El Colegio de la Frontera Norte

FRONTERA NORTE

e-ISSN: 2594-0260

Revista internacional de fronteras, territorios y regiones / International Journal of Borders, Territories and Regions

FRONTERA NORTE, VOL. 38, ART. 10, 2026
e-ISSN 2594-0260 https://doi.org/10.33679/rfn.v.e2432

Neither Land nor Water: Green Area Management in Hermosillo, Mexico

Ni suelo ni agua: gestión de áreas verdes en Hermosillo, México

Luis Alan Navarro Navarro,[1] & Juan Carlos López Torrero[2]

ABSTRACT

The objective of this study is to analyze the procedures for creating urban parks in Hermosillo, Sonora, as well as water management regulations, incentives, and challenges related to their maintenance. The research applies the Institutional Analysis and Development framework developed by Elinor Ostrom and employs qualitative methods such as semi-structured interviews and document analysis. Findings reveal an opaque and discretionary administrative process, impacting equity in access and sustainability. The privatization of maintenance is confirmed due to limited public resources. This study provides evidence of the institutional complexity in neighborhood park management and highlights the need for clearer regulations. It concludes that strengthening urban planning and governance is essential to ensuring accessibility and sustainability of these spaces. The main limitations of the study lie in the subjectivity of sampling and the theoretical saturation.

Keywords: 1. urban park, 2. exactions, 3. open public space, 4. Hermosillo, 5. Mexico.

RESUMEN

El objetivo es analizar los procedimientos para la creación de parques urbanos en Hermosillo, Sonora, así como las regulaciones para la gestión del agua, los incentivos y retos de su mantenimiento. La investigación emplea el marco de análisis y desarrollo institucional de Elinor Ostrom y métodos cualitativos como entrevistas semiestructuradas y análisis documental. Los resultados revelan que el proceso administrativo es opaco y discrecional, lo que afecta la equidad en el acceso y la sostenibilidad de estos espacios; además, se confirma la privatización del mantenimiento debido a la falta de recursos públicos. Este estudio aporta evidencia sobre la complejidad institucional en la gestión de parques vecinales y destaca la necesidad de regulaciones más claras. Se concluye que es imperativo fortalecer la planificación urbana y la gobernanza de estos espacios para garantizar su sostenibilidad y acceso igualitario. Las principales limitaciones del estudio radican en la subjetividad del muestreo y saturación teórica.

Palabras clave: 1. parques urbanos, 2. donaciones, 3. espacio público abierto, 4. Hermosillo, 5. México.

Received: September 30, 2024
Accepted: March 10, 2025
Available online: May 30, 2026

[1] (Corresponding author) El Colegio de Sonora (https://ror.org/04habxs80), lnavarro@colson.edu.mx, https://orcid.org/0000-0002-5819-9628

[2] Independent researcher, arqtorrero@gmail.com, https://orcid.org/0000-0001-5779-7987

INTRODUCTION

The scarcity and unequal distribution of open public space (hereafter referred to as OPS) in urban centers worldwide is an urgent issue that requires attention (Banerjee, 2001; Lindholm, 2019; Dong et al., 2023). Despite recommendations put forward by urban planners and experts in urban forestry and ecology, public policies appear to perpetuate urban growth characterized by a lack of public green spaces (Colding et al., 2020) and the predominance of privatized open spaces (Sun et al., 2022; Calonge-Reillo, 2022; Pavón Ureña & Enríquez Acosta, 2024). As a result, several major cities around the world face serious environmental challenges. Cases such as Begusarai and New Delhi in India, or Hotan in China, illustrate the severe environmental consequences associated with deteriorating air quality (IQAir, 2023).

Environmental challenges resulting from poor air quality (Kan et al., 2012; Carozzi & Roth, 2023), rising temperatures associated with the urban heat island effect, and reduced thermal comfort are further intensified by issues such as the overcrowding of open spaces, fragmented and dispersed urban expansion, limited walkability, and excessive automobile use. These environmental disadvantages are often distributed in socially inequitable ways (Wu et al., 2020; Hsu et al., 2021), highlighting the urgent need for immediate intervention.

According to the United Nations' 2030 Agenda action plan, the availability of OPS is essential for cities. As outlined in Sustainable Development Goal (SDG) no. 11, the objective is to "make cities and human settlements inclusive, safe, resilient and sustainable" (ONU-Hábitat [Programa de las Naciones Unidas para los Asentamientos Humanos], 2017, p. 4). In addition, ecosystems depend on OPS, as it serves as habitat for flora and fauna within urban boundaries. In this regard, limited availability of OPS can generate conflicts between residents and urban trees (Dahlhausen et al., 2016; Oliveira Fernandes et al., 2019).

Likewise, SDG target 11.7 seeks to provide "universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities" (United Nations Human Settlements Programme [UN-Habitat], 2018, p. 1). However, this target is often misinterpreted by limiting such spaces to urban parks—assumed to be green (vegetated) spaces—when in fact these represent only a subset of OPS (López Torrero & Navarro Navarro, 2023).

At the local level, regulatory frameworks establish standards for urban development and renewal, as well as for the provision of and access to OPS and parks (Law 283 of 2018; Agreement of 2018; Decree-Law 144 of 2020; IMPLAN, 2023). In Mexico, OPS are created with support from the private sector through urban development requirements or land donations (Decree of 2016). Accordingly, land designated for public facilities, streets, sidewalks, medians, and equipped parks is transferred by developers to public ownership (Law 283 of 2018; Agreement of 2018).

Therefore, this article examines the process of urban park creation as a vital component of OPS in Hermosillo, a city located in northwestern Mexico. It suggests that, despite the existence of an institutional framework, the administrative process regulating water and land management in

neighborhood parks is opaque and discretionary, hindering the effective implementation of regulations and leading to inconsistent outcomes regarding sustainability (maintenance) and equitable access to these spaces.

To address gaps in knowledge regarding the public policies shaping open public space (OPS) in the municipality of Hermosillo, this study establishes four objectives—derived from the research questions: *1)* to describe the administrative process underlying the creation of neighborhood parks; *2)* to explain how large urban parks are developed; *3)* to identify the challenges involved in maintaining these spaces; and *4)* to document the process of water management for urban parks. In addition, the following hypotheses are proposed: H1) the administrative process for creating neighborhood parks through residential subdivision approvals is complex, discretionary, and opaque; H2) larger parks, often promoted as municipal three-year administration projects, result from a parallel and independent process separate from that of neighborhood parks and with citizen support; H3) maintenance activities show a tendency toward privatization due to limited public resources; and H4) water resources designated for green areas are managed informally.

To understand this administrative process, the Institutional Analysis and Development (IAD) framework developed by Elinor Ostrom (1999, 2005a, 2005b) was employed. In addition, the institutional analysis is grounded in empirical evidence obtained through documentary review and testimonial accounts from key social actors involved across different sectors. Likewise, the collected information was processed using thematic analysis with deductive and inductive coding (Wolgemuth et al., 2024), policy pathway frameworks to explain the administrative routes of public policies (Haasnoot et al., 2013), and flowcharts.

CASE STUDY

The city of Hermosillo was selected as an appropriate case for the phenomenon under study. It has a population of 855 563 inhabitants (Instituto Nacional de Estadística y Geografía, 2020) and is located in the state of Sonora, northwestern Mexico (Map 1). It has been a rapidly growing city, as its population increased by 57% between 2000 and 2020 and it experienced a 40% expansion of urbanized land.

Map 1. Location of Hermosillo

Source: Own elaboration.

According to Monkkonen et al. (2021), the implementation of urban planning in the municipality is relatively recent. The authors report that the first Comprehensive Urban Development Plan (PIDU)[3] was developed in 1994 and has since been updated in 1997, 2000, 2003, 2007, 2014, and most recently in 2023. In this context, the Municipal Institute for Urban Planning and Public Space (IMPLAN)[4] was established in 2011 as a decentralized agency responsible for the development and implementation of the PIDUs and, as discussed later, plays an important role in issuing permits for urban land development.

It is worth noting that Navarro-Estupiñan et al. (2020) report that 40.89% of urban areas correspond to streets and sidewalks, while parks account for only 1.87% of the total urban area (López González et al., 2021). In addition, there is no comprehensive, public, and up-to-date inventory of public parks (López Torrero & Navarro Navarro, 2023). Furthermore, the city lacks sufficient water to meet users' needs; for example, 2023 and 2024 were extremely dry years, and by summer 2025 the water deficit estimated by the water utility agency (OOA)[5] was approximately 1 000 liters per second.

[3] Unofficial English translation of Plan Integral de Desarrollo Urbano.

[4] Unofficial English translation of Instituto Municipal de Planeación Urbana y del Espacio Público.

[5] Spanish acronym for Organismo Operador de Agua.

THEORETICAL AND CONCEPTUAL FRAMEWORK

Within a public framework involving common-pool resources (CPRs), a social dilemma consistently arises between the party responsible for providing these resources and the one responsible for maintaining them. Since users lack incentives to assume these responsibilities, such dilemmas are typically addressed through government intervention. Thus, within a context of exchange among institutional actors, uncertainty is reduced because these actors formalize processes and encourage compliance with agreements (North, 1990). In the case of urban parks, these are framed within public policy as public goods requiring government provision due to market inefficiencies[6] (Aguilar Villanueva, 1993). In this context, local governments are responsible for the provision and maintenance of public parks, in accordance with Article 115 of the Political Constitution of the United Mexican States[7] (CPEUM, 1917). Likewise, compliance with these responsibilities contributes to the achievement of SDG 11.7, which incorporates theoretical dimensions related to the distribution of urban space (Jian et al., 2020) and environmental justice (Gelobter, 1994).

In this context, urban public parks—as a subset of OPS—are generated through land donations. Although the Spanish term *donar* is defined as giving or transferring something, or the rights associated with it, to another person voluntarily (Real Academia Española, n.d.), the English term *exaction* more closely reflects the implications associated with urban development practices: "the act of demanding and obtaining something, sometimes using force or threats" (Cambridge Dictionary, n.d.).

Land donations are an essential aspect of urbanization and carry a significant historical background. The practice of conditioning real estate development on the allocation of public space for green areas, roadways, sidewalks, and land designated for future public facilities is not a recent phenomenon. For example, in the United States, the tradition of land dedication for parks dates back a century, with the state of Montana approving the first ordinance in 1919 (Crompton, 2010). In general terms, the urban land development process does not differ significantly from that carried out in many cities across the United States and Latin America.

Although many historical gazettes, official journals, or bulletins are not available for online consultation, publications from some states were successfully retrieved. For example, regulations concerning land subdivision in Baja California stipulated that each residential subdivision was required to allocate 15% of its marketable area (Reglamento sobre Fraccionamientos de Terrenos en el Territorio Norte de la Baja California, 1951, Art. 37). The 1958 Ley de Fraccionamientos del Estado de México (Decree of 1958) was also recovered, establishing that developers were required to provide public services, as evidenced by subdivision creation agreements published in the *Gaceta del Gobierno del Estado de México* under this law (Agreement of 1977). In the case of the state of Sonora,

[6] The provision of public goods by private actors often presents market failures due to issues such as externalities and insufficient incentives. Therefore, intervention through public policies is required to ensure collective access and maintenance.

[7] Unofficial English translation of Constitución Política de los Estados Unidos Mexicanos (CPEUM).

the concept of land donation appears explicitly in Article 8, Section VIII of the Ley sobre Fraccionamientos Residenciales, Industriales y Campestres published in 1944 (Law 66 of 1944).

In this regard, the Ley General de Asentamientos Humanos, Ordenamiento Territorial y Desarrollo Urbano (Decree of 2016) grants responsibilities to municipal governments, including the requirement to impose urban development obligations on land developers for the integration of OPS. This decentralization of power and responsibility is further reflected in the creation of similar laws at the state level, generally with very similar names. For example, the state of Sonora has the Ley de Ordenamiento Territorial y Desarrollo Urbano del Estado de Sonora (Law 283 of 2018).

The document analysis conducted on land dedication regulations across Mexico's 32 states shows that these may vary depending on the type of subdivision. To calculate dedication percentages, states use different types of land area, such as marketable area, the total subdivision area, or square meters per housing unit; none of these methods is based on the future number of residents, which contrasts with the U.S. tradition of establishing land requirements per 1 000 inhabitants (Pepler, 1923). In this regard, in the State of Mexico and Quintana Roo, land dedication is specified per housing unit; however, in states such as Chihuahua, Hidalgo, and Veracruz, legislation does not establish specific dedication percentages, leaving this decision to municipal councils. On average, subdivisions must allocate 15% of their area to land dedications, distributed almost equally between green areas (7%) and urban infrastructure (8%); the statistical mode is 9% for green areas and 6 percent for urban infrastructure.

In the state of Sonora, developers are required to donate 12% of the saleable urbanizable area, allocating 5% to green areas and 7% to urban facilities (Decree-Law 144 of 2020), which contrasts with the provisions established in the Programa Municipal de Desarrollo Urbano de la ciudad de Hermosillo, highlighting the authority of local government to modify donated land areas:

> In affordable housing projects, minimum lot sizes of 91 square meters with a minimum frontage of 6.50 meters may be permitted only when the land dedication area is increased to 17% of the total saleable area, of which 7% shall be allocated to facilities and 10% to green public space. (H. Ayuntamiento de Hermosillo & IMPLAN, 2023, p. 259)

Despite the regulations governing land dedication, cities often face difficulties in meeting international standards for public access to green spaces. In this regard, the World Health Organization (WHO) recommends that all cities provide at least 9 square meters of green space per person.[8] However, this represents a challenge, as most cities in Mexico—if not all—fail to meet this threshold (Ojeda-Revah et al., 2020). This disparity highlights the urgent need to develop more effective urban planning strategies, as the current approach often replicates the same patterns without considering local needs and conditions.

[8] Bernal Grijalva et al. (2019, p. 12) discuss the difficulty of identifying a bibliographic reference for this widely cited indicator.

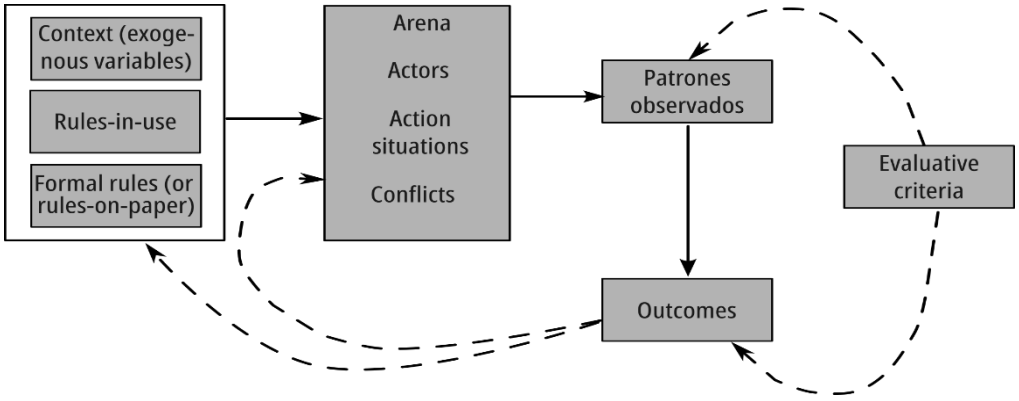
The same applies to OPS, where ordinances establish minimum dimensions for sidewalks and streets. In this regard, SDG Target 11.7 is often confused with the WHO indicator mentioned above. According to Ojeda-Revah et al. (2020), the concept of urban green space is not clearly defined in major Mexican cities. The portion of OPS that includes vegetation cover and functions as parkland represents a subset of the area encompassed by SDG Indicator 11.7.1: the average share of the built-up area of cities that is open space for public use (UN-Habitat, 2021). Nevertheless, Mexican cities also scored poorly on this indicator.

In this regard, the program UN-Habitat recommends that only between 30% and 35% of total OPS be dedicated to streets and sidewalks, and between 15% and 20% to open spaces such as parks, plazas, boardwalks, esplanades, and similar public areas. In 2020, the methodology proposed by UN-Habitat (2021) was applied in 23 cities across Mexico, excluding Hermosillo. The averages obtained fell below the recommended ranges: streets and sidewalks accounted for 13.28%, while open spaces represented 2.51%. This reveals that OPS is insufficient at the national level and that, although local regulations require developers to dedicate such space, they fail to meet international standards.

Institutional Analysis and Development (IAD) Framework

The administrative procedure involved in the creation of OPS encompasses a governance arena in which a significant number of social actors participate, including developers, real estate promoters, government officials from all three levels of government, academics, residents, environmental groups, and other civil society organizations. Initially, an analysis of this administrative process revealed substantial room for interpretation due to the discretion involved in the application of regulations and official standards, which were adapted to the context of each case and period. In this regard, the IAD framework developed by Elinor Ostrom (1999; 2005a; 2005b) makes it possible to analyze this governance arena as a dependent variable, as well as to examine its implementation, the behavior of the actors involved, informal arrangements, points of conflict, and the outcomes generated. Figure 1 presents its adaptation to the case study.

Figure 1. Institutional Analysis and Development (IAD) Framework Model



Source: Adapted from Ostrom (1999; 2005a; 2005b).

METHODOLOGY

To operationalize the IAD framework within the qualitative database, thematic analysis with hybrid coding strategy was employed. Through a deductive codebook (Figure 1), the content of the semi-structured interviews was interpreted; these codes were, in turn, linked to subcategories corresponding to specific segments of the administrative process under study—for example, water and land management, the maintenance of these spaces, and the creation of large parks—thereby allowing for inductive or emergent coding based on the interview content.

Interview participants were identified and selected using theoretical and chain-referral (snowball sampling) techniques. Informants referred by an initial group of participants were recognized as individuals with knowledge and experience related to the phenomena under study. Thus, prior to obtaining informed consent, in-person interviews were conducted with 55 participants (Table 1), totaling 40 hours of recorded semi-structured interviews conducted by the second author between October 2021 and December 2024.[9] Simultaneously with the interview process, anonymized transcripts were analyzed, and coding was carried out on two occasions by all authors of this article.

Table 1. Social Actors Interviewed by Category

Actors	*Category*
6	Academics from local universities and research centers
5	Members of neighborhood committees (associations)
7	Leaders of civil society organizations (CSOs)
10	Former municipal government officials
9	Municipal government officials
1	State government officials
13	Urban land developers
2	Expert consultants
2	IMPLAN advisory council members

Source: Own elaboration.

Before and during the interview process, an in-depth document analysis was conducted of urban development plans, residential development authorizations published in the *Boletín Oficial* of the state government, press publications, and other available sources of information. To describe and simplify administrative processes, graphical tools such as flowcharts and administrative pathway diagrams were used.

[9] Some interviewees were contacted multiple times to clarify specific aspects of the process.

DATA ANALYSIS, RESULTS, AND DISCUSSION

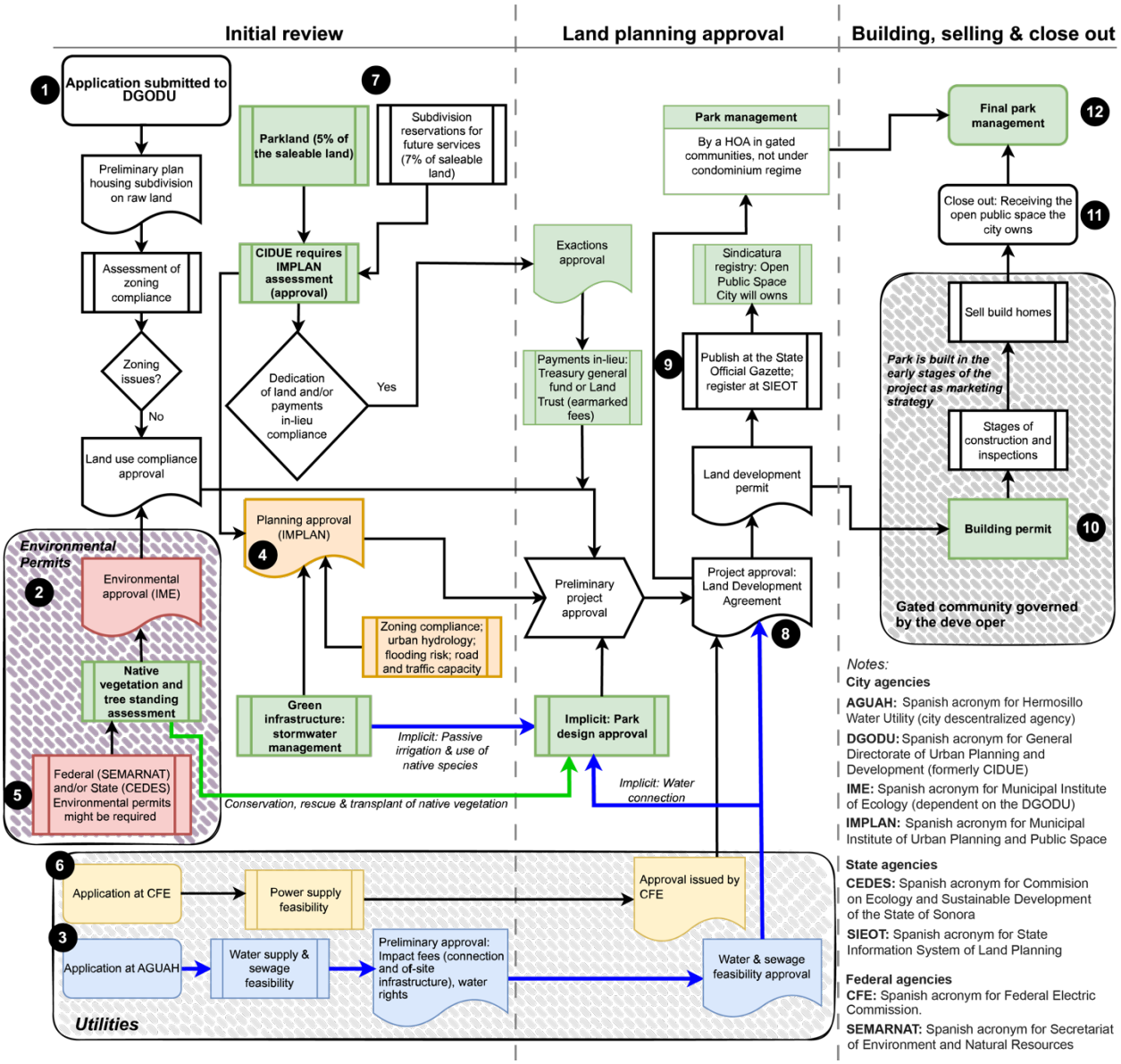
The deductive and inductive coding of interview transcripts generated a total of 2 466 coded text segments (1 130 deductive and 1 336 inductive). Through deductive coding, segments related to the following issues were classified: *a)* formal rules (272) or rules-in-use (363) to determine the contrast between regulations and their practical implementation; *b)* action situations (112), reflecting actors' micro-level behaviors in specific circumstances; *c)* identification of the actors involved (129); *d)* points of conflict (67), where neither formal nor informal rules resolve interactions among actors; *e)* exogenous or contextual variables (83), including cultural, political, or biophysical factors; and *f)* outcomes perceived by social actors (104). In addition, graphical tools such as flowcharts and policy pathways were used to explain and simplify administrative processes.

Action Arena

This section characterizes the action arena that gives rise to land donations resulting from the land development process for the construction of new residential housing as a condition for subdivision approval. To describe and explain the administrative process through which urban land development is approved in Hermosillo, a flowchart was developed, the initial version of which was provided by an interviewed developer; subsequent revisions and adaptations were made by the authors.[10] Figure 2 presents the final diagram, which includes most of the actors involved in the action arena.

[10] This refined version was validated by both the developer and a municipal official.

Figure 2. Administrative Process of Urban Land Development for the Creation of Neighborhood Parks[11]



Note: The green color corresponds to stages of the process that directly involve neighborhood park management; the blue color is related to water management for irrigation.

Source: Own elaboration.

With regard to the permitting process for the development of new residential subdivisions, urban development obligations (land donations) intended for green areas are intrinsically linked to a regulatory framework whose permits and approvals span the local, state, and federal levels of government. From the perspective of some interviewed developers, this regulatory process is

[11] The names of the agencies presented in the notes to Figure 2 were translated by the authors and, therefore, do not constitute official translations.

characterized by its lengthy nature, marked by significant bureaucratic obstacles, a high degree of discretion in decision-making, and a tendency for procedural management priorities to shift with each new local administration.

In a presentation, a representative of the Cámara Nacional de la Industria de la Vivienda (CANADEVI) in Sonora stated that "the process takes an average of 27 months, despite ongoing regulatory improvements" (CSO leader 1, personal communication, July 17, 2024). In this regard, some participants commented that each administration tends to reinterpret regulations according to its own criteria:

> It depends on each administration; we return to the issue of the three-year term. With these three-year cycles, some administrations allow [gated communities], while others tell you, "you must establish a condominium regime." For example, the subdivision [name of a gated community] operates under a horizontal condominium regime; they are perfectly compliant because that is how it should be, a condominium. (Developer 1, personal communication, September 14, 2022)

By contrast, administrative authorities and some interviewed academics argued that their intention is simply to enforce the PIDU and the corresponding regulations. However, from the perspective of some local developers, technical limitations within municipalities persist in the proper implementation of these instruments. In this regard, one interviewee stated: "But then, there is another group of people who do not understand the subject; they come in without knowing, so you have to explain everything to them from scratch." The same interviewee further added that "they have people within the municipality who do not understand urban development" (Developer 1, personal communication, September 14, 2022), which requires the continuous explanation of basic and technical aspects related to urban planning. These perceptions reflect tensions between institutional regulatory intent and the actual technical capacities of some municipal officials.

The urban planning administrative process begins when developers submit their project proposals to la Dirección General de Ordenamiento y Desarrollo Urbano (DGODU, formerly CIDUE[12]) (Figure 2, step 1). At this stage, multiple interrelated procedures are conducted simultaneously with other municipal agencies, reflecting the complex regulatory structure that governs urban development initiatives.

Among these agencies is el Instituto Municipal de Ecología (IME), which maintains an autonomous advisory council while remaining functionally linked to the DGODU. Its role is central to the evaluation of and guidance on the ecological and environmental dimensions of proposed projects (Figure 2, step 2). Some environmental advocacy groups identify this arrangement as a source of tension, arguing that the IME should not be institutionally dependent on the DGODU, as such subordination constrains its autonomy and limits its capacity to act.

[12] Spanish acronym of Coordinación General de Infraestructura y Desarrollo Urbano.

Similarly, Agua de Hermosillo (Aguah) is a decentralized municipal agency responsible for evaluating water-related implications in development projects (Figure 2, step 3). In a comparable manner, IMPLAN operates through an independent advisory council, and its primary function is to ensure that proposed projects are aligned with urban planning objectives and public space considerations (Figure 2, steps 4 and 7).

It is important to note that the permitting process within the IME may follow different pathways depending on the environmental impact of the project. When environmental effects are deemed significant, the involvement of additional regulatory agencies may be required (Figure 2, step 5), such as la Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) at the federal level and the Comisión de Ecología y Desarrollo Sustentable (CEDES) of the state of Sonora. These authorities play a significant role in environmental assessment and the permitting process. In addition, la Comisión Federal de Electricidad (CFE) issues an electrical service feasibility assessment, which constitutes an essential component of this administrative procedure (Figure 2, step 6). Within this framework, each required permit is processed and granted independently. According to some interviewees, the initial review of these permits is particularly significant because of the potential financial obligations they may impose on developers, thereby affecting the project's overall economic viability.

As previously noted, Decree-Law 144 of 2020, which amends Article 89 of Law 283 of 2018, together with the Programa Municipal de Desarrollo Urbano de Hermosillo (PMDUH), establishes land dedications as a percentage of commercially developable land (H. Ayuntamiento de Hermosillo & IMPLAN, 2023). Developers are generally allowed to provide in-lieu payments or land exchanges, particularly with respect to land reserved for public facilities and green spaces. This procedure is carried out through the DGODU but incorporates input from IMPLAN and the Sindicatura Municipal (Figure 2, step 7).

The síndico is an elected official who appears on the ballot alongside the municipal president and council members. This official is responsible for legally representing the municipality in commercial matters, serving as its official notary, and managing municipal assets. Accordingly, the Sindicatura plays a central role in receiving and maintaining the inventory of public parks, as well as all land acquired through land dedication requirements.

Once all requirements have been fulfilled, the municipality formalizes an agreement with the developer outlining all project specifications (Figure 2, step 8). At this stage, the dimensions of the OPS and land reserved for public facilities are on the verge of becoming public property. Although the park design is assumed to have been approved at this point in the process—including water provision and green infrastructure for stormwater retention—interviews revealed the absence of minimum park design guidelines. The agreement also specifies the governance structure of the gated community, either through a neighborhood committee under a condominium regime or a civil association. In either case, responsibility for park management and maintenance rests with future residents.

The agreement is published in the *Boletín Oficial del Estado de Sonora*, and the development is registered in the Sistema Estatal de Información para el Ordenamiento Territorial (SEIOT) of the state of Sonora (Figure 2, step 9). Publication formally grants municipal ownership of urban land designated for the OPS (including the park) and land reserved for public facilities. Subsequently, the developer may obtain a construction permit (Figure 2, step 10). The park is typically built during an early phase of the project as a strategy to attract prospective homebuyers. Initially, the gated community remains under the operational management of the developer, who assumes responsibility for the maintenance of the park and all common areas. A primary objective of the developer is to ensure high standards of maintenance and the efficient operation of the gated community, with particular emphasis on the upkeep of shared spaces.

During the construction phase, a gray area emerges as housing units are built and sold while the community begins to populate. According to some interviewees, the threshold for establishing a neighborhood committee and transferring control of the community, including the park, is 50% occupancy. In the final stage of the project, the developer transfers public infrastructure to Aguah, CFE, and the DGODU (Figure 2, step 11), a process commonly referred to as *entrega-recepción* (formal transfer and acceptance). Responsibility for park management and maintenance is then assumed by the neighborhood committee (Figure 2, step 12).

IAD Framework Analysis

In this context, the IAD framework makes it possible to understand the public policy arena as the dependent variable in which actors, rules, and decision-making processes interact, while both formal regulations and informal practices coexist. However, an academic specializing in urbanism argued that this action arena rests on a solid legal foundation that should leave little room for informal rules, stating:

> The law does not permit partially completed housing developments [meaning that the law cannot be only partially enforced]. [Moreover,] the notion of private property, and of the developer [as the property owner] as someone free to do whatever they wish with the land, [is subject to] la Ley General de Asentamientos Humanos, which derives from Article 27 of the Constitution [meaning], in short, that the nation has the full right to place public interest above private interests regarding land-use arrangements. Therefore, ownership of [urban] property is limited [by] what is established in the urban development program and by decisions of the municipal government." (Academic 1, May 20, 2022)

Even when laws are applied strictly, an institutional design flaw remains in the process of creating the OPS and urban parks: park land dedication is determined according to commercially developable land rather than the future resident population, meaning that demographic pressure on these spaces is not taken into account. The clearest evidence of this issue lies in the fact that vertical housing developments built on previously urbanized lots do not contribute OPS land. Moreover, the donated space is not strictly public. Based on the information analyzed in this study, it is more accurately classified as a "club good," serving a group of residents who pay maintenance fees and

restrict access. This contrasts with most international indicators—such as SDG 11.7 and those established by UN-Habitat (2021)—which define green space in terms of square meters per inhabitant and assume the creation of open public space.

A defining feature of this action arena is that all space is provided by developers; in other words, the private sector is responsible for creating the OPS. However, this arrangement is not new, as municipalities lack sufficient financial resources:

> The municipality [of Hermosillo] is basically broke [without money], and municipalities in general […] So, they want to get everything from here [the private sector]: they raise licensing fees; "Oh, you want to build a housing development? Fine, build me a road over there, do this or that," meaning things unrelated to my project. They impose urban infrastructure works because they do not have funding and [basically say], "Go ahead and pay for it if you want approval." (Developer 2, personal communication, October 23, 2022)

In this context, several developers point out that the urban development obligations they must assume have progressively increased. These include the creation of green infrastructure, the planting of one tree per housing unit,[13] and the obligation to secure sufficient water supply capacity for the subdivision in order to obtain water feasibility approval from the public utility Aguah. The extent to which the costs associated with these urban development obligations are ultimately passed on to homebuyers falls outside the scope of this study.

Similarly, some developers adopting disruptive approaches have integrated subdivision reservations into park areas, creating larger and more functional spaces. However, their testimony points to the presence of informal rules and a lack of trust regarding the future use of donated land, as well as a sense of social responsibility to ensure habitability and the success of the housing development:

> Part of it was green space; some sections were inside and others outside, but I incorporated the subdivision reservations [into the green area]. What did I do? Well, I started equipping it, and now people will not let it be taken away. I am interested in incorporating facilities within my housing development—I have always thought that way—to create something meaningful, but I want to create something that benefits the housing development. (Developer 3, personal communication, October 5, 2022)

Although legislation establishes that resources derived from land exchanges must be deposited into a land trust (Agreement of 2018, Art. 75) and, more recently, into a land fund administered by a Technical Committee composed primarily of municipal officials—with the participation of an opposition council member as a counterbalance (Agreement of 2023, Art. 124)—some developers claim that such a trust does not exist and that funds are instead managed through a bank account, preventing oversight by private-sector institutions such as CANADEVI in Sonora. As a

[13] Based on the thematic analysis of the interviews, it became evident that the formal requirement of one tree per housing unit (Law 95 of 2016) is not widely known, and its implementation is partial or, in some cases, nonexistent.

result, the way in which this new regulation will operate remains uncertain. Previously, a developer and a public official indicated that the trust contemplated under Law 283 of 2018 had not been established because its maintenance was not considered cost-effective. Developers and some consultants also perceive a lack of transparency in the land valuation process for exchanged parcels.

It is important to note that misinformation regarding public-domain property has generated a phenomenon referred to in this study as "green encroachment." This occurs when residents assume that certain parcels constitute green areas or land designated for sports and recreational activities, when in fact they are privately owned properties transferred to the municipality as settlement for tax liabilities. These forms of encroachment have led to social conflicts that, in some cases, have escalated to involve federal authorities, as occurred with Parque El Cárcamo. Interviews revealed that, on multiple occasions, even the municipality itself is unaware of the origin of these parcels, which, under social pressure, ultimately receive maintenance and are even equipped with urban amenities. In this regard, a former municipal official from the technical division of Catastro Municipal was consulted about the existence of an open inventory of public-domain land:

> The inventory maintained by the cadaster is not publicly accessible […] the question is whether there is a public database allowing citizens to identify land available for green areas [or public-domain property]. There is not; an official request must be submitted to the Sindicatura, and they would respond, of course, by consulting the cadastral database to which they have access. (Former municipal official 1, personal communication, December 12, 2024)

Similarly, regarding the El Cárcamo case, an official from the Sindicatura stated:

> The basis of the citizens' claim rests on a false premise: "the parcel [El Cárcamo] belonged to the municipality," when in reality it was never registered in the municipal asset inventory because it was subject to an immediate foreclosure and auction process. By origin, the parcel entered municipal assets as settlement for tax liabilities and was classified as private-domain property; it was never public-domain property. The use of these spaces for sports activities was informal […] it gradually came to be used in that way, and eventually, during an update of the urban development program, IMPLAN designated it as a green area without any request from the Sindicatura. (Developer 2, personal communication, January 14, 2022)

Document analysis revealed that El Cárcamo was a longstanding case dating back many years. According to one interviewee, the parcel was initially lent to sports leagues in order to prevent encroachment. In this regard, another informant used the phrase "*procesos mostrencos*" to refer to the large number of incomplete administrative procedures that remain open and unresolved following each change in municipal administration.

The failure to complete the formal transfer process of land dedications emerged as a highly recurrent code in the thematic analysis. This situation has affected the subsequent management of parks, including access to public services (e.g., water supply), and has also weakened oversight by the Sindicatura in its role of maintaining the cadaster of public-domain property. This code was

likewise associated with irregular administrative procedures. When asked about perceptions regarding delays in the formal transfer process of land dedications and infrastructure, one land developer responded:

> Non-transfer is the government's fault, in my view. We come back to the same issue: the government has no interest in receiving the OPS; I mean, tell me, why would a public official want to take on the burden of a housing development as the municipality? Why would they want to deal with complaints from all the residents? Better to let the developer take the blame, right? I can tell you that I have never completed one; in fact, I do not know anyone who has. (Developer 1, September 14, 2022)

The institutional analysis based on the IAD framework made it possible to identify a broad set of rules-in-use and action situations that shape the administrative process on a case-by-case basis, depending on the administration in office. Given the analytical effort devoted to clarifying this process, the first hypothesis regarding system complexity and the existence of institutional gaps that foster discretionality cannot be rejected. However, not all findings identified during the coding process were negative. Table 2 summarizes some of the strengths identified.

Table 2. Positive Aspects of the Administrative Process for Urban Land Development That Creates Neighborhood Parks

Aspect	*Action situation*
Local developers with greater experience in the city's construction sector express a genuine concern for ensuring that their developments include green areas and adequate facilities. Their objective is to guarantee the success of these projects, improve their livability, and increase their added value.	There is distrust toward municipal authorities due to the short-term nature of local administrations and the constant turnover of public officials. There is concern that the municipality may fail to provide the necessary facilities in a timely manner, that land intended for such purposes may be sold or exchanged, and that financial resources may be allocated to other purposes within the general budget.[14]
Despite the challenges they face, homeowners' associations have successfully taken responsibility for maintaining their common spaces. Given the municipality's limited operational capacity and the broader context of insecurity, residents have formally or informally adopted a model of self-management to ensure the preservation of these spaces.	These actors have tacitly assumed their role and, to a large extent, have lost the expectation that local government will solve their problems.

(continues)

[14] The term "*La Licuadora*" ("The Blender") refers to a municipal practice suggesting that funds allocated for the creation of parks are instead spent on unrelated purposes.

Aspect	*Action situation*
(continuation)	
The IMPLAN has led the incorporation of new perspectives on sustainable and inclusive urbanism, as well as nature-based solutions. Its advisory council has sought to preserve the diversity of its members and to issue independent technical opinions, free from political interference, including that of the acting mayor.	High expectations have been placed on this agency, despite its limited resources and restricted institutional autonomy.
Environmental groups have played a fundamental role in defending public spaces and urban parks. They have functioned similarly to a public land-use and public space prosecutor's office, which, until now, had not been formally established.	Civic groups have strengthened their presence through public protest, which has encouraged authorities to take them into consideration during the project formulation process.

Source: Own elaboration.

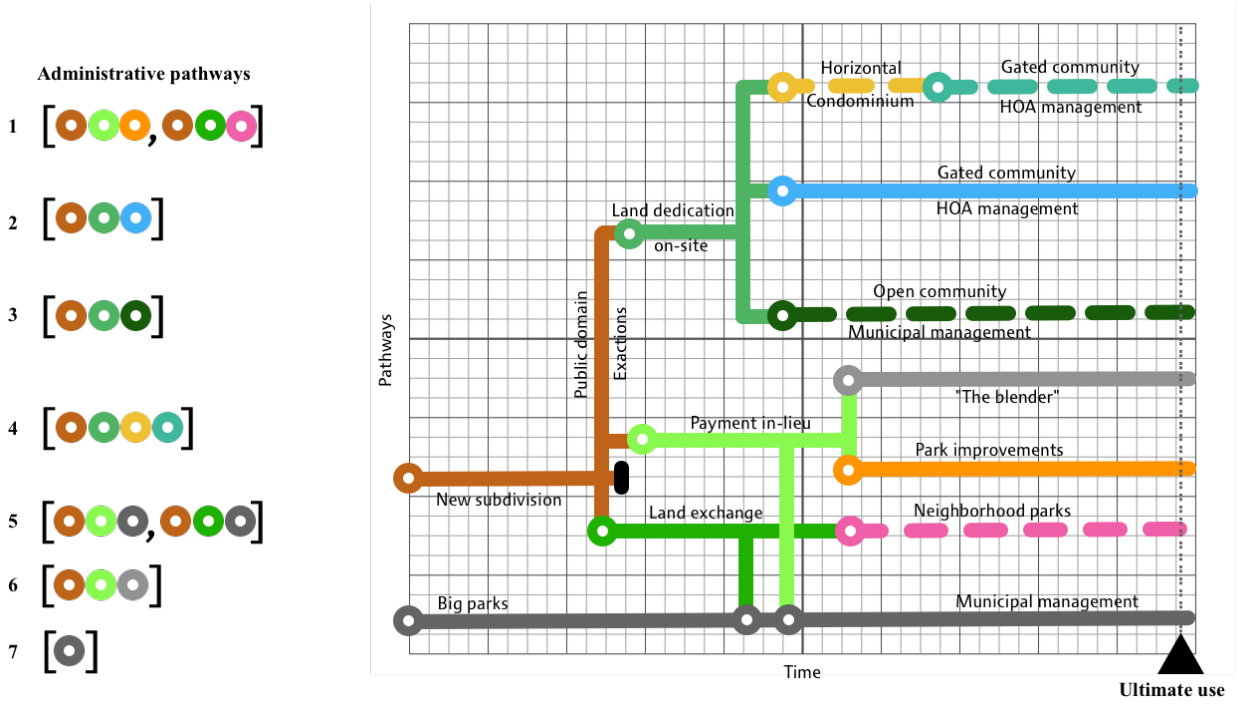
Large Parks

One of the initial questions guiding this study concerned the origin of larger parks in Hermosillo. The city has only a limited number of iconic parks that exceed the average size of neighborhood parks. According to López Torrero and Navarro Navarro (2023), 634 of the 700 parks managed by the municipality covered less than 0.5 hectares. Within the local urban landscape, several examples of large parks stand out. One of these is Parque Madero, which spans approximately 8.9 hectares and is fully operational. Another is Parque Pitic, covering 3.6 hectares, as well as La Sauceda, a 40-hectare park managed by the state government that, at the time of the study, was in a state of abandonment.[15] Finally, the recently constructed Eco-Parque covers 49.8 hectares and was also found to be abandoned. Although there are fewer than a dozen large parks in the city, most are significant because they include sports facilities such as baseball or soccer fields.

Much like a subway map, the route diagram in Figure 3 illustrates seven possible administrative pathways through which land dedications or land exchanges may lead to park creation Two development pathways can be identified. The first begins with residential subdivision development on urban land and culminates in the creation of a new large neighborhood park, where the park's size is determined by the total authorized saleable area, while its quality reflects the market value of the housing units. The second pathway begins with the construction of large parks that appear to emerge independently from the administrative process through which neighborhood parks are typically produced.

[15] This park was rehabilitated and reopened to the public on March 23, 2025 (Gobierno del Estado de Sonora, 2025).

Figure 3. Administrative Pathways for the Creation of Urban Parks



Source: Own elaboration.

Information gathered through interviews revealed that larger parks tend to emerge as projects promoted as part of a political strategy (Figure 3), meaning that they are typically driven through top-down decision-making, commonly without public consultation and under the assumption that citizens will not oppose them. In this context, such projects are generally introduced into the public sphere through media coverage and promotion and are later subjected to public scrutiny if necessary. In this regard, when asked about the specific case of Parque de la Esperanza,[16] a former IMPLAN official responded: "Unfortunately, IMPLAN had nothing to do with that case; at the time, the mayor ordered it to be built" (Former municipal official 2, October 21, 2021).

In Figure 3, following the brown line, the process branches into three administrative pathways (2, 3, and 4), in which parks remain within new developments and are ultimately managed by neighborhood committees. Pathway 2 represents the most common route for the creation of small or medium-sized neighborhood parks, which, despite being public property, are located within gated subdivisions that are not formally constituted as condominiums. Open subdivisions are uncommon (Pathway 3) because, according to the developers interviewed, houses located on open streets are more difficult to sell. Moreover, an open public park is unlikely to be maintained by a homeowners' associations and is generally transferred to the Dirección de Parques y Jardines

[16] This park covers an area of approximately 1.1 to 1.8 hectares and was built in 2018 on land previously used as material extraction sites. In this regard, residents have raised numerous complaints concerning flooding and land subsidence (Nápoles Manríquez, 2020).

(DPJ). In turn, Pathway 4 is relatively uncommon and represents new subdivisions that are formally incorporated as condominiums and operate through a combination of jointly owned open spaces (*communi pro indiviso*) and land ceded to the municipality.

In the case of new subdivisions that are too small to accommodate a park, developers are permitted to make a payment in lieu pursuant to Articles 79–80 of Decree-Law 144 of 2020. In such cases, funds are intended to be deposited into the municipal land fund (Figure 3, administrative pathways 1 and 6). However, as previously noted, this trust was never implemented, and the funds instead entered a bank account within the municipal general fund (administrative pathway 6). In this regard, Decree-Law 144 of 2020 allows these resources to be used for infrastructure and maintenance of public spaces (Figure 3, orange line), though not necessarily for land acquisition (Agreement of 2023, Art. 121, Section II), as some interviewed actors commonly assume. In Figure 3, the dashed pink line indicates that these funds could also be allocated to land purchases for the creation of small or medium-sized neighborhood parks; however, no documented cases or interview testimony supporting this practice were identified.

When asked about the ways in which municipal authorities acquire land for large-scale parks, participants reported that these parks have been created through the consolidation of land exchanges and payments in lieu. In addition, direct observation and documentary research identified that large parks have been established on low-value land located on the urban periphery, generally on former landfills or abandoned sand and gravel extraction sites. As shown in Figure 3 (gray line, Pathway 7), management and maintenance of large-scale parks are typically carried out by the DPJ.

Although these parks do not have permanent staff and remain open to the public, it is unclear whether any nongovernmental organization is responsible for administration. Therefore, based on information derived from interviews and document analysis, the second hypothesis can be rejected, given that the land on which large parks are established is typically the result of consolidated land donations and, moreover, that such parks emerge from political processes rather than from a prescribed need or a citizen consultation process.

Maintenance

According to the institutional analysis conducted, maintenance of urban parks can be divided into two categories: public and private. As previously noted, maintenance constitutes one of the key components of common-pool resources. A social dilemma exists, characterized by a lack of incentives for individuals responsible for cleaning and maintaining these spaces in good condition. To address this issue, members of environmental groups who perform this work voluntarily were interviewed; however, findings revealed that capacity is insufficient to cover all parks. In this regard, public parks left unattended continue to move toward the scenario described by Hardin (1968, p. 1) in the “tragedy of the commons.”

A. Public Maintenance

The Dirección de Parques y Jardines (DPJ) operates efficiently; however, capacity is insufficient to meet the city's demands. According to several interviewees, management and maintenance of new parks by the DPJ are relatively uncommon. Participants also noted that this agency is no longer what it was in the early 1990s, when it had a larger workforce and even specialized gardeners assigned exclusively to gardens and medians. Nevertheless, the area under DPJ responsibility continues to expand each year. In this regard, one participant estimated that the waiting time for park cleaning is approximately three months, suggesting that the DPJ is overburdened. Likewise, López Torrero and Navarro Navarro (2023) reported that 474 out of 776 neighborhoods lacked a park maintained by the DPJ, providing an indication of the agency's geographic coverage.

B. Private Maintenance

As a result of the above, management and maintenance of new parks fall under the responsibility of neighborhood committees (see Figure 3, administrative pathways 2 and 4). However, the primary challenge faced by these committees is the collection of maintenance fees from residents. In the case of gated communities operating under a condominium regime, the Ley de Propiedad en Condominio de Inmuebles para el Estado de Sonora (Law 101 of 2016) regulates all aspects of community governance, and residents are legally required to pay such fees.

On the other hand, the "informal condominium" arrangements are more flexible. In this regard, one interviewee, referring to a rule-in-use aimed at avoiding the formal establishment of horizontal condominiums, noted that the term cerrada ("gated enclave") is preferred to describe an internal common space whose infrastructure remains under public ownership. When developers were asked about the reasons for not opting to create condominiums, they explained that legal incorporation and lot titling are highly complicated, as this process "took too much time for notary offices." In addition, they argued that future residents were uncomfortable knowing that streets, sidewalks, and other internal infrastructure would fall under their responsibility.

According to a rule-in-use, new subdivisions are designed to function as gated communities with a single entrance and infrastructure enabling private guards to control access. However, a condominium regime is not stipulated in the land development agreement (see Figure 2, step 8). In this regard, according to testimony from one developer, an action situation reveals that subdivisions are managed "as if, once built, future residents independently decided to close them off." Nevertheless, for this to occur, formal rules require approval by a simple majority. In such cases, residents organize through a neighborhood committee and ideally establish a nonprofit civil association before a notary public. Public space within the gated community remains municipal property; therefore, a *comodato* agreement should be established to grant custodianship of these spaces to the neighborhood committee.

In this context, interviews showed that most neighborhood committees face difficulties collecting fees due to the lack of coercive mechanisms to ensure payment. This creates financial challenges in the administration of gated subdivisions, as expressed by one real estate agent: "The

problem with administration in gated subdivisions is that there are no consequences if residents stop paying" (Consultant 1, personal communication, August 19, 2022). In addition, there is a strong market preference for gated subdivisions, driven by perceptions of insecurity. The subsequent difficulties associated with managing these communities were highlighted by a new housing sales consultant in the following action situation:

> It all depends on the market [homebuyers]; I have noticed […] that almost everyone looking to buy a house wants it to be inside a gated community for security reasons. However, I feel that developers do not leave these communities properly managed or consolidated, and the government does not provide [either developers or neighborhood committees] with tools or incentives; I feel that everything is left too flexible, and in the end, [the security] marketed as a benefit also becomes a problem. (Consultant 1, personal communication, August 19, 2022)

According to the information collected, the third hypothesis can be accepted, as a trend toward privatized maintenance exists due to the lack of public resources.

Water

Although not initially a central aspect of the action arena, water management in urban parks emerged as a significant concern. Through direct observation, parks and other green spaces—including medians, road shoulders, and roundabouts—were found to be connected to the potable water supply, often without contracts or metering. According to one interviewee, irrigation of these green spaces through public water infrastructure is not accounted for, highlighting the seriousness of the issue.

Water use for the maintenance of urban ecosystems is not regarded as a concealed practice. These water connections exist in plain sight and have traditionally been considered legitimate and tacitly accepted. On occasion, the OOA imposes an estimated charge on municipal utility bills. The issue of unaccounted water connections in parks is not merely an oversight but a complex matter shaped by the administration in office, the political actors involved, and the ruling political party. In addition, authorities also consider the political cost of cutting off water supply to a park and potentially allowing the vegetated landscape—generally composed of exotic (non-native) species—to dry out.

On the other hand, the severity of water scarcity further complicates the decision-making process. It should be noted that not all parks have water connections or infrastructure for rainwater harvesting. Academic studies reveal that most park landscapes display shades ranging from brown to gray and are characterized primarily by exposed bare soil (Clemente-Marroquín, 2007; Bernal Grijalva et al., 2019).

In 2018, the municipal government introduced the Norma Técnica of green infrastructure (Dictum of 2018), requiring the inclusion of passive irrigation mechanisms for rainwater harvesting and runoff capture in parks. The regulation also mandates the use of low-water-consumption native species in the landscaping of new developments. However, the ordinance is not retroactive, resulting in the slow adoption of green infrastructure in existing parks and underscoring the challenges of implementing such measures in everyday practice.

A commonly proposed solution is the use of treated water; however, the municipality lacks sufficient distribution pipelines—commonly known in Mexican hydraulic terminology as línea morada ("purple line"). As a result, the water would need to be transported over long distances by truck, substantially increasing costs. Through direct observation, it was found that in several parts of the city, irrigation systems in public green spaces operating without oversight frequently waste and leak water. In this regard, a senior official from the DPJ agreed with the utility operator Aguah that water connections in green spaces should be shut off, given the current lack of oversight and control. Furthermore, because much of the vegetation in the parks consists of non-native species, these plants experience water stress and eventually dry out.

Few neighborhood committees clearly understand how to establish a legal water connection properly. A service contract must be established, along with the acquisition of a Service Identification Number (NIS)[17] and a water meter to monitor monthly water consumption. Parks located within gated communities that charge maintenance fees are subject to commercial water rates, which are the highest tariff category. For example, a monthly consumption of 30 cubic meters (m^3) under a residential rate amounts to MXN 792.34, whereas the same level of consumption under a commercial rate costs MXN 2 987.88. In a desert city such as Hermosillo, park water requirements far exceed 30 m^3 per month. In this regard, an Aguah official explained the formal rules:

> The issue is that these [water] contracts originally begin under the developer's name because the developer states: "This land belongs to me," and it will eventually become a park. Then, once the developer withdraws [at project completion], the park is transferred to the municipality, which assumes responsibility. Suppose the municipality grants it to the neighborhood committee. In that case, it provides an assignment of rights under a comodato agreement [a no-cost loan arrangement]. With the committee's articles of incorporation [as a legally incorporated nonprofit organization] and all required documentation, they come [to Aguah] and change the name on the water contract to that of the neighborhood committee. (Municipal official 2, personal communication, September 2, 2022).

Although future park water consumption must be considered in the approval of water feasibility (Figure 2, step 3), it often remains "paper water" rather than "wet water" (actual water).[18] Delays in project closure (Figure 2, step 11), during which the municipality formally receives the parks through the transfer process, gated communities operating as "false condominiums," and neighborhood committees lacking formal legal incorporation further complicate water management for parks.

Although laws require a water feasibility study for green areas and the Norma Técnica of green infrastructure mandates the construction of water-capture infrastructure (passive irrigation), most

[17] Unofficial English translation of Número de Identificación del Servicio.

[18] "Paper water" is an analogy used to refer to the overallocation of water rights (on paper) beyond the actual water available in a system (Sanchez et al., 2023).

public parks and those located within private developments continue to operate through irregular water connections. In this regard, one resident suggested that there is *huachicoleo de agua* ("water tapping") for parks, a situation attributable to the lack of decisive enforcement measures by authorities to shut down these connections. Accordingly, the fourth hypothesis is confirmed, given the existence of informal water management in green areas.

CONCLUSIONS

The analysis of the creation and management of urban parks in Hermosillo, as evidenced through the IAD framework, reveals institutional complexity and discretionality in the implementation of regulations. The findings confirm that, despite the existence of a formal regulatory framework, the management of these spaces is affected by opacity and the absence of clear guidelines, resulting in unequal access to and maintenance of green areas. The involvement of multiple actors—from developers to citizen groups—has also fostered self-management strategies in response to the government's limited capacity to ensure the sustainability of these spaces.

The study also reveals that the creation of both large and neighborhood parks responds to political dynamics and administrative processes, although findings suggest that their development stems from the consolidation of land cessions. Likewise, the study confirms a trend toward the privatization of green space maintenance driven by insufficient public resources, reinforcing the exclusion of certain population groups from the use and enjoyment of these spaces.

Opacity, lack of transparency, and discretionality in the OPS formation process frequently give rise to social conflicts as a result of incomplete administrative procedures. At the same time, the findings highlight the presence of an institutional design flaw, as formal rules governing green space provision remain disconnected from the international indicators commonly used to assess the success of these policies. Moreover, the spaces created are not public in nature but are instead more accurately classified as "club goods."

Regarding water management, the findings confirm the existence of informal practices that enable unregulated access to water resources, suggesting limited governmental oversight of water supply and use in these spaces. The absence of effective measures to regulate these connections, together with the lack of adequate infrastructure for rainwater harvesting, compromises the long-term viability of parks.

Overall, the findings of the study reinforce the need to improve urban planning through the implementation of existing regulations, the effective regulation of park access and maintenance, and the adoption of sustainable water management strategies. Therefore, it is imperative that authorities strengthen their role in the provision of these spaces to ensure equitable and sustainable access for the population.

Translation: Evelyne Rosales Cortes.

REFERENCES

Agreement of 1977 [Gobierno del Estado de México]. El Ejecutivo del Estado autoriza el fraccionamiento de tipo habitación popular denominado "Valle Verde", ubicado en el Municipio de Naucalpan, Distrito de Tlalnepantla, Estado de México. December 6, 1977. https://legislacion.edomex.gob.mx/sites/legislacion.edomex.gob.mx/files/files/pdf/gct/1977/dic062.pdf

Agreement of 2018 [H. Ayuntamiento de Hermosillo]. Relativo a la aprobación del Reglamento de Desarrollo Urbano y del Espacio Público para el Municipio de Hermosillo. September 3, 2018. https://boletinoficial.sonora.gob.mx/boletin/images/boletinesPdf/2018/09/2018CCII19III.pdf

Agreement of 2023 [H. Ayuntamiento de Hermosillo]. Que reforma y adiciona diversas disposiciones del Reglamento de Desarrollo Urbano y del Espacio Público para el Municipio de Hermosillo. June 12, 2023. https://boletinoficial.sonora.gob.mx/images/boletines/2023/06/2023CCXI47I.pdf

Aguilar Villanueva, L. F. (1993). *Problemas públicos y agenda de gobierno*. Miguel Ángel Porrúa.

Banerjee, T. (2001). The future of public space: Beyond invented streets and reinvented places. *Journal of the American Planning Association*, *67*(1), 9–24. https://doi.org/10.1080/01944360108976352

Bernal Grijalva, M. M., Navarro Navarro, L. A., & Moreno Vázquez, J. L. (2019). Adopción de especies nativas en la gestión de espacios verdes públicos sostenibles: el caso de Hermosillo. *Frontera Norte*, *31*(1), 1–27. https://doi.org/10.33679/rfn.v1i1.2049

Calonge-Reillo, F. (2022). More fear, less walking: Taking a walk in fortified housing environments in urban Mexico. *Journal of Housing and the Built Environment*, *37*(1), 443–458. https://doi.org/10.1007/s10901-021-09846-9

Cambridge Dictionary (n.d.) Exaction. In *Cambridge Advanced Learner's Dictionary & Thesaurus*. https://dictionary.cambridge.org/us/dictionary/english/exaction

Carozzi, F., & Roth, S. (2023). Dirty density: Air quality and the density of American cities. *Journal of Environmental Economics and Management, 118,* 1–27. https://doi.org/10.1016/j.jeem.2022.102767

Clemente-Marroquín, B. (2007). *Los parques urbanos en Hermosillo de 1997 a 2007: ¿abandono o recuperación?* [Master's thesis, El Colegio de Sonora]. https://biblioteca.colson.edu.mx/e-docs/RED/RED000028/mobile/index.html

Colding, J., Gren, A., & Barthel, S. (2020). The incremental demise of urban green spaces. *Land, 9*(5), 162. https://doi.org/10.3390/land9050162

Constitución Política de los Estados Unidos Mexicanos [CPEUM]. Art. 115. February 5, 1917 (Mexico). https://www.diputados.gob.mx/LeyesBiblio/pdf/CPEUM.pdf

Crompton, J. L. (2010). An analysis of parkland dedication ordinances in Texas. *Journal of Park and Recreation Administration, 28*(1), 70–102. https://js.sagamorepub.com/index.php/jpra/article/view/1268

Dahlhausen, J., Biber, P., Rötzer, T., Uhl, E., & Pretzsch, H. (2016). Tree species and their space requirements in six urban environments worldwide. *Forests, 7*(12), 111. https://doi.org/10.3390/f7060111

Decree-Law 144 of 2020. Que reforma y adiciona diversas disposiciones de la Ley de Equilibrio Ecológico y Protección al Ambiente del Estado de Sonora y de la Ley de Ordenamiento Territorial y Desarrollo Urbano del Estado de Sonora. November 17, 2020. *Boletín Oficial del Estado de Sonora* no. 40.

Decree of 1958 [Gobierno del Estado de México]. Se expide la Ley de Fraccionamientos de Terrenos del Estado de México. December 20, 1958. *Periódico Oficial Gaceta del Gobierno del Estado de México.*

Decree of 2016 [Secretaría de Desarrollo Agrario, Territorial y Urbano]. Por el que se expide la Ley General de Asentamientos Humanos, Ordenamiento Territorial y Desarrollo Urbano. November 28, 2016. *Diario Oficial de la Federación* núm. 21. https://www.dof.gob.mx/nota_detalle.php?codigo=5462755&fecha=28/11/2016#gsc.tab=0

Dictum of 2018 [Comisión de Desarrollo Urbano, Obra Pública, Asentamientos Humanos y Preservación Ecológica]. Relativo a la aprobación de la Norma Técnica que establece las características y requerimientos para la infraestructura verde en el municipio de Hermosillo. September 27, 2018. https://boletinoficial.sonora.gob.mx/boletin/images/boletinesPdf/2018/09/2018CCII26II.pdf

Dong, J., Wang, Y., Yang, Y., Luo, X., & Wang, L. (2023). A multi-level framework for assessing the spatial equity of urban public space towards SDG 11.7.1. A case study in Beijing. *Applied Geography, 161,* 1–13. https://doi.org/10.1016/j.apgeog.2023.103142

Gelobter, M. (1994). The meaning of urban environmental justice. *Fordham Urban Law Journal*, *21*(3), 841. https://ir.lawnet.fordham.edu/ulj/vol21/iss3/19

Gobierno del Estado de Sonora (2025, March 25). Celebra gobernador Durazo exitosa inauguración de La Sauceda con saldo blanco. Sonora Digital. https://www.sonora.gob.mx/gobierno/acciones/gobernador/celebra-gobernador-durazoexitosa-inauguracion-de-la-sauceda-con-saldo-blanco

Haasnoot, M., Kwakkel, J. H., Walker, W. E., & Ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change*, *23*(2), 485–498. https://doi.org/10.1016/j.gloenvcha.2012.12.006

Hardin, G. (1968). The tragedy of the commons: The population problem has no technical solution; it requires a fundamental extension in morality. *Science*, *162*(3859), 1243–1248. https://doi.org/10.1126/science.162.3859.1243

H. Ayuntamiento de Hermosillo, & Instituto Municipal de Planeación Urbana (IMPLAN). (2023). *Programa Municipal de Desarrollo Urbano de Hermosillo 2023.* Secretaría de Desarrollo Agrario, Territorial y Urbano. https://implanhermosillo.gob.mx/wp-content/uploads/2025/09/PMDUH-2023.pdf

Hsu, A., Sheriff, G., Chakraborty, T., & Manya, D. (2021). Disproportionate exposure to urban heat island intensity across major US cities. *Nature Communications*, *12*(2721), 1–11. https://doi.org/10.1038/s41467-021-22799-5

Instituto Nacional de Estadística y Geografía. (2020). Censo de Población y Vivienda (CPV) 2020 [Conjunto de datos]. https://www.inegi.org.mx/programas/ccpv/2020/#Resultados_generales

IQAir. (2023). World's most polluted cities. https://www.iqair.com/world-most-polluted-cities

Jian, I. Y., Luo, J., & Chan, E. H. W. (2020). Spatial justice in public open space planning: Accessibility and inclusivity. *Habitat International, 97,* 1–10. https://doi.org/10.1016/j.habitatint.2020.102122

Kan, H., Chen, R., & Tong, S. (2012). Ambient air pollution, climate change, and population health in China. *Environment International, 42,* 10–19. https://doi.org/10.1016/j.envint.2011.03.003

Ley de Ordenamiento Territorial y Desarrollo Urbano del Estado de Sonora [Law 283]. *Boletín Oficial del Estado de Sonora*, June 11, 2018 (Mexico). https://boletinoficial.sonora.gob.mx/boletin/images/boletinesPdf/2018/06/2018CCI47IV.pdf

Ley de Propiedad en Condominios de Inmuebles para el Estado de Sonora [Law 101]. *Boletín Oficial del Estado de Sonora*, December 19, 2016 (Mexico).

Ley para la Protección, Conservación y Fomento del Árbol en las Zonas Urbanas del Estado de Sonora [Law 95]. *Boletín Oficial del Estado de Sonora,* August 8, 2016 (Mexico).

Ley sobre Fraccionamientos Residenciales Industriales y Campestres [Law 66], *Boletín Oficial del Estado de Sonora,* November 8, 1944 (Mexico).

Lindholm, G. (2019). Land and landscape; linking use, experience and property development in urban areas. *Land, 8*(9), 137. https://doi.org/10.3390/land8090137

López González, F. M., Navarro Navarro, L. A., Díaz Caravantes, R. E., & Navarro Estupiñan, J. (2021). Cobertura vegetal y la distribución de islas de calor/oasis urbanos en Hermosillo, Sonora, *Frontera Norte*, *33*(6), 1–32. https://doi.org/10.33679/rfn.v1i1.2088

López Torrero, J. C., & Navarro Navarro, L. A. (2023). Inventario de parques urbanos para el cumplimiento de la Agenda 2030: el caso de Hermosillo, Sonora. *Frontera Norte, 35, 1–25.* https://doi.org/10.33679/rfn.v1i1.2307

Monkkonen, P., Echavarria, A., & Cáñez, J. (2021). Urban planning in Mexico: The cases of Morelia, Leon, Hermosillo, and Campeche. UCLA-Latin American Cities Initiative. https://drive.google.com/file/d/1V0aoDrYuTbGFcub6LZIKvwXHqBTLdcP_/view

Nápoles Manríquez, A. A. (2020). *La participación como herramienta de rehabilitación del espacio público: los casos del Parque Madero y Parque La Esperanza en Hermosillo, Sonora* (Mater's thesis, El Colegio de Sonora). https://repositorio.colson.edu.mx/handle/2012/44510

Navarro-Estupiñan, J., Robles-Morua, A., Díaz-Caravantes, R., & Vivoni, E. R. (2020). Heat risk mapping through spatial analysis of remotely-sensed data and socioeconomic vulnerability in Hermosillo, México. *Urban Climate*, *31*. https://doi.org/10.1016/j.uclim.2019.100576

North, D. (1990). *Institutions, institutional change and economic performance.* Cambridge University Press.

Ojeda-Revah, L., Ochoa González, Y., & Vera, L. (2020). Fragmented urban greenspace planning in major Mexican municipalities. *Journal of Urban Planning and Development*, *146*(2), 1–10. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000573

Oliveira Fernandes, C., Martinho da Silva, I., Patoilo Teixeira, C., & Costa, L. (2019). Between tree lovers and tree haters. Drivers of public perception regarding street trees and its implications on the urban green infrastructure planning. *Urban Forestry & Urban Greening, 37,* 97–108. https://doi.org/10.1016/j.ufug.2018.03.014

ONU-Hábitat (Programa de las Naciones Unidas para los Asentamientos Humanos). (2017). *Nueva Agenda Urbana* (A/RES/71/256). Asamblea General de las Naciones Unidas. https://onu-habitat.org/index.php/la-nueva-agenda-urbana-en-espanol

Ostrom, E. (1999). Institutional rational choice: An assessment of the institutional analysis and development framework. In P. A. Sabatier (Ed.), *Theories of the policy process* (pp. 35–72). Westview Press.

Ostrom, E. (2005a). *Understanding institutional diversity.* Princeton University Press.

Ostrom, E. (2005b). Towards a behavioral theory linking trust, reciprocity and reputation. In E. Ostrom, & J. Walker (Eds.), *Trust and reciprocity* (pp. 19–79). Russell Sage Foundation.

Pavón Ureña, R., & Enríquez Acosta, J. (2024). Segregación residencial como efecto de los fraccionamientos cerrados en Hermosillo, Sonora. *Topofilia. Revista de Arquitectura, Urbanismo y Territorios*, *17*(28), 1–23. https://topofilia.buap.mx/index.php/topofilia/article/view/520

Pepler, G. L. (1923). Open spaces. *The Town Planning Review*, *10*(1), 11–24. http://www.jstor.org/stable/40101635

Real Academia Española (n.d.). Donar. In *Diccionario de la lengua española* (Ed. del Tricentenario). https://dle.rae.es/donar

Reglamento sobre Fraccionamientos de Terrenos en el Territorio Norte de la Baja California. *Periódico Oficial*. March 30, 1951 (Mexico). https://wsextbc.ebajacalifornia.gob.mx/CdnBc/api/Imagenes/ObtenerImagenDeSistema?sistemaSolicitante=PeriodicoOficial/1951/Marzo&nombreArchivo=Periodico-9-LXIV-1951330-INDICE.pdf&descargar=false

Sanchez, L., Leonard, B., & Edwards, E. C. (2023). Paper water, wet water, and the recognition of indigenous property rights. *Journal of the Association of Environmental and Resource Economists*, *10*(6), 1545–1579. https://doi.org/10.1086/725400

Sun, Y., Saha, S., Tost, H., Kong, X., & Xu, C. (2022). Literature review reveals a global access inequity to urban green spaces. *Sustainability*, *14*(3), 1062. https://doi.org/10.3390/su14031062

United Nations Human Settlements Programme (UN-Habitat). (2018, October). *Metadata on SDGs indicator 11.7.1. Indicator category: Tier II.* https://unhabitat.org/sites/default/files/2020/07/metadata_on_sdg_indicator_11.7.1.pdf

United Nations Human Settlements Programme (UN-Habitat). (2021). *Urban indicators data base: 11.7.1 provision and access to open spaces in cities 2020* [Dataset]. Retrieved on May 24, 2023. https://data.unhabitat.org/datasets/GUO-UN-Habitat::11-7-1-provision-and-access-to-open-spaces-in-cities-2020/about

Wolgemuth, J. R., Guyotte, K. W., & Shelton, S. A. (Eds.). (2024). *Expanding approaches to thematic analysis: Creative engagements with qualitative data.* Taylor & Francis.

Wu, J., He, Q., Chen, Y., Lin, J., & Wang, S. (2020). Dismantling the fence for social justice? Evidence based on the inequity of urban green space accessibility in the central urban area of Beijing. *Environment and Planning B: Urban Analytics and City Science, 47*(4), 626–644. https://doi.org/10.1177/2399808318793139