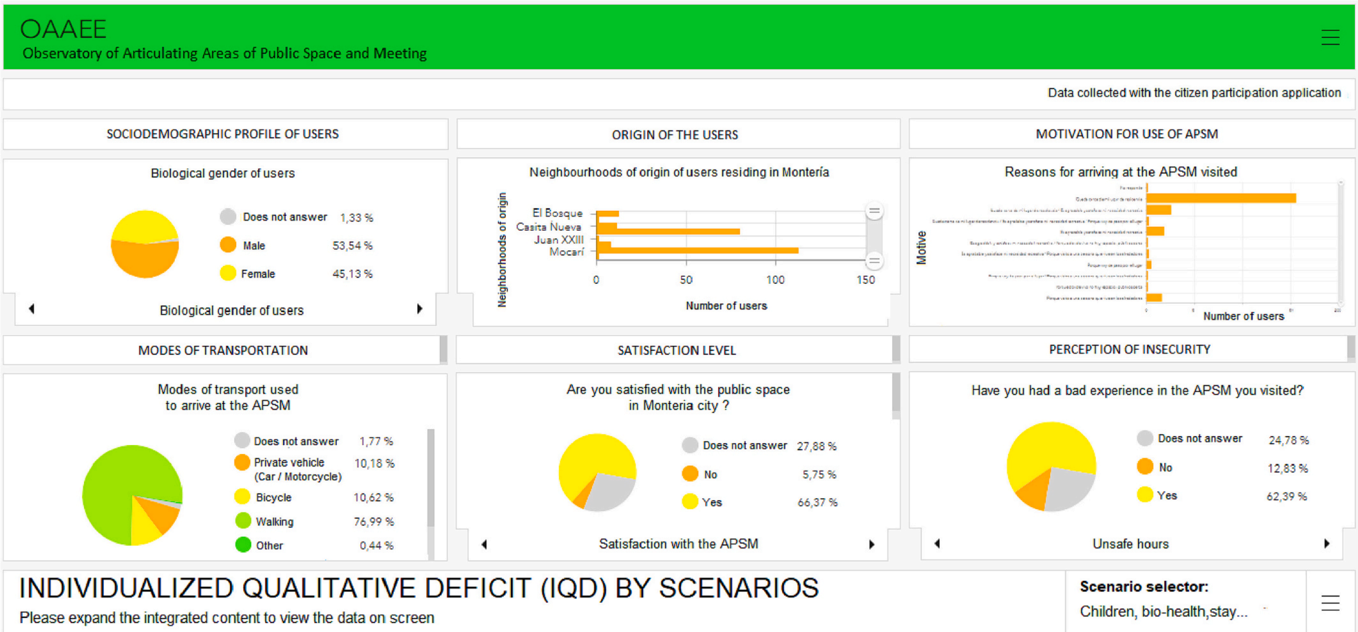

Fig. 9. Example of the dashboard used for the presentation and visualization of the data collected with the Crowdsourcing Geoform.

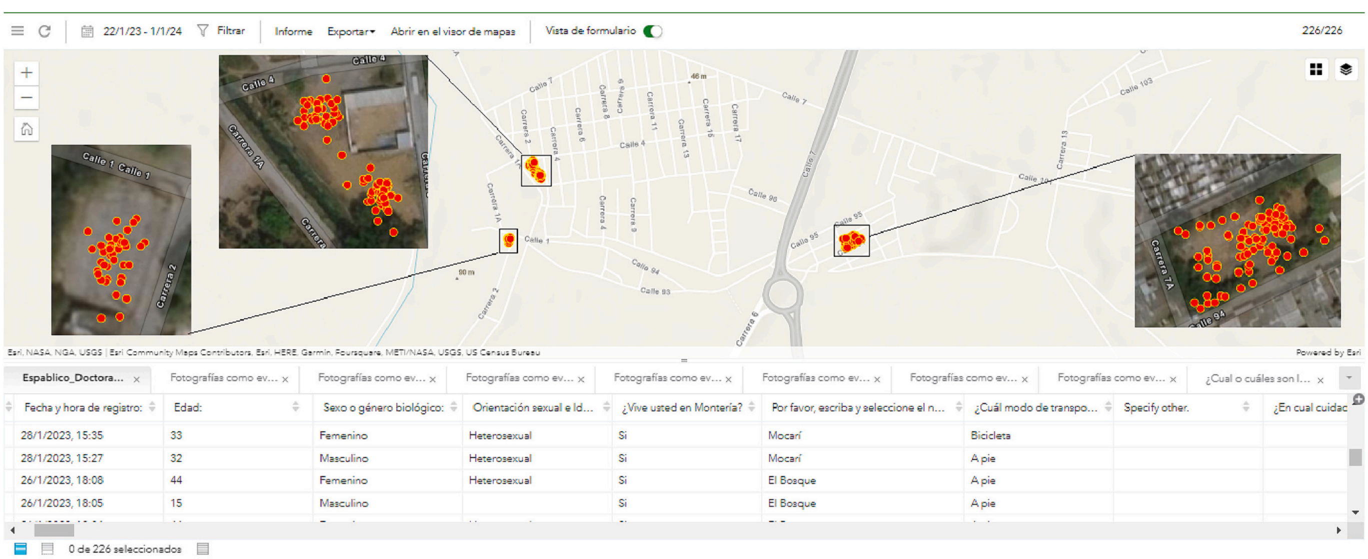

Fig. 10. Visualizer of data collected with ArcGIS Survey 123 web geoforms. Data collected with the Crowdsourcing Geoform.

4. Discussion

4.1. Geoinformatics tools in urban public space planning and management

The democratization of public space planning and management is pivotal for fostering inclusive and sustainable cities (Nour, 2011; Raut & Raut, 2013; UN-HABITAT, 2019). It is a particular commitment to demonstrate the advantages of implementing the smart city approach during urban planning, with geographic information technologies (GIT) and mobile technologies being fundamental in this process (Liu et al., 2023; Sharma et al., 2021; Turek & Stępniak, 2021). They empower communities by facilitating efficient spatial data collection and analysis (Kuorum.org, n.d.; Brabham, 2009; Certomà et al., 2015; Colom, 2015; Ranulfo & Aragón, 2012). These tools enable active citizens participation in the modelling of urban environments, ensuring that public spaces align with the needs of the community.

Crowdsourcing and spatially enabled society approaches contribute significantly to enhancing the planning and management of public spaces. Leveraging geographic information technologies allows citizens to actively and informedly contribute to urban decisions (Roche, 2014; Vidal-Filho et al., 2013; Williamson et al., 2010). These methods align with the global movement towards democratized urban planning and management, emphasizing the importance of inclusive approaches to foster socio-territorial cohesion.

The integration of geoinformatic tools, such as FG and CG, marks a significant advancement in urban planning methodologies focused on community participation. Our results demonstrate the efficacy of these tools in streamlining the collection and analysis of necessary data. They offer a dynamic and real-time approach to understand and respond to the evolving needs of urban public spaces and their users. The permissiveness of these tools to be deployed and used on mobile devices provides a considerable advantage over traditional data collection methods, often reliant on analog formats (Jiménez-Caldera & Garnica, 2016).

However, the literature offers various approaches based on dynamic and participatory exploration and visualization of the urban environment, differing from the fixed and data-oriented structure of web geoforms. Mobile applications and online platforms have been employed to facilitate citizen interaction with real-time visualizations of public space. These platforms enable users to view and modify digital representations of urban spaces, actively participating in the design and reimagination of these spaces (Konomi et al., 2013).

Mixed reality technologies, involving real-time digital visualizations, provided with an interactive and tangible experience for city residents to redesign and reimagine their environment (UN-HABITAT, 2019). This method focuses on creating an accessible and attractive visual language for citizen participation, contrasting with web geoforms that prioritize data collection and georeferenced analysis. Mixed reality offers a more immersive and visual experience, while web geoforms provide an accessible, easy-to-use platform for collecting spatial data and citizen feedback.

Participatory design of public spaces has explored innovative platforms, including an interactive three-dimensional model that uses theories and models from cybernetics to manage the complexity and diversity of opinions in urban planning (Karadimitriou et al., 2022). This methodology emphasizes participation, enabling users to upload ideas and participate in the co-creation of spaces. This approach differs from web geoforms by placing a greater emphasis on interactive design and managing the complexity of opinions, providing a broader framework for citizen participation.

The combination of active and passive crowdsourcing approaches has proven useful in evaluating citizens' preferences for urban green spaces (Schrammeijer et al., 2021). This involved comparing direct observations with three crowdsourcing methods: a dedicated mobile application, passive social media, and a municipal reporting application. This approach contrasts with the use of web geoforms for data capture, focusing on capturing subjective perceptions and preferences in specific situations, rather than collecting more general georeferenced data in a targeted manner. This approach demonstrates that data collection processes may not be fully effective without a combination of several methods. Dedicated applications have been essential to collect in situ data on perceptions, preferences and actual uses of spaces (Schrammeijer et al., 2021), and to map violence against women in public places, supporting authorities in improving surveillance and security (D'Silva, 2017).

Novel community participation approaches based on advanced technology present serious limitations, as not all sectors or types of the population are prepared or comfortable using them. Lack of familiarity with advanced technology is one of the main barriers for certain population groups, including those who have limited access to it (Karadimitriou et al., 2022). Additionally, despite its potential, advanced technology is still in its initial stages of development and application in urban contexts (UN-HABITAT, 2019).

Data collection with georeferenced web geoforms is effective for obtaining spatial data but may be less dynamic for involving citizens in creative processes or visualization of urban proposals. Our research may have a more limited scope in technologies compared to studies that use more diverse digital tools for urban planning and citizen participation.

The methodology proposed in our research overcomes the limitations of advanced technology to include marginalized groups. This is evidenced by the participatory data obtained, showcasing diversity in gender, age, and other factors, indicating progress towards democratization in the planning and management of public spaces. Involving diverse citizens, including women, men, children, and elderly reflects that the needs and opinions about public spaces come from a wide section of society, a key aspect in the democratization of urban planning.

Although smartphones are common, their use in mobile geoforms has technological limitations. Our study, focused on democratization, achieved sociodemographic diversity by assisting in data collection to include those without technology or internet access. The limitations of Observed access to geoinformatic tools may vary in other areas with different socioeconomic conditions and where there is free public access to the internet. Future research should consider these limitations and contexts for a more equitable and representative participation in urban planning.

Finally, our research also highlights the potential that web geoforms have as a method to link established methodologies and approaches to strengthen the planning and management of public spaces. This is significant because it demonstrates a practical and results-oriented application of these methodologies. By using structured geoforms based on references from technical and scientific literature, the research is aligned with proven approaches in urban planning, taking advantage of geospatial technologies to obtain detailed and relevant data. This reinforces the validity and applicability of the findings in the real context of public space management.

4.2. Implications for APSM planning and management

The utilization of crowdsourcing in urban data collection, as highlighted by Liao et al. (2019), necessitates adjustments in urban planning mechanisms. In the context of countries like Colombia, there is a need to reformulate public policies to ensure that city planning and management address pertinent variables and elements of analysis. These should lead to comprehensive urban assessments that shed light on complex issues and socio-spatial conflicts that impact urban life quality (Jiménez-Caldera et al., 2022).

Continuous monitoring of these variables is imperative, requiring recurrent data collection. This, in turn, compels urban management systems to adapt to the advantages and potentialities of Information and Communication Technologies (ICTs). The democratization process observed in this study suggests a promising direction for urban planners and policymakers. It encourages a shift towards more inclusive planning practices, ensuring that public spaces serve as true reflections of the communities they are intended to benefit.

The geoinformatic instruments created optimize the mapping and characterization process of the APSM based on established approaches and methodologies, which is key to achieving comprehensive and accurate diagnoses that allow the formulation of adequate proposals for the spatial organization of these infrastructures and that must be outlined in territorial planning instruments. Participation in city development is a civic duty, and sustaining community interest in this participation falls upon decision-makers who influence urban configuration.

Although discontent with urban conditions has fostered grassroots city-building efforts, it can also lead to disengagement from community involvement when the course of urban development has already been predetermined (Hernandez-Araque, 2016). Therefore, it is crucial for decision-makers to instil confidence in the community by addressing citizen demands that could be expressed through community participation geoinformatics tools such as Crowdsourcing Geoform. These demands may be related to the maintenance of infrastructure, and the improvement of safety conditions and satisfaction levels, among others.

Urban planning and management should recognize the scientific community's role in identifying and resolving socio-spatial problems and conflicts. They should also acknowledge the promotion of novel ways of analyzing and understanding territory. Open tools for visualizing data derived from community participation are essential and should be accessible to all stakeholders involved in urban development and growth. Observatories can serve as viable mechanisms for engaging various actors, as they can collect, process, and disseminate information on specific themes. They facilitate the promotion, reflection, and exchange of knowledge within the network (Angulo, 2009).

The capabilities of ICTs, characterized by high information flow and collaborative participation, enhance functionality, allowing for knowledge dissemination and ongoing updates. In conclusion, the integration of geoinformatics in urban planning holds immense potential to transform the way we perceive and manage public spaces. Our research indicates that a thoughtful and inclusive approach, combining traditional and innovative methodologies, is essential for effective urban development. As we navigate the complexities of urban planning, recognizing diverse perspectives and leveraging technological advancements will be crucial for creating cities that truly serve the needs of their inhabitants.

5. Conclusions

This study underscores the pivotal role of geoforms in enhancing the planning and management processes of the city's Public Meeting Spaces (APSM). The seamless integration of the Field Geoform (FG) and Crowdsourcing Geoform (CG) tools underscores the significance of amalgamating scientific methodologies with the insights and experiences of the local community. Both tools have demonstrated effectiveness in collecting and analyzing pertinent data, streamlining the identification, characterization, and evaluation of APSM conservation status of APSM. Moreover, they successfully garner data on factors influencing the intent to utilize these infrastructures.

However, notable challenges have emerged, particularly the marginalization of certain social groups in the CG data collection due to limited access to requisite technological resources. The implementation of assisted data collection strategies has proven crucial, ensuring a more inclusive representation of all segments of society. This approach is imperative to incorporate population excluded from these processes due to various circumstances.

The integration of geoforms with web-based data visualization tools has birthed a geoinformatics mechanism, facilitating the dissemination of detailed insights to the general community. This mechanism provides updated, comprehensive information essential for holistic APSM analysis, monitoring, and controlling the physical-spatial conditions influencing their functionality. Ultimately, it alleviates the burden on those responsible for APSM restoration and maintenance, as well as for decision-makers in urban management.

Looking ahead, this methodology and its findings aspire to serve as inspiration and guidance for future research and urban planning practices, placing renewed emphasis on democratization, sustainability, and active community participation. The research underscores the imperative for more inclusive and collaborative urban policies capable of adapting to urban dynamics and responding to the diverse needs and aspirations of citizens.

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CRediT authorship contribution statement

Juan Jiménez-Caldera: Writing – original draft, Visualization, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Gren Y. Durango-Severiche:** Writing – original draft, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Raúl Pérez-Arévalo:** Visualization, Software, Resources, Investigation, Formal analysis. **José Luis Serrano-Montes:** Writing – review & editing, Validation, Resources, Data curation, Conceptualization. **Jesús Rodrigo-Comino:** Writing – review & editing, Visualization, Validation, Funding acquisition, Data curation. **Andrés Caballero-Calvo:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Data curation, Conceptualization.

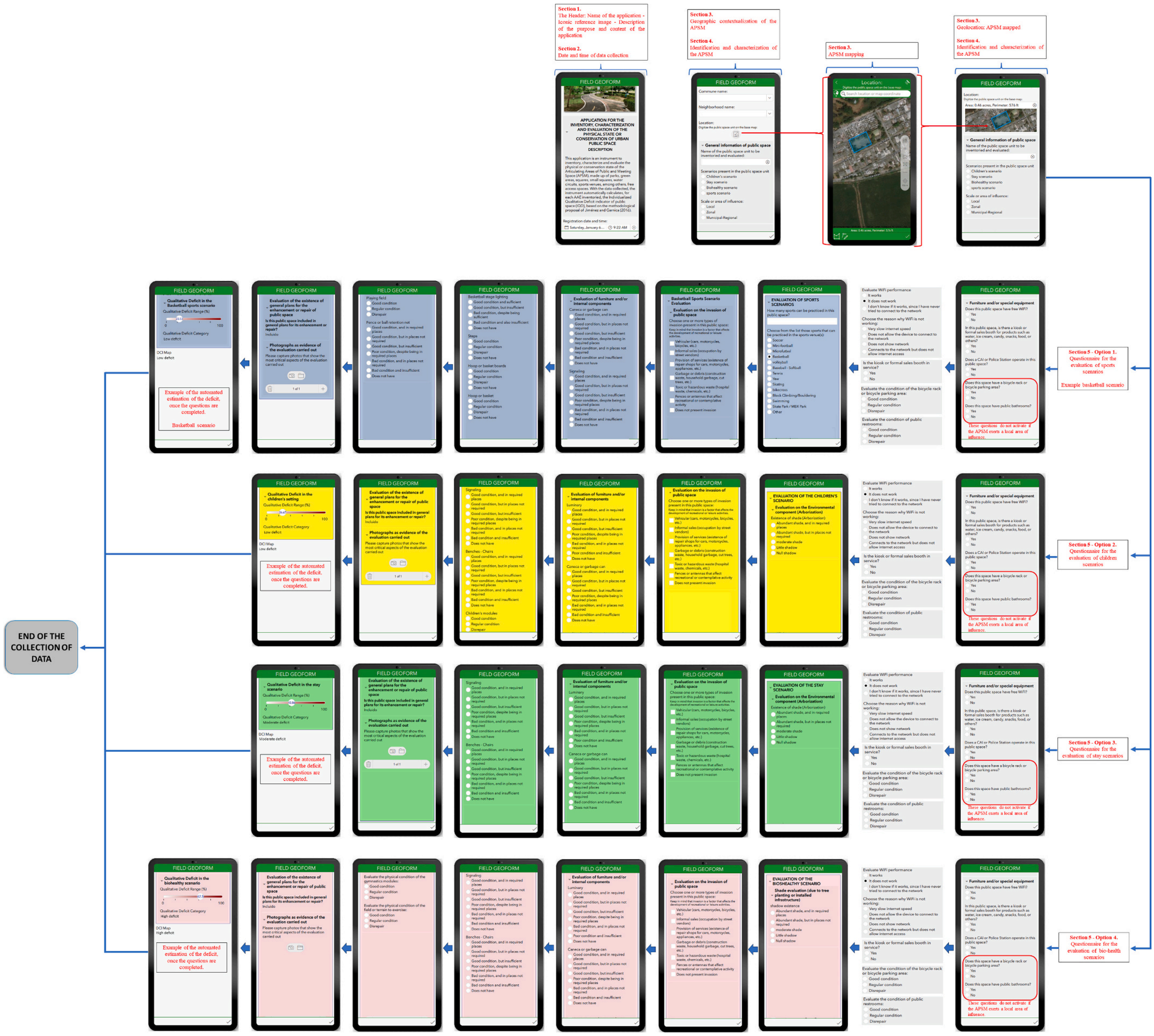
Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

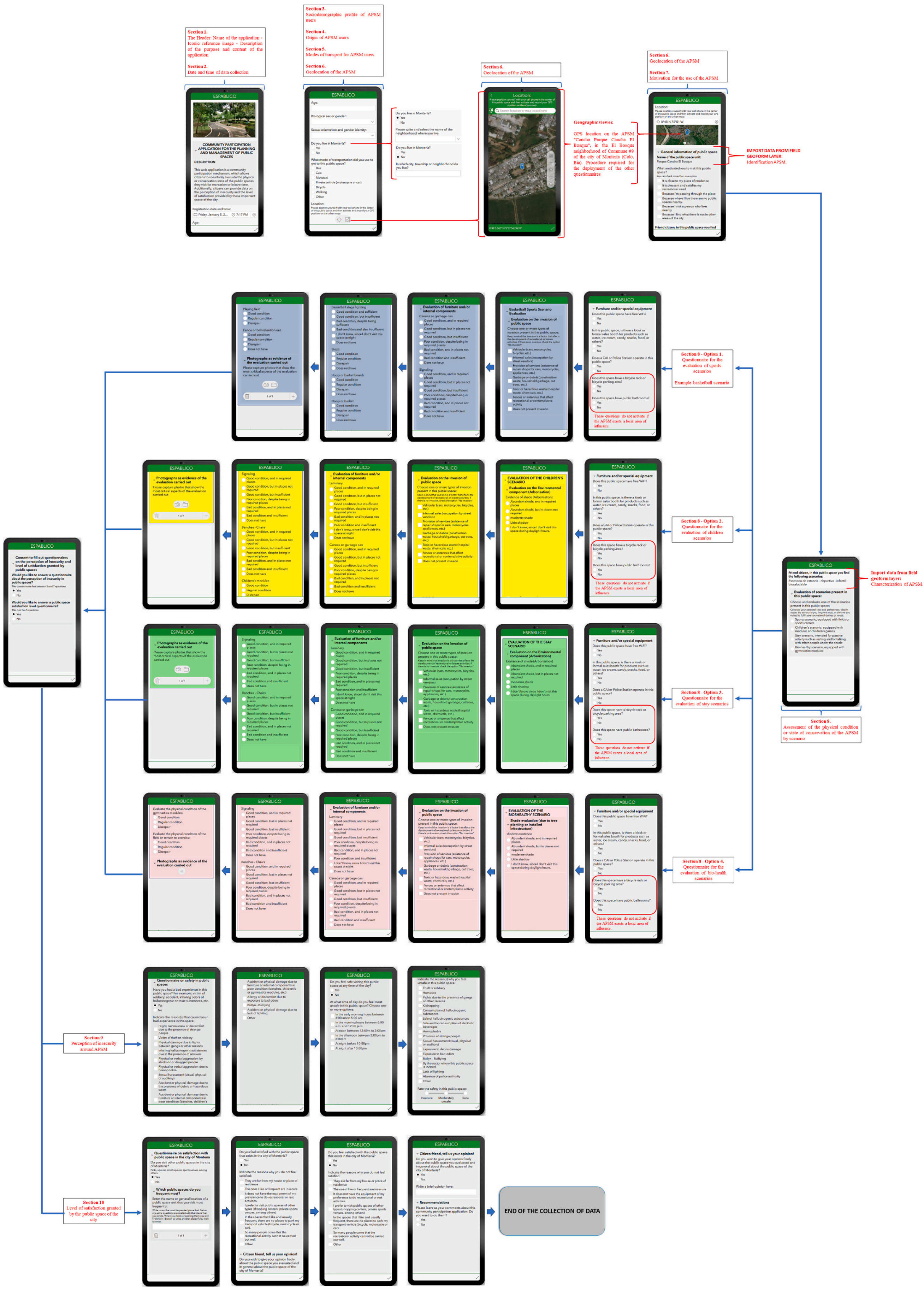
Data availability

Data will be made available on request.

Appendix A



Appendix 1. Field Geoform.


Section 1.
The Header: Name of the application - Iconic reference image - Description of the purpose and content of the application
Section 2.
Date and time of data collection
Section 3.
Sociodemographic profile of APSM users
Section 4.
Origin of APSM users
Section 5.
Modes of transport for APSM users
Section 6.
Geolocation of the APSM
Section 6.
Geolocation of the APSM
Section 6.
Geolocation of the APSM
Section 7.
Motivation for the use of the APSM
Geographic viewer.
GPS location on the APSM "Cancha Parque Cancha El Bosque", in the El Bosque neighborhood of Commune #9 of the city of Montería (Colo, Bia). Procedure required for the deployment of the other questionnaires
IMPORT DATA FROM FIELD GEOFORM LAYER:
Identification APSM.
Import data from field geoform layer:
Characterization of APSM.
Section 8.
Assessment of the physical condition or state of conservation of the APSM by scenario
Section 8 - Option 1.
Questionnaire for the evaluation of sports scenarios
Example basketball scenario
Section 8 - Option 2.
Questionnaire for the evaluation of children scenarios
Section 8 - Option 3.
Questionnaire for the evaluation of stay scenarios
Section 8 - Option 4.
Questionnaire for the evaluation of bio-health scenarios
These questions do not activate if the APSM exerts a local area of influence.
Section 9
Perception of insecurity around APSM
Section 10
Level of satisfaction granted by the public space of the city
END OF THE COLLECTION OF DATA

Appendix 2. Crowdsourcing Geoform.

References

Adjei Mensah, C., Andres, L., Baidoo, P., Eshun, J. K., & Antwi, K. B. (2016). Community participation in urban planning: The case of managing green spaces in Kumasi, Ghana. *Urban Forum 2016 28:2, 28*(2), 125–141. https://doi.org/10.1007/S12132-016-9295-7

Alfasi, N. (2004). Public participation and the democratization of urban planning. *Horiz. Geogr./*21–28 *,60/61 ,*אופקים בגאוגרפיה. https://www.jstor.org/stable/23712680.

Agunbiade, M. M. (2012). Spatially enabling urban planning for city growth and housing production in Australia: an imperative for evidence-informed policy. In 6th Australasian Housing Researchers' Conference 2012 (AHRC12) 8-10 februari 2012, Adalaide, Australia (pp. s1-s20).

Angulo, N. (2009). ¿Qué son los observatorios y cuáles son sus funciones? *Innovación Educativa, 9*(47), 5–17. https://www.redalyc.org/articulo.oa?id=179414895002.

ANPR México. (2020, October 23). 8 Pasos para establecer un sistema de parques exitoso. https://anpr.org.mx/8-pasos-para-establecer-un-sistema-de-parques-exitos o/.

Bernal, E. (2018). Software de aplicación para el control de los elementos constitutivos y complementarios del sistema de espacio público construido de parques distritales en Bogotá a través de información geográfica voluntaria caso de estudio parque Urbanización Rafael Núñez Localidad de Teusaquillo. https://repository.udistrital.edu.co/handle/11349/13795.

Björgvinsson, E., Ehn, P., & Hillgren, P. A. (2012). Agonistic participatory design: working with marginalised social movements. *CoDesign, 8*(2-3), 127–144. https://doi.org/10.1080/15710882.2012.672577

Borges, J., Jankowski, P., & Davis, C. A. (2015). Crowdsourcing for geodesign: opportunities and challenges for stakeholder input in urban planning. *Lecture Notes in Geoinformation and Cartography, 361–373*. https://doi.org/10.1007/978-3-319-17738-0_25/COVER

Bozzano, H. (2018). Territorios posibles e inteligencia territorial: una fórmula entre la gente, la ciencia y las políticas públicas. Casos en Argentina y Colombia. *Anál. Geogr., 54*, 26–85. https://www.memoria.fahce.unlp.edu.ar/library?a=d&c=arti&d=Jpr11609.

Brabham, D. C. (2009). Crowdsourcing the public participation process for planning projects. Planning Theory, 8(3), 242–262. https://doi.org/https://doi.org/10.1177/1473095209104824.

Caballero-Calvo, A., & Serrano-Montes, J. L. (2020). Influence of logos on social attitudes towards the landscape of protected areas: the case of national and natural parks of Spain. *Land, 9(1), 106*, 15. https://doi.org/10.3390/land9040106

Caquimbo Salazar, S., Lucía, O., Ramos, C., & López Pérez, C. (2017). Espacio público, periferia urbana y derecho a la ciudad. *Intervención Parque Caracolí, Ciudad Bolívar. Revista INVI, 32*(89), 113–143. https://revistainvi.uchile.cl/index.php/INVI/article/view/62743.

Cárdenas O'Byrne, S. (2017). Medir el uso del espacio público urbano seguro. *Sociedad y Economía, 33*, 34–54. https://doi.org/10.25100/SYE.V0I33.5620

Castelao, G. F., Gómez, N. J., & Finelli, N. B. (2019). Distribución de espacios verdes públicos y calidad de vida. In XXI Jornadas de Geografía de la UNLP (La Plata, 9 al 11 de octubre de 2019).

Castrillon Osorio, O. (2015). Metodología para el análisis de la invasión del espacio público en la ciudad de Bogotá, utilizando colaboración ciudadana (crowdsourcing), zona de estudio Chapinero. http://hdl.handle.net/11349/7728.

Cedeño Pérez, M. C. (2006). *Relaciones sociales y prácticas de apropiación espacial en los parques públicos urbanos. (El caso del Parc de Les Planes de L'Hospitalet de Llobregat-Barcelona)*. Universitat de Barcelona. https://diposit.ub.edu/dspace/handle/2445/35202.

Certomà, C., Corsini, F., & Rizzi, F. (2015). Crowdsourcing urban sustainability. Data, people and technologies in participatory governance. *Futures, 74*, 93–106. https://doi.org/10.1016/J.FUTURES.2014.11.006

Chenal, J. B., Xia, B., Tucunduva, T., Cortese, P., Marques, J. S., Diop, E. B., Chenal, J., Cédric, S., Tekouabou, K., & Azmi, R. (2022). Crowdsourcing public engagement for urban planning in the global south: methods, challenges and suggestions for future research. Sustainability 2022, Vol. 14, Page 11461, 14(18), 11461. https://doi.org/10.3390/SU141811461.

Chiesura, A. (2004). The role of urban parks for the sustainable city. *Landscape and Urban Planning, 68*(1), 129–138. https://doi.org/10.1016/J.LANDURBPLAN.2003.08.003

Cohen, S. (2018). The Sustainable City. Columbia University Press doi:https://doi.org/10.7312/COHE18204.

Colom, A. (2015). *Guía básica y ejercicios prácticos para la gestión empresarial: aplicación multisectorial*. https://books.google.com.co/books?id=2zHwCgAAQBAJ&printsec=frontcover#v=onepage&q&f=false.

Council of Europe. (2000). *Convenio Europeo del Paisaje*. Council of Europe, Cultural Heritage, Landscape and Spatial Planning Division.

Crooks, A., Pfoser, D., Jenkins, A., Croitoru, A., Stefanidis, A., Smith, D., Karagiorgou, S., Efentakis, A., & Lamprianidis, G. (2015). Crowdsourcing urban form and function. *29*(5), 720–741. https://doi.org/10.1080/13658816.2014.977905.

Cuartas, S. A., & Valencia, A. L. (2021). Diseño Urbano Participativo del Espacio Público. Una herramienta de apropiación social. *Bitácora Urbano Territorial, 31*(3), 13–26. https://doi.org/10.15446/bitacora.v31n3.86798

DADEP - Departamento Administrativo de La Defensoría Del Espacio Público. (2020). Observatorio del Espacio Público de Bogotá. In *, 2020. Reporte técnico de Indicadores de Espacio Público*. https://observatorio.dadep.gov.co/sites/default/files/reporte_indicadores_2020.pdf.

DANE. (2022). Proyecciones de población. https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/proyecciones-de-poblacion.

Dejtiar, F. (2022, June 19). Naomi Hoogervorst sobre democratización del diseño: "Ciudades equitativas necesitan voces equitativas". ArchDaily Colombia https://www.archdaily.co/co/983652/naomi-hoogervorst-sobre-democratizacion-del-diseno-ciudades-equitativas-necesitan-voces-equitativas.

D'Silva, E. (2017). Creando ciudades seguras para las mujeres a través la tecnología y el crowdsourcing - Abierto al Público. https://blogs.iadb.org/conocimiento-abierto/es/como-la-tecnologia-y-el-crowdsourcing-estan-creando-ciudades-mas-seguras-para-las-mujeres/.

Dziekonsky, M., José Rodríguez, M., Muñoz, C., Henríquez, K., Pavéz, A., & Muñoz, A. (2015). Espacios públicos y calidad de vida: Consideraciones interdisciplinarias. *Revista Austral de Ciencias Sociales, 28*, 29–46. https://www.redalyc.org/pdf/459/45955899002.pdf.

Espinoza Durán, J., Hugo Méndez Estrada, V., & Monge-Nájera, J. (2017). Percepción de seguridad, uso y mantenimiento de los parques municipales en Costa Rica, según el sexo de los usuarios. *Junio, 9*(1), 65–71.

ESRI INC. (2017). 5 reasons to use Survey123 for ArcGIS. https://www.esri.com/about/newsroom/arcuser/5-reasons-to-use-survey123-for-arcgis/.

ESRI INC. (2022). ArcGIS Survey123 | Crear encuestas y formularios inteligentes para la captura de datos. https://www.esri.com/es-es/arcgis/products/arcgis-survey123/overview.

ESRI INC. (2023a). Plantillas de informe - ArcGIS Survey123 - Documentación. https://doc.arcgis.com/es/survey123/browser/analyze-results/featurereporttemplates.htm.

ESRI INC. (2023b). Ver los resultados—ArcGIS Survey123 | Documentación. https://doc.arcgis.com/es/survey123/browser/analyze-results/viewresults.htm.

Estellés-Arolas, E., & González-Ladrón-De-Guevara, F. (2012). Towards an integrated crowdsourcing definition. https://doi.org/10.1177/0165551512437638, *38*(2), 189–200. doi:https://doi.org/10.1177/0165551512437638.

Flores-Xolocotzi, A. C., González-Guillén, R., & de Jesús, M. (2007). Economía, Sociedad y Territorio. *Economía, Sociedad y Territorio., 24*, 913–951. http://www.redalyc.org/articulo.oa?id=11162403.

Foth, M. (2017). Participation, co-creation, and public space. *J. Public Space, 2*(4), 21–36. https://eprints.qut.edu.au/115905/.

Garnica, R., & Jiménez Caldera, J. E. (2014). La calidad de vida urbana y la dimensión físico-espacial del espacio público: aportes metodológicos para el ordenamiento territorial de Montería. *Perspectiva Geográfica, 18*(2), 257–280. https://doi.org/10.19053/01233769.2678

Giraldo Gutiérrez, F. L., De Jesús Toro Ríos, H., Perlaza Lopera, C., & Mejía Upegui, J. E. (2023). Citizen laboratories as scenarios of cultural and political democratization. *Soc. Sci., 12*(10), 548. https://www.mdpi.com/2076-0760/12/10/548.

Gómez, J., Hernández, V., & Cobo, L. (2015). ScienceDirect the 6th international conference on ambient systems, networks and technologies (ANT 2015) URBAN SECURITY SYSTEM BASED ON QUADRANTS. *Procedia Computer Science, 52*, 636–640. https://doi.org/10.1016/j.procs.2015.05.063

Gutiérrez-López, J. A., Quenguan-López, L. F., & Betancourt-Carvajal, M. A. (2019). ¿Equidad en la dotación de espacio público en Bogotá? *Revista de Arquitectura, 22*(1), 44–56. https://doi.org/10.14718/REVARQ.2020.2606

Guzmán, L., & Cisneros, C. (2019). La ciudad en los ODS y la agenda 2030. Especial referencia al caso del manejo del espacio público en Colombia. *Rev. Eurolatinoam. Derecho Adm., 6*(2). https://www.redalyc.org/journal/6559/655969806003/655969806003.pdf.

Hadj Kaddour, N. Z., Meguenni, B., Benshila, N., Bouakkaz, K., & Mebrek, A. (2022). Development of a collaborative platform for intelligent territorial mapping of the city of ORAN. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLVIII-4-W1-2022(4/W1-2022)*, 175–180. https://doi.org/10.5194/ISPRS-ARCHIVES-XLVIII-4-W1-2022-175-2022

Hammon, L., & Hippner, H. (2012). Crowdsourcing. *Business and Information. Systems Engineering, 4*(3), 163–166. https://doi.org/10.1007/S12599-012-0215-7/METRICS

Heal Cities Campaign, & ChangeLab Solutions. (2016). Participación Protección Activación Financiamiento Crecimiento Conexión Los sistemas completos de parques Ubicación. www.changelabsolutions.org/.

Hernandez-Araque, M. J. (2016). Urbanismo participativo: construcción social del espacio urbano. Revista de Arquitectura (Bogotá), 18(1), 6–17. doi:10.14718/REVARQ .2016.18.1.2.

Herrera-Cáceres, M. (2017). Crowdsourcing y datos abiertos a través del uso de tecnologías móviles como instrumento de participación ciudadana en la ciudad de San José de Cúcuta. *Cuad. Act., 9*, 37–49. https://repositorio.ufps.edu.co/handle/ufps/488.

Horák, J., & Ivan, I. (2020). Applied GIS in the context of smart regions and cities. *GeoScape, 13*(2), 86–87.

Ioniţă, A., Vişan, M., Niculescu, C., & Popa, A. (2015). Smart collaborative platform for eLearning with application in spatial enabled society. *Procedia - Social and Behavioral Sciences, 191*, 2097–2107. https://doi.org/10.1016/j.sbspro.2015.04.676

Ismail, W. A. W., & Said, I. (2015). Integrating the community in urban design and planning of public spaces: A review in Malaysian cities. *Procedia - Social and Behavioral Sciences, 168*, 357–364. https://doi.org/10.1016/J.SBSPRO.2014.10.241

Jiménez-Caldera, J., & Durango, G. (2021). Diagnóstico y planificación del espacio público urbano. Análisis espacial soportado en la participación ciudadana. *Bitácora Urbano Territorial, 31*(2), 257–283. https://doi.org/10.15446/bitacora.v31n2.86738

Jiménez-Caldera, J., & Garnica, R. (2016). Metodología para la Medición del Déficit Cualitativo de Espacio Público en Colombia. Revista de Urbanismo, 35, 69–99. https://doi.org/https://doi.org/10.5354/RU.V0I35.42481.

Jiménez-Caldera, J., Serrano-Montes, J. L., Pérez-Arévalo, R., Rodrigo-Comino, J., Salvati, L., & Caballero-Calvo, A. (2022). A conceptual model for planning and Management of Public and Meeting Areas in Colombia. Land 2022, Vol. 11, Page 1922, 11(11), 1922. doi:https://doi.org/10.3390/LAND11111922.

Jung, J. K., & Kang, J. E. (2023). Smart engagement and smart urbanism: Integrating "the smart" into participatory planning and community engagement. *Urban Planning, 8* (2), 1–5. https://doi.org/10.17645/up.v8i2.7034

Jupp, E. (2007). Participation, local knowledge and empowerment: researching public space with young people. *Environ Plan A, 39*(12), 2832–2844. https://doi.org/10.1068/a38204

Karadimitriou, N., Magnani, G., Timmerman, R., Marshall, S., & Hudson-Smith, A. (2022). Designing an incubator of public spaces platform: Applying cybernetic principles to the co-creation of spaces. *Land Use Policy, 119*, Article 106187. https://doi.org/10.1016/J.LANDUSEPOL.2022.106187

Khan, H. U., Ali, F., Ghadi, Y. Y., Ullah Khan, H., Ali, F., Yasin Ghadi, Y., Nazir, S., Ullah, I., & Mohamed, H. G. (2023). Human-computer interaction and participation in software crowdsourcing. Electronics 2023, Vol. 12, Page 934, 12(4), 934. doi:https://doi.org/10.3390/ELECTRONICS12040934.

Konomi, S. I., Sasao, T., Ohno, W., & Shoji, K. (2013, December). Crowd-powered mechanisms for viewing and imagining public spaces. In *The 2013 international conference on computer graphics, visualization, computer vision, and game technology* (pp. 57–62). Atlantis Press. https://doi.org/10.2991/visio-13.2014.10.

Kuorum.org. (n.d.). *¿Por qué es importante la participación ciudadana?* Retrieved September 29, 2022, from https://www.kuorum.org/en/post/why-is-community-engagement-important.

LALI - The Latin American Landscape Initiative. (2012). "PATRIMONIO": Economía Cultural y Educación para la Paz (MEC-EDUPAZ). *1*(15). http://www.mec-edupaz.unam.mx/index.php/mecedupaz/article/view/68919/60752.

Li, X., Zhang, F., Hui, E. C., & man, & Lang, W.. (2020). Collaborative workshop and community participation: A new approach to urban regeneration in China. *Cities, 102*, Article 102743. https://doi.org/10.1016/J.CITIES.2020.102743

Liao, P., Wan, Y., Tang, P., Wu, C., Hu, Y., & Zhang, S. (2019). Applying crowdsourcing techniques in urban planning: A bibliometric analysis of research and practice prospects. *Cities, 94*, 33–43. https://doi.org/10.1016/J.CITIES.2019.05.024

Liu, Y., Wu, Y., Cao, H., Wang, Z., Wang, Z., Cui, Y., & Li, G. (2023). The application of GIS Technology in the Construction of Smart City. *Academic Journal of Science and Technology, 5*(2), 183–186. https://doi.org/10.54097/ajst.v5i2.6861

Madrid, A. F. (2010). *Perfil, actividades y grado de satisfacción de los usuarios en parques urbanos*. Santiago, Chile: Estudio en tres parques urbanos. https://mgpa.forestaluchile.cl/Tesis/Madrid%20Andres.pdf.

Maia Ribeiro, M., & Medina Macaya, J. F. (2022, October). Smart governance approaches and indicators in smart cities measurement frameworks. In Proceedings of the 15th international conference on theory and practice of electronic governance (pp. 353-359). doi:https://doi.org/10.1145/3560107.3560308.

Man, M. N. S. B., & Manaf, H. A. (2022). A systematic literature review on smart city project initiatives for rural community participation. *Journal of Social Transformation and Regional Development, 4*(2).

Mehta, V. (2007). A toolkit for performance measures of public space. In *43rd Isocarp Congress* (pp. 1–9). https://www.isocarp.net/Data/case_studies/983.pdf.

Mehta, V. (2013). Evaluating Public Space *19*(1), 53–88. doi:https://doi.org/10.1080/13574809.2013.854698.

Muñoz-Vanegas, P. C., Quizhpe-Marín, M. A., & Salazar-Guaman, X. (2019). Uso y percepción del espacio público, una mirada desde la población: el caso de Cuenca, Ecuador. *Revista de Urbanismo, 41*. https://doi.org/10.5354/0717-5051.2019.53536

Murcia-Daza, W. J. (2020). *Espacio público y calidad de vida urbana: la intervención del espacio público como estrategia para el mejoramiento de la calidad de vida urbana: caso de estudio : Valle de Villalobos*. Pitalito - Huila. https://doi.org/10.11144/JAVERIANA.10554.234.

Nour, A. M. (2011). Challenges and advantages of community participation as an approach for sustainable urban development in Egypt. *Journal of Sustainable Development, 4*(1). https://doi.org/10.5539/jsd.v4n1p79

ONU-Habitat. (2021). Participación comunitaria en proyectos de espacio público y diseño urbano durante la pandemia. https://onuhabitat.org.mx/index.php/participacion-comunitaria-en-proyectos-de-espacio-publico-y-diseno-urbano-durante-la-pandemia.

Otzen, T., & Manterola, C. (2017). Técnicas de Muestreo sobre una Población a Estudio. *Int. J. Morphol., 35*(1), 227–232. https://www.scielo.cl/scielo.php?pid=S0717-95022017000100037&script=sci_arttext&tlng=pt.

Páramo, P., & Burbano-Arroyo, A. M. (2013). Valoración de las condiciones que hacen habitable el espacio público en Colombia. *Territorios, 28*, 187–206. https://www.redalyc.org/pdf/357/35728173009.pdf.

Páramo, P., Burbano, A., Jiménez-Domínguez, B., Barrios, V., Pasquali, C., Vivas, F., … Moyano, E. (2018). La habitabilidad del espacio público en las ciudades de América Latina. *Avances En Psicologia Latinoamericana, 36*(2), 345–362. https://doi.org/10.12804/REVISTAS.UROSARIO.EDU.CO/APL/A.4874

Pérez-Arévalo, R. & Caballero-Calvo, A. (2021). El capital humano en las" ciudades creativas" latinoamericanas: el caso de Barranquilla y otras ciudades colombianas. Sociologia urbana e rurale, 126, 2021: 79–96. https://doi:https://doi.org/10.3280/SUR2021-126005.

Pérez-Arévalo, R., Serrano-Montes, J. L., Jiménez-Caldera, J. E., Rodrigo-Comino, J., Smith, P., & Caballero-Calvo, A. (2023). Facing climate change and improving emergency responses in southern America by analysing urban cyclonic wind events. *Urban Climate, 49*, Article 101489. https://doi.org/10.1016/j.uclim.2023.101489

Ranulfo, O., & Aragón, A. (2012). Las tecnologías de información y comunicación como recursos educativos en la formación para el ejercicio ciudadano. *Revista Integra Educativa, 5*(2), 105–118. http://www.scielo.org.bo/scielo.php?pid=S1997-40432012000200007&script=sci_arttext.

Raut, S. K., & Raut, P. B. (2013). *Smart community participation for revitalization of urban green spaces over time: Case study New Delhi*. 793–800. https://conference.corp.at/archive/CORP2013_172.pdf.

Rengert, G. (1980). Spatial aspects of criminal behavior. In *Crime: A Spatial Perspective* (pp. 47–57). Columbia University Press. https://doi.org/10.7312/geor90788-007.

Restrepo Carvajal, D. (2017). Espacio público como estructurante de las ciudades y el territorio. https://repositorio.unal.edu.co/handle/unal/60959.

Roche, S. (2014). Geographic information science I: Why does a smart city need to be spatially enabled? *Progress in Human Geography, 38*(5), 703–711. https://doi.org/10.1177/0309132513517365

Romero, C. (2016). Espacios públicos y calidad de vida urbana: estudio de caso en Tijuana, baja California. https://www.colef.mx/posgrado/wp-content/uploads/2016/12/TESIS-Romero-Ch%C3%A1vez-Christian-Rodrigo.pdf.

Salas-Zapata, L., López-Ríos, J. M., Gómez-Molina, S., Franco-Moreno, D., & Martínez-Herrera, E. (2015). Ciudades sostenibles y saludables: estrategias en busca de la calidad de vida. *Revista Facultad Nacional de Salud Pública, 34*(1), 96–104. https://doi.org/10.17533/udea.rfnsp.v34n1a13

Schrammeijer, E. A., van Zanten, B. T., & Verburg, P. H. (2021). Whose park? Crowdsourcing citizen's urban green space preferences to inform needs-based management decisions. *Sustainable Cities and Society, 74*, Article 103249. https://doi.org/10.1016/J.SCS.2021.103249

Schubert, H., Rauchecker, M., Caballero Calvo, A., & Schütt, B. (2019). Land use changes and their perception in the hinterland of Barranquilla, Colombian Caribbean. *Sustainability, 11*(23), 6729. https://doi.org/10.3390/su11236729

Segovia, O., & Jordán Fuchs, R. (2005). Espacios públicos urbanos, pobreza y construcción social. *Medio Ambiente y Desarrollo, 122*, 1–52. https://repositorio.cepal.org/handle/11362/5660.

Sharma, P., Singh, R., & Srivastava, A. (2021). Analyzing the role of geospatial technology in smart city development. In P. Sharma (Ed.), *Geospatial technology and smart cities. The urban book series*. Cham: Springer. https://doi.org/10.1007/978-3-030-71945-6_1.

Shen, Y., Sun, F., & Che, Y. (2017). Public green spaces and human wellbeing: Mapping the spatial inequity and mismatching status of public green space in the Central City of Shanghai. *Urban Forestry & Urban Greening, 27*, 59–68. https://doi.org/10.1016/J.UFUG.2017.06.018

Shuib, K. B., Hashim, H., & Nasir, N. A. M. (2015). Community participation strategies in planning for urban parks. *Procedia - Social and Behavioral Sciences, 168*, 311–320. https://doi.org/10.1016/J.SBSPRO.2014.10.236

Soporta.. (2021). DESCUBRE EL POTENCIAL DE ARCGIS DASHBOARDS DE ESRI. https://www.soporta.cl/blog-soporta/arcgis-dashboards-esri.

Sosa, M. F. (2018). Políticas urbanas para la democratización del derecho a la ciudad. *3° Congreso Internacional Vivienda y Ciudad: Debate En Torno a La Nueva Agenda Urbana*, 436–447. https://rdu.unc.edu.ar/bitstream/handle/11086/11577/1D.6-Sosa.pdf?sequence=64& isAllowed=y.

Supriyanto, E., Saputra, J., Rachmawati, M., & Nugroho, F. (2022, January). Community participation-based smart city development. In Proceedings of the first multidiscipline international conference, MIC 2021, October 30 2021, Jakarta, Indonesia.

Syukron, M. A. (2022). Community participation in policy implementation green open spaces of Kampung city settlement. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences, 5*(1), 3189–3202. https://doi.org/10.33258/BIRCI.V5I1.3975

Terán, A. M., Vázquez, I., & Ziccardi, A. (2012). Pobreza urbana, segregación residencial y mejoramiento del espacio público en la Ciudad de México. *Sociologias, 14*(30), 118–155. https://doi.org/10.1590/S1517-45222012000200005

Terraza, H., Rubio, D., & Vera, F. (2016). *De ciudades emergentes a ciudades sostenibles*. comprendiendo y proyectando las metrópolis del Siglo XXI (pp. 161-161). https://publications.iadb.org/es/de-ciudades-emergentes-ciudades-sostenibles.

Torres, P., & Caicedo, C. (2015). Las ciudades intermedias con mayor potencial en Colombia: Un sistema de identificación. https://publications.iadb.org/publications/spanish/viewer/Las-ciudades-intermedias-con-mayor-potencial-en-Colombia-Un-sistema-de-identificaci%C3%B3n.pdf.

Turek, T., & Stępniak, C. (2021). Areas of integration of GIS technology and smart city tools. *Research findings. Procedia Computer Science, 192*, 4681–4690. https://doi.org/10.1016/j.procs.2021.09.246

UN-HABITAT. (2019). Mixed reality for public participation in urban and public space design. https://unhabitat.org/mixed-reality-for-public-participation-in-urban-and-public-space-design-towards-a-new-way-of.

Vidal-Filho, J. N., Lisboa-Filho, J., de Souza, W. D., & dos Santos, G. R. (2013). Qualitative analysis of volunteered geographic information in a spatially enabled society project. In Computational science and its applications–ICCSA 2013: 13th international conference, Ho Chi Minh City, Vietnam, June 24-27, 2013, Proceedings, Part III 13 (pp. 378-393). Springer Berlin Heidelberg. doi:https://doi.org/10.1007/978-3-642-39646-5_28.

Williamson, I., Rajabifard, A., & Holland, P. (2010, April). Spatially enabled society. In Proceedings of the FIGURE Congress.

Wojnarowska, A. (2016). Model for assessment of public space quality in town centers. *European Spatial Research and Policy, 23*(1). https://doi.org/10.1515/esrp-2016-0005

Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. *Landscape and Urban Planning, 125*, 234–244. https://doi.org/10.1016/J.LANDURBPLAN.2014.01.017

Zalloom, B. (2022). Smart cities: Using GIS technology in urban infrastructure development at migration areas. In *, 18. The Eurasia proceedings of science technology engineering and mathematics* (pp. 64–71).

Zhang, H., Matsuoka, R. H., & Huang, Y. J. (2018). How do community planning features affect the place relationship of residents? An investigation of place attachment, social interaction, and community participation. *Sustainability, 10*(8), 2726.