Quantification of the Urban Public Open Space for Metropolitan Municipalities in Mexico Using OpenStreetMap

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ABSTRACT

This is the first study to quantify urban public open space and its accessibility across all metropolitan municipalities in Mexico, following a methodology similar to that proposed by UN-Habitat for Sustainable Development Goal (SDG) 11.7. It relies exclusively on open data from official sources, National Institute of Statistics, Geography and Informatics (INEGI), the Ministry of Agrarian, Territorial and Urban Development (SEDATU) and from OpenStreetMap (OSM), alongside a precise definition of the OSM dataset subset constituting public open space. The objective is to create a catalog for comparing municipalities or metropolitan areas and to provide an overview of the situation nationwide. The data used included: public space area polygons from OSM; urban zone polygons from INEGI's *National Geostatistical Framework*; metropolitan area data from SEDATU's *Metrópolis de México 2020* publication; and population data from INEGI's *Population and Housing Census*. The SDG 11.7.1 indicator comprising the proportion of land allocated to urban public open space and the proportion of the urban population with access to such space was calculated for all metropolitan municipalities in Mexico.

1. Introduction

Urban public open space comprising parks, gardens, playgrounds, sports facilities, public beaches, riverbanks, and waterfronts, among other areas must be publicly owned and for public use, accessible and enjoyable by all, free of charge, and non-profit in nature (UN-Habitat, 2018; Garau et al., 2015; Garau, 2017). Such space is essential for the proper functioning of a city and the quality of life of its inhabitants. Evidence shows that well-planned and well-managed public space can improve the physical and mental health of the surrounding population (Hartig et al., 2003; Taylor et al., 2001), increase life expectancy (Takano et al., 2002), reduce the perception of insecurity (Garau, 2016), and positively impact housing prices (Carmona et al., 2004; Luttik, 2000). For these reasons, it is crucial that local, regional, and federal governments build and maintain a network of adequate and sufficient public spaces, kept in optimal condition for the public's enjoyment.

The United Nations Human Settlements Programme (UN-Habitat) recommends that 15 to 20% of the total urban area be allocated to public open space; furthermore, for areas ranging from 300 m² to 4,000 m², it limits it's area of influence to a distance of 400m (a 5-minute walk) along public streets, and to 800m (10 minutes) for areas between 0.4 and 10 hectares (UN-Habitat, 2018). In accordance with the 2030 Agenda, which established the goals for sustainable cities and human settlements (SDG 11) in 2015, UN-Habitat also recommends that each country, through its national statistical offices, measure and report progress on each goal every five years (i.e., 2020, 2025, and 2030); these offices must report the indicator at the national level so that it can be aggregated by UN-Habitat at the global level (UN-Habitat, 2016).

Regarding public space, Target 11.7 establishes that: "*By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities*"; and to this end, it establishes Indicator 11.7.1: "*Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities*"

The objective of this study is to quantify public open space within the urban areas of all metropolitan municipalities in Mexico. Specifically, the aim is to create a catalogue that provides an objective, quantitative assessment of the area dedicated to public space in each metropolitan municipality; to identify which municipalities meet the UN-Habitat recommendation of allocating 15 to 20% of their land to public space; and to determine the urban zones located within the area of influence of these public spaces, and with this the total population that each areas serves. This information enables comparisons among all metropolitan municipalities and metropolitan areas, providing local, state, and federal authorities, as well as the general public, with an overview to evaluate the current state of public open space in the urban municipalities of Mexico's metropolitan areas, as well as in the metropolitan areas themselves.

Other studies have focused on estimating public open space within the context of SDG 11.7 of the 2030 Agenda using satellite imagery, OpenStreetMap (OSM) data, or both, although they generally are focused on case studies of specific cities or regions. In (Cimini et al., 2024), OSM data is used to quantify green urban public spaces; however, SDG 11.7 refers to public open space rather than just green public space, given that not all green areas are public and not all public spaces are green areas (Garau, 2017). In (Cheng et al., 2022) they use both satellite images and OSM data

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to calculate indicator 11.7.1, however they also only obtain green space and include public space inside buildings, when the indicator clearly refers to public open space, in addition to obtaining public space area per capita when what the indicator measures is the proportion of the population that has access to public space and the only recommendation that UN-Habitat makes on the amount of public space is on the percentage of urban public open space with respect to the total urban area; In (Giuliani et al., 2021), green public space is also measured, but the OSM tags used do not guarantee that the resulting area corresponds to open space, as some tags may include spaces within buildings. Finally, in (Verde et al., 2022), satellite imagery is used in an attempt to estimate indicator 11.7.1 by detecting only open green space, without distinguishing between public and private areas, and the study fails to actually calculate indicator 11.7.1.

To the best of the author's knowledge, this is the first study to quantify urban public open space and its accessibility across all metropolitan municipalities in Mexico, using a unified methodology and relying exclusively on open data from official sources (INEGI and SEDATU) and OpenStreetMap; it also compares the amount of public space across metropolitan areas.

The OpenStreetMap project[1] is a global effort to map the planet and to create and provide free, open geographic data; it began in 2004 and now has over two million volunteers worldwide, up from the 40 it had in 2008 (Haklay and Weber, 2008). Over its two decades of existence, it has contributed significantly to geospatial information science; consequently, the number of scientific publications utilizing OSM data has steadily increased (Sun et al., 2026).

This paper is structured as follows: §2 describes the methodology used to quantify public open space in the metropolitan municipalities; §3 presents the results obtained using the described methodology; and §4 presents the conclusions of this study.

2. Methodology

To achieve the stated objective, a methodology similar to that proposed by UN-Habitat (UN-Habitat, 2018) was followed, utilising only open data and open-source tools. The data used included the urban areas of the Mexican Republic obtained from the National Geostatistical Framework 2024 of the National Institute of Statistics, Geography and Informatics (INEGI), which provides vector information, attribute tables and catalogues of each of the geostatistical areas. The data for metropolitan areas were obtained from the publication *Metropolis de México 2020* of the Ministry of Agrarian, Territorial and Urban Development (SEDATU) (Ramírez Méndez and Plata Garbutt, 2023); population data came from INEGI's *2020 Population and Housing Census*, which provides figures at the national, state, municipal, and local levels, as well as by AGEB[2] and urban city block. Finally, the polygons of the areas corresponding to the public open space were obtained from the OpenStreetMap data using the *Overpass* API[3].

The National Geostatistical Framework also includes a dataset titled *services and complementary information* that supposedly contains parks, gardens, green areas, sports courts, and zoos[4]; however, besides being far from an exhaustive list of the aforementioned infrastructure, it includes both public and private property, rendering it unsuitable for the present study.

2.1. Public Open Space

Definitions regarding the types of areas that constitute public open space vary (Mehta, 2014); even the UN-Habitat definition (UN-Habitat, 2018) leaves room for interpretation. This study presents an exhaustive list of areas constituting public space—based on the UN-Habitat definition and utilising OpenStreetMap tags, comprising: a) leisure areas[5] that are not located within a building and are freely accessible; b) freely accessible green areas, including grass, playgrounds, forests, nurseries, and cemeteries[6] (Rae, 2021; UN-Habitat, 2016); and c) protected natural areas (ANPs) of types 2, 3, 4, and 6[7], excluding any land designated for residential, commercial, industrial, agricultural, or military use. According to Mexican regulations[8], these protected natural areas correspond to national parks, natural monuments, sanctuaries, and natural resource protection areas, respectively, all of which allow for recreational use.

The definition of public open space used in this study is given by a subset, **OPS**, of the universe of all OpenStreetMap polygons obtained via Equation 5, which utilises subsets of OpenStreetMap data (tag = *value*) $\subset$ **OSM**; these polygons are subsequently intersected with urban AGEB polygons to obtain only public open space within urban areas.

$$\begin{aligned}\textbf{LEISURE} = {} & \text{leisure} \cap (\text{leisure} \neq \textit{natural\_reserve}) \\ & \cap (\text{garden} : \text{type} \neq \textit{residential}) \\ & \cap (\text{building} \neq \textit{yes}) \\ & \cap (\text{access} \neq \textit{private}) \\ & \cap (\text{access} \neq \textit{customers})\end{aligned} \tag{1}$$

$$\textbf{LAND} = (\text{access} \neq \textit{private}) \cap (\text{access} \neq \textit{customers}) \cap$$

[1] openstreetmap.org

[2] A Basic Geostatistical Area (AGEB) is the territorial extent corresponding to the subdivision of municipal geostatistical areas. It constitutes the basic unit of the National Geostatistical Framework and, depending on its characteristics, is classified as either rural or urban.

[3] github.com/mvexel/overpass-api-python-wrapper

[4] SIA: area-type services and complementary information (green areas, medians, traffic circles) and SIP: point-type services and complementary information (municipal halls or auxiliary administrative offices, parks or gardens)

[5] wiki.openstreetmap.org/wiki/Key:leisure

[6] Mark Treskon, Can Cities Reclaim Cemeteries as Public Space?

[7] wiki.openstreetmap.org/wiki/Key:protect_class

[8] General Law on Ecological Equilibrium and Environmental Protection, DOF 19-01-2026

$$\begin{aligned}&((\text{landuse} = grass) \cup (\text{landuse} = recreation\_ground)\\&\cup (\text{landuse} = forest) \cup (\text{landuse} = plant\_nursery)\\&\cup ((\text{landuse} = wood) \cap (\text{managed} = yes))\\&\cup(\text{landuse} = cemetery))\end{aligned} \tag{2}$$

$$\begin{aligned}\mathbf{ANP} = &((\text{landuse} = natural\_reserve)\\&\cup(\text{boundary} = protected\_area)\cap(\text{protected\_class} = 2)\\&\cup(\text{boundary} = protected\_area)\cap(\text{protected\_class} = 3)\\&\cup(\text{boundary} = protected\_area)\cap(\text{protected\_class} = 4)\\&\cup(\text{boundary} = protected\_area)\cap(\text{protected\_class} = 6))\\&\cap (\text{access} \neq private) \cap (\text{access} \neq customers)\end{aligned} \tag{3}$$

$$\begin{aligned}\mathbf{ZONE} = &(\text{landuse} = residential)\\&\cup (\text{landuse} = commercial)\\&\cup (\text{landuse} = industrial)\\&\cup (\text{landuse} = farmaland)\\&\cup (\text{landuse} = military)\end{aligned} \tag{4}$$

$$\mathbf{OPS} = \mathbf{LEISURE} \cup \mathbf{LAND} \cup (\mathbf{ANP} - \mathbf{ZONE}) \tag{5}$$

OpenStreetMap tags corresponding to protected natural areas or conservation zones encompass areas designated at federal, state, and municipal levels, whether publicly or privately owned and with either open or restricted access. For various reasons, some urban settlements are located within these conservation areas, thereby reducing the effective area that should be considered as urban public open space; in such cases, the expression 5 subtracts these settlements from the conservation area. Figure 1 illustrates the case of the municipality of Ixtaczoquitlán, Veracruz, demonstrating the utility of expression 5 in subtracting human settlements from natural areas.

For some municipalities with these characteristics, i.e., urban AGEBs containing natural areas with settlements inside them, it was necessary to manually map these settlements using the OpenStreetMap web editor [9], aided by satellite imagery.

2.2. Public Space Accessibility

UN-Habitat classifies public space by size into 5 types: 1) Local (0.03 to 0.04 hectares); 2) neighborhood (0.04 to 0.4 hectares); 3) district (0.4 to 10 hectares); 4) regional (10 to 50 hectares); and 5) metropolitan or national (50 to 200 hectares). And although it recognises that each one has different areas of influence, to report the population's access

[9] ideditor.com

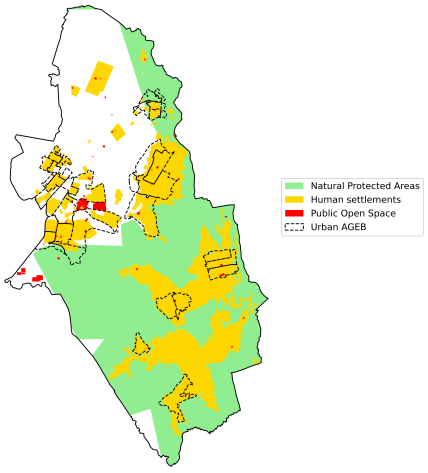

Figure 1: Polygons obtained from OpenStreetMap using the sets 1–4, for the municipality of Ixtaczoquitlán, Veracruz.

to public space, it establishes as area of influence a distance of 400m or 5 minutes on foot for all types of public space (Garau, 2016).

To obtain the percentage of the population served by the public space of a municipality, according to its area of influence, the OSMnx tool [10] (Boeing, 2025) was used to obtain the graph of the public access road network, $G = (V, E)$, with intersections (vertices) V and streets (edges) E; subsequently, using the NetworkX tool [11], isochrones centred on each vertex of the polygon $\mathbf{p}$ of each public space were obtained (Equation 7) and intersected with the municipality's urban blocks (Equation 12).

An isochrone is the polygon formed by the convex hull, $C(\cdot)$, containing all road network nodes located at a distance, $d(\cdot)$, equal to or less than a certain value, in this case, 400m.

This is illustrated in the map in Figure 2 for the municipality of Coyoacán, CDMX; In it, the public open space is shown in shades of blue, the protected natural areas in shades of magenta, the city blocks within the area of influence of the public space are shown in green, and the blocks outside the area of influence are shown in grey.

$$v^*(V, p) = \underset{v_j \in V = \{v_1, \ldots, v_j\}}{\arg\min} d(v_j, p) \tag{6}$$

$$\text{Iso}(\mathbf{p}) = \bigcup_{p_i \in \mathbf{p} = \{p_1, \ldots, p_i\}} \text{C}(\mathbf{v}) | \mathbf{v} = \{v \in V : d\left(v^*(p_i), v\right) \leq 400\} \tag{7}$$

2.3. Indicator SDG 11.7.1

The purpose of indicator 11.7.1 is to provide timely and necessary information to enable informed decision-making

[10] github.com/gboeing/osmnx
[11] networkx.org

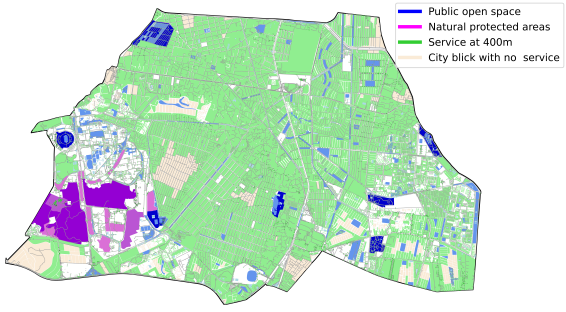

Figure 2: Public open space for the municipality of Coyoacán, CDMX, and it's area of influence

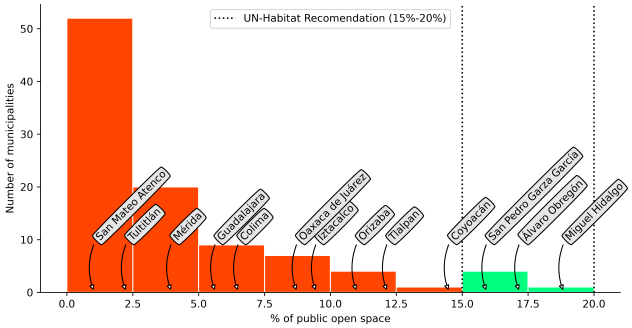

Figure 3: Histogram showing the distribution of urban public open space across all metropolitan municipalities in Mexico; the labels indicate the percentage of public space for specific municipalities.

that ensures universal access to safe and inclusive public spaces (UN-Habitat, 2018). Regarding public open space, the indicator measures: a) the percentage of public open space relative to a city's total area (equation 14); b) the percentage of the population with access to public space (equation 15); and c) the size of the population with access to public space, disaggregated by age group, sex, and persons with disabilities.

To calculate these indicators we have: the set, **Mzn**, of all urban blocks obtained from the *population and housing census 2020*, from INEGI; and the set **AGEB** of all urban AGEBs and the polygon of the municipality of interest **Mun**, obtained from INEGI's *National Geostatistical Framework 2024*.

For a polygon **p**, the function A(**p**) denotes its area, and the function P(**p**) denotes the population inhabiting it.

$$\mathbf{U_{ops}} = \mathbf{OPS} \cap \mathbf{Mun} \cap \mathbf{AGEB} \tag{8}$$

$$\mathbf{ISO} = \bigcup_{i \in \mathbf{U_{ops}}} \mathrm{Iso}(ops_i) \tag{9}$$

$$\mathrm{A_{OPS}} = \sum_{i \in \mathbf{U_{ops}}} \mathrm{A}(ops_i) \tag{10}$$

$$\mathrm{A_U} = \sum_{i \in \mathbf{Mun}} \mathrm{A}(ageb_i) \tag{11}$$

$$\mathrm{Pop_{serv}} = \sum_{i \in \mathbf{Mzn} \cap \mathbf{ISO}} \mathrm{P}(mzn_i) \tag{12}$$

$$\mathrm{Pop_{tot}} = \sum_{i \in \mathbf{Mzn} \cap \mathbf{Mun}} \mathrm{P}(mzn_i) \tag{13}$$

$$\%\mathrm{OPS} = 100 * \frac{\mathrm{A_{OPS}}}{\mathrm{A_U}} \tag{14}$$

$$\%\mathrm{Pop} = 100 * \frac{\mathrm{Pop_{serv}}}{\mathrm{Pop_{tot}}} \tag{15}$$

3. Results

Mexico has 48 metropolitan areas comprising 237 central municipalities, which were analysed using the described methodology. The results are shown in table 1 which contains the data for the 10 municipalities with the highest percentage of urban public open space; Table 2, showing the results for the 10 metropolitan areas with more urban public open space; in figure 4, which contains all municipalities of the first 10 metropolitan areas; in the histogram of figure 3 which shows the distribution of public space for the 237 central municipalities; and in appendix A that contains the results for all metropolitan municipalities in Mexico.

It is observed that only 5 municipalities (2.1%) meet the UN-Habitat recommendations for the 2030 Agenda regarding the allocation of 15 to 20% of urban land to public open space. These 5 urban municipalities are concentrated in only 2 of the 48 metropolitan areas (4.1%): the metropolitan area of Mexico City and the metropolitan area of Monterrey. The table also shows the value of the total area of public space according to official data obtained from: the public space habitability index of Mexico City (González et al., 2022); the municipal urban development plan, Monterrey 2040 (IMPLANc, 2024); the municipal urban development program of the city of Guadalupe, Nuevo León 2040 (UANL, 2023); the municipal urban development plan of San Pedro Garza García, N.L. and the Orizaba, Veracruz Metropolitan Program 2024 (Jiménez Reyes and Herrera Bautista, 2024). The discrepancy in the data may be due to differences in the methodologies used, as well as errors derived from the lack of data in OpenStreetMap, highlighting the inclusion of privately owned spaces that have not been labelled as such, the inclusion of protected natural areas without access, or that have human settlements despite their protected status, as well as spaces that are used as if they were public but are actually privately owned (Pratt, 2017), this together causes an over-estimation of the total available public space.

It should be noted that the source code developed for this work is available as a JupyterLab notebook for replication[12].

4. Conclusion

As part of the 2030 Agenda, national governments are required to submit national aggregate reports on progress toward each Sustainable Development Goal every five years

[12] gitlab.centrogeo.edu.mx/mario.chirinos/espaciopublico

Municipality	Met.	A_U (Km²)	A_{OPS} (Km²)	Of.	Pop_{tot}	Pop_{serv}	A_{OPS} (%)	%Pop
Miguel Hidalgo	CDMX	46.2	8.70	7.6	414,470	338,816	**18.86**	81.75
Álvaro Obregón	CDMX	69.4	11.93	0.6	759,137	651,147	**17.18**	85.77
Gustavo A. M.	CDMX	87.4	14.41	2.3	1,173,351	843,182	**16.50**	71.86
Monterrey	MTY	217.0	35.17	7.9	1,142,994	927,945	**16.21**	81.19
San Pedro G. G.	MTY	47.1	7.50	3.2	132,169	119,754	**15.94**	90.61
Coyoacán	CDMX	53.6	7.78	2.0	614,447	535,523	**14.51**	87.16
Tlalpan	CDMX	93.2	11.34	81.0	699,928	375,634	**12.17**	53.67
Xalapa	Xalapa	63.8	7.59		488,531	343,610	**11.90**	70.34
Orizaba	Orizaba	19.4	2.13	0.3	123,182	106,156	**11.01**	86.18
Guadalupe	MTY	96.5	10.39	3.6	643,143	605,182	**10.78**	94.10

Table 1
List with the results for the 10 metropolitan municipalities with the highest percentage of public space relative to the total area of the urban zone. The "Of." column shows the total urban public space area obtained from official sources.

CVEMET	Metopolitan Zone	Population	A_U (Km²)	A_{OPS} (Km²)	A_{ops} (%)
30.1.07	Xalapa	619,677	79.13	7.98	**10.09**
19.1.01	Monterrey	4,881,260	883.69	78.35	**8.87**
06.1.01	Colima	306,810	65.06	4.86	**7.47**
09.1.01	Ciudad de México	20,510,985	2,071.28	133.14	**6.43**
30.1.04	Orizaba	421,063	74.72	4.60	**6.16**
14.1.01	Guadalajara	5,079,762	671.11	36.61	**5.46**
07.1.02	Tuxtla Gutiérrez	716,222	153.48	8.26	**5.38**
24.1.01	San Luis Potosí	1,243,980	184.87	9.59	**5.19**
14.1.02	Puerto Vallarta	479,471	90.68	4.44	**4.90**
01.1.01	Aguascalientes	1,078,919	154.06	7.45	**4.84**

Table 2
List with the results of the 10 metropolitan areas with the highest percentage of public space relative to the total area of the urban zone.

between 2015 and 2030 (totaling three reports). Regarding Goal 11.7.1[13], the institution responsible for reporting progress in Mexico is the Secretariat of Agrarian, Territorial, and Urban Development (SEDATU) (Franco and Jurado, 2020); So far this institution has only reported the data corresponding to the first report for the year 2020, despite the existence of a national strategy to meet the goals set by the 2030 agenda. The data reported by SEDATU cover only the total area of public space at the national and state levels, without providing a breakdown by urban locality or the percentage of the population with access to such spaces; this is likely because not all municipalities possess data on their public spaces or have up-to-date records (UN-Habitat, 2016).

In July 2026, the report on progress towards the Sustainable Development Goals of the 2030 Agenda was published (UN-DESA2026). It notes that for SDG 11.7, sufficient data has not been provided globally to measure progress, but that data from 414 cities indicate that on average only 2% of the urban area is designated as outdoor public space and that only 45.9% of the population has access to it.

This is why analyses like the one presented here, using OpenStreetMap data, are important: they allow for the assessment of public open space with greater frequency and detail. They enable evaluation at municipal, local, state, metropolitan, and national levels, utilizing the full set of

[13]SDG 11.7.1 Average share of the built-up area of cities that is open space for public use for all.

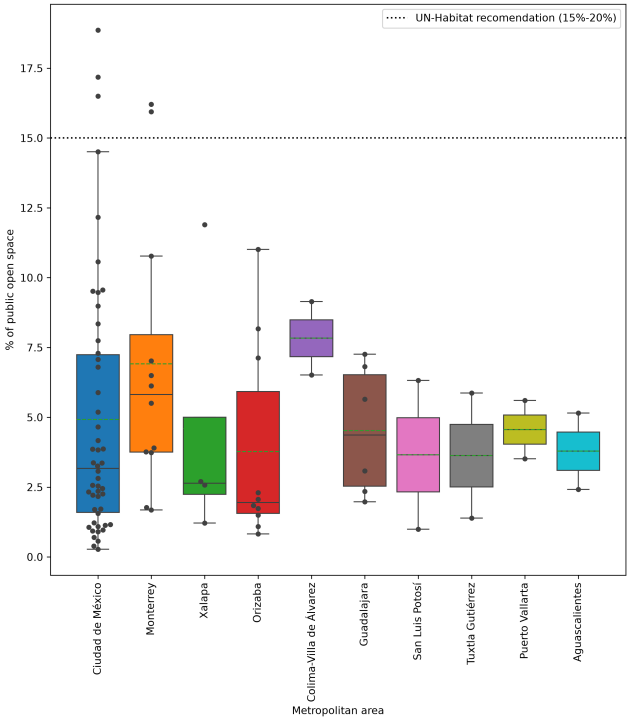

Figure 4: Box plot showing the value of urban public open space in municipalities within the main metropolitan areas of the Mexican Republic.

metropolitan municipalities rather than just a sample subset, using a methodology similar to that suggested by UN-Habitat. Furthermore, although metropolitan areas comprise distinct local administrations, they often function as a single geographic unit in many respects; analyzing them in this way facilitates the planning of coordinated actions.

While the quantity and accessibility of public space are quantified, this study does not take its quality into account. The quality of public space is crucial, as the extent to which citizens actually utilize it depends on it (UN-Habitat, 2016). Indeed, when public space is improved to meet basic comfort standards, new and more diverse patterns of city life emerge (Gehl, 2006).

This work aims to contribute to the ongoing analysis of public space in urban areas by integrating OpenStreetMap data with data from government sources, specifically INEGI and SEDATU, and by providing a unified methodology for measuring public space across all the country's urban areas. Furthermore, future efforts will seek to evaluate the quality of the data obtained from OpenStreetMap to determine their suitability for the aforementioned monitoring and to identify areas where more extensive and higher-quality mapping surveys are required.

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A. Metropolitan Public Space Data

Table 3: Data on urban public open spaces for all metropolitan municipalities.

	CVEGEO	Municipality	Population	A_U (Km²)	A_{OPS} (Km²)	A_{OPS} (%)	Metropolitan Zone
1	09016	Miguel Hidalgo	414,470	46.15	8.70	**18.86**	Ciudad de México
2	09010	Álvaro Obregón	759,137	69.41	11.93	**17.18**	Ciudad de México
3	09005	Gustavo A. Madero	1,173,351	87.38	14.41	**16.50**	Ciudad de México
4	19039	Monterrey	1,142,994	216.95	35.17	**16.21**	Monterrey
5	19019	San Pedro Garza García	132,169	47.06	7.50	**15.94**	Monterrey
6	09003	Coyoacán	614,447	53.62	7.78	**14.51**	Ciudad de México
7	09012	Tlalpan	699,928	93.25	11.34	**12.17**	Ciudad de México
8	30087	Xalapa	488,531	63.83	7.59	**11.90**	Xalapa
9	30118	Orizaba	123,182	19.36	2.13	**11.01**	Orizaba
10	19026	Guadalupe	643,143	96.46	10.39	**10.78**	Monterrey
11	09007	Iztapalapa	1,835,486	112.43	11.88	**10.57**	Ciudad de México
12	15121	Cuautitlán Izcalli	555,163	85.20	8.14	**9.56**	Ciudad de México
13	09017	Venustiano Carranza	443,704	33.67	3.20	**9.52**	Ciudad de México
14	09006	Iztacalco	404,695	22.96	2.18	**9.47**	Ciudad de México
15	15051	Lerma	170,327	32.18	3.01	**9.36**	Toluca
16	06010	Villa de Álvarez	149,762	23.60	2.16	**9.15**	Colima-Villa de Álvarez
17	09008	La Magdalena Contreras	247,622	18.14	1.63	**8.99**	Ciudad de México
18	20067	Oaxaca de Juárez	270,955	47.57	4.16	**8.74**	Oaxaca
19	29036	Totolac	22,529	5.18	0.45	**8.68**	Tlaxcala-Apizaco
20	15067	Otzolotepec	88,783	11.67	1.01	**8.68**	Toluca
21	15057	Naucalpan de Juárez	834,434	79.66	6.65	**8.34**	Ciudad de México
22	30085	Ixtaczoquitlán	74,004	21.26	1.74	**8.17**	Orizaba
23	09004	Cuajimalpa de Morelos	217,686	32.12	2.49	**7.75**	Ciudad de México
24	09011	Tláhuac	392,313	39.20	2.86	**7.30**	Ciudad de México
25	14120	Zapopan	1,476,491	220.75	16.02	**7.26**	Guadalajara
26	30101	Mariano Escobedo	38,670	2.17	0.15	**7.13**	Orizaba
27	15104	Tlalnepantla de Baz	672,202	70.19	4.96	**7.07**	Ciudad de México
28	19049	Santiago	46,784	68.63	4.82	**7.02**	Monterrey
29	14097	Tlajomulco de Zúñiga	727,750	108.90	7.43	**6.82**	Guadalajara
30	09013	Xochimilco	442,178	63.99	4.35	**6.80**	Ciudad de México
31	06002	Colima	157,048	41.46	2.70	**6.52**	Colima-Villa de Álvarez
32	19046	San Nicolás de los Garza	412,199	59.57	3.87	**6.50**	Monterrey
33	29031	Tetla de la Solidaridad	35,284	35.03	2.26	**6.45**	Tlaxcala-Apizaco
34	24028	San Luis Potosí	911,908	145.61	9.20	**6.32**	San Luis Potosí
35	19048	Santa Catarina	306,322	48.95	3.00	**6.12**	Monterrey
36	13048	Pachuca de Soto	314,331	73.20	4.48	**6.12**	Pachuca
37	30068	Fortín	66,372	12.00	0.73	**6.12**	Córdoba
38	09002	Azcapotzalco	432,205	32.89	1.94	**5.88**	Ciudad de México
39	07101	Tuxtla Gutiérrez	604,147	136.82	8.02	**5.87**	Tuxtla Gutiérrez
40	14039	Guadalajara	1,385,629	141.18	7.97	**5.65**	Guadalajara
41	14067	Puerto Vallarta	291,839	60.03	3.36	**5.60**	Puerto Vallarta
42	19031	Juárez	471,523	63.80	3.52	**5.51**	Monterrey
43	29033	Tlaxcala	99,896	45.01	2.41	**5.36**	Tlaxcala-Apizaco
44	15118	Zinacantepec	203,872	43.76	2.34	**5.35**	Toluca
45	15099	Texcoco	277,562	75.19	3.90	**5.19**	Ciudad de México
46	01001	Aguascalientes	948,990	136.35	7.02	**5.15**	Aguascalientes
47	21015	Amozoc	125,876	25.30	1.30	**5.13**	Puebla-Tlaxcala
48	30193	Veracruz	607,209	85.15	4.06	**4.76**	Veracruz
49	15054	Metepec	242,307	47.65	2.27	**4.76**	Toluca
50	15060	Nicolás Romero	430,601	58.76	2.74	**4.66**	Ciudad de México
51	29009	Cuaxomulco	5,928	6.89	0.32	**4.61**	Tlaxcala-Apizaco
52	10012	Lerdo	163,313	35.09	1.60	**4.55**	La Laguna
53	21114	Puebla	1,692,181	229.32	10.42	**4.55**	Puebla-Tlaxcala
54	30039	Coatzacoalcos	310,698	76.84	3.35	**4.36**	Coatzacoalcos
55	05035	Torreón	720,848	156.39	6.76	**4.32**	La Laguna
56	18017	Tepic	425,924	57.78	2.48	**4.29**	Tepic

Table 3: Data on urban public open spaces for all metropolitan municipalities.

	CVEGEO	Municipality	Population	A_U (Km²)	A_{OPS} (Km²)	A_{OPS} (%)	Metropolitan Zone
57	21156	Tehuacán	327,312	65.69	2.82	**4.29**	Tehuacán
58	15106	Toluca	910,608	190.95	8.16	**4.27**	Toluca
59	28038	Tampico	297,562	54.97	2.33	**4.25**	Tampico
60	29002	Apetatitlán de Antonio Carvajal	16,003	11.24	0.47	**4.21**	Tlaxcala-Apizaco
61	15125	Tonanitla	14,883	2.39	0.10	**4.17**	Ciudad de México
62	32056	Zacatecas	149,607	28.45	1.17	**4.10**	Zacatecas-Guadalupe
63	31050	Mérida	995,129	268.26	10.67	**3.98**	Mérida
64	19006	Apodaca	656,464	115.00	4.49	**3.90**	Monterrey
65	16053	Morelia	849,053	143.73	5.60	**3.89**	Morelia
66	22014	Querétaro	1,049,777	170.53	6.63	**3.89**	Querétaro
67	15058	Nezahualcóyotl	1,077,208	53.15	2.06	**3.87**	Ciudad de México
68	15020	Coacalco de Berriozábal	293,444	21.94	0.85	**3.86**	Ciudad de México
69	09015	Cuauhtémoc	545,884	32.17	1.23	**3.83**	Ciudad de México
70	19018	García	397,205	58.76	2.21	**3.76**	Monterrey
71	19021	General Escobedo	481,213	74.52	2.79	**3.74**	Monterrey
72	28009	Ciudad Madero	205,933	48.02	1.74	**3.62**	Tampico
73	30028	Boca del Río	144,550	19.95	0.71	**3.58**	Veracruz
74	08021	Delicias	150,506	36.92	1.31	**3.54**	Delicias
75	05030	Saltillo	879,958	193.94	6.84	**3.53**	Saltillo
76	18020	Bahía de Banderas	187,632	30.65	1.08	**3.52**	Puerto Vallarta
77	18008	Xalisco	65,229	7.81	0.27	**3.50**	Tepic
78	15044	Jaltenco	28,217	4.66	0.16	**3.37**	Ciudad de México
79	09014	Benito Juárez	434,153	26.55	0.89	**3.36**	Ciudad de México
80	23005	Benito Juárez	911,503	156.94	5.19	**3.31**	Cancún
81	11007	Celaya	521,169	82.23	2.69	**3.27**	Celaya
82	15033	Ecatepec de Morelos	1,645,352	128.90	4.20	**3.26**	Ciudad de México
83	28032	Reynosa	704,767	168.76	5.39	**3.19**	Reynosa
84	30044	Córdoba	204,721	27.55	0.88	**3.18**	Córdoba
85	10007	Gómez Palacio	372,750	64.64	2.05	**3.17**	La Laguna
86	27004	Centro	683,607	108.52	3.41	**3.14**	Villahermosa
87	20385	Santa Cruz Xoxocotlán	100,402	17.08	0.54	**3.13**	Oaxaca
88	11020	León	1,721,215	235.50	7.38	**3.13**	León
89	02004	Tijuana	1,922,523	322.56	10.01	**3.10**	Tijuana
90	08019	Chihuahua	937,674	283.32	8.76	**3.09**	Chihuahua
91	14098	San Pedro Tlaquepaque	687,127	87.97	2.71	**3.08**	Guadalajara
92	15029	Chicoloapan	200,750	14.31	0.44	**3.08**	Ciudad de México
93	15108	Tultepec	157,645	17.02	0.48	**2.82**	Ciudad de México
94	32017	Guadalupe	211,740	35.53	0.98	**2.76**	Zacatecas-Guadalupe
95	30026	Banderilla	25,993	5.13	0.14	**2.70**	Xalapa
96	29054	San Lorenzo Axocomanitla	5,689	1.55	0.04	**2.66**	Puebla-Tlaxcala
97	22006	Corregidora	212,567	39.26	1.02	**2.61**	Querétaro
98	30065	Emiliano Zapata	85,489	9.32	0.24	**2.58**	Xalapa
99	15081	Tecámac	547,503	71.22	1.83	**2.56**	Ciudad de México
100	23003	Isla Mujeres	22,686	6.64	0.17	**2.56**	Cancún
101	15039	Ixtapaluca	542,211	54.84	1.39	**2.54**	Ciudad de México
102	26029	Guaymas	156,863	58.25	1.47	**2.53**	Guaymas
103	27013	Nacajuca	150,300	11.64	0.29	**2.50**	Villahermosa
104	15037	Huixquilucan	284,965	43.20	1.06	**2.45**	Ciudad de México
105	05017	Matamoros	118,337	23.04	0.56	**2.44**	La Laguna
106	15018	Calimaya	68,489	9.29	0.23	**2.42**	Toluca
107	01005	Jesús María	129,929	17.71	0.43	**2.42**	Aguascalientes
108	21119	San Andrés Cholula	154,448	52.56	1.25	**2.38**	Puebla-Tlaxcala
109	30131	Poza Rica de Hidalgo	189,457	42.19	0.99	**2.36**	Poza Rica
110	15069	Papalotla	4,862	2.17	0.05	**2.36**	Ciudad de México
111	14101	Tonalá	569,913	71.12	1.67	**2.35**	Guadalajara
112	07089	Tapachula	353,706	59.54	1.40	**2.35**	Tapachula
113	15013	Atizapán de Zaragoza	523,674	74.83	1.74	**2.33**	Ciudad de México
114	29005	Apizaco	80,725	26.34	0.61	**2.32**	Tlaxcala-Apizaco
115	30030	Camerino Z. Mendoza	41,835	5.67	0.13	**2.31**	Orizaba

Table 3: Data on urban public open spaces for all metropolitan municipalities.

	CVEGEO	Municipality	Population	A_U (Km²)	A_{OPS} (Km²)	A_{OPS} (%)	Metropolitan Zone
116	15109	Tultitlán	516,341	51.47	1.16	**2.26**	Ciudad de México
117	05004	Arteaga	29,578	15.70	0.35	**2.23**	Saltillo
118	15122	Valle de Chalco Solidaridad	391,731	28.97	0.64	**2.21**	Ciudad de México
119	17006	Cuautla	187,118	37.81	0.83	**2.19**	Cuautla
120	11023	Pénjamo	154,960	17.30	0.38	**2.19**	La Piedad-Pénjamo
121	15011	Atenco	75,489	12.16	0.26	**2.17**	Ciudad de México
122	02005	Playas de Rosarito	126,890	40.87	0.87	**2.12**	Tijuana
123	20390	Santa Lucía del Camino	50,362	9.39	0.20	**2.08**	Oaxaca
124	30115	Nogales	37,314	6.38	0.13	**2.07**	Orizaba
125	20409	Santa María del Tule	8,939	3.04	0.06	**2.03**	Oaxaca
126	16069	La Piedad	106,490	23.28	0.47	**2.02**	La Piedad-Pénjamo
127	05018	Monclova	237,951	71.73	1.41	**1.97**	Monclova-Frontera
128	14070	El Salto	232,852	41.18	0.81	**1.97**	Guadalajara
129	16043	Jacona	68,781	12.68	0.25	**1.97**	Zamora
130	15055	Mexicaltzingo	13,807	1.82	0.04	**1.95**	Toluca
131	21140	San Pedro Cholula	138,433	44.53	0.86	**1.94**	Puebla-Tlaxcala
132	30108	Minatitlán	144,776	36.03	0.67	**1.86**	Minatitlán
133	30138	Río Blanco	41,795	7.99	0.15	**1.84**	Orizaba
134	29041	Papalotla de Xicohténcatl	33,499	15.75	0.29	**1.84**	Puebla-Tlaxcala
135	22011	El Marqués	231,668	33.88	0.60	**1.77**	Querétaro
136	19045	Salinas Victoria	86,766	18.58	0.33	**1.77**	Monterrey
137	31101	Umán	69,147	16.92	0.30	**1.76**	Mérida
138	16108	Zamora	204,860	31.49	0.55	**1.75**	Zamora
139	30135	Rafael Delgado	24,127	6.13	0.11	**1.74**	Orizaba
140	29022	Acuamanala de Miguel Hidalgo	6,432	1.28	0.02	**1.73**	Puebla-Tlaxcala
141	15030	Chiconcuac	27,692	5.22	0.09	**1.72**	Ciudad de México
142	15100	Tezoyuca	47,044	10.91	0.19	**1.70**	Ciudad de México
143	17007	Cuernavaca	378,476	82.80	1.41	**1.70**	Cuernavaca
144	19010	El Carmen	104,478	15.41	0.26	**1.69**	Monterrey
145	05027	Ramos Arizpe	122,243	42.87	0.71	**1.65**	Saltillo
146	13051	Mineral de la Reforma	202,749	35.48	0.57	**1.60**	Pachuca
147	29026	Santa Cruz Tlaxcala	24,116	20.62	0.33	**1.59**	Tlaxcala-Apizaco
148	29044	Zacatelco	45,717	13.21	0.21	**1.59**	Puebla-Tlaxcala
149	30123	Pánuco	96,185	20.33	0.32	**1.58**	Tampico
150	29024	Panotla	28,357	9.24	0.15	**1.57**	Tlaxcala-Apizaco
151	17011	Jiutepec	215,357	37.99	0.59	**1.57**	Cuernavaca
152	15028	Chiautla	30,045	8.57	0.13	**1.56**	Ciudad de México
153	21149	Santiago Miahuatlán	30,309	9.84	0.15	**1.53**	Tehuacán
154	30185	Tlilapan	5,548	1.33	0.02	**1.50**	Orizaba
155	28003	Altamira	269,790	60.57	0.86	**1.42**	Tampico
156	29010	Chiautempan	73,215	27.94	0.39	**1.40**	Tlaxcala-Apizaco
157	07027	Chiapa de Corzo	112,075	16.67	0.23	**1.39**	Tuxtla Gutiérrez
158	05025	Piedras Negras	176,327	54.77	0.67	**1.23**	Piedras Negras
159	17004	Ayala	89,834	16.10	0.20	**1.23**	Cuautla
160	15070	La Paz	304,088	31.53	0.39	**1.22**	Ciudad de México
161	30182	Tlalnelhuayocan	19,664	0.84	0.01	**1.22**	Xalapa
162	05010	Frontera	82,409	23.18	0.27	**1.19**	Monclova-Frontera
163	30040	Coatzintla	55,016	5.52	0.06	**1.16**	Poza Rica
164	15002	Acolman	171,507	35.46	0.41	**1.16**	Ciudad de México
165	17018	Temixco	122,263	24.69	0.29	**1.16**	Cuernavaca
166	29053	San Juan Huactzinco	7,688	2.98	0.03	**1.13**	Puebla-Tlaxcala
167	15024	Cuautitlán	178,847	31.54	0.36	**1.13**	Ciudad de México
168	30081	Ixhuatlancillo	27,295	2.99	0.03	**1.09**	Orizaba
169	15095	Tepotzotlán	103,696	34.26	0.37	**1.09**	Ciudad de México
170	15053	Melchor Ocampo	61,220	11.71	0.12	**1.06**	Ciudad de México
171	15076	San Mateo Atenco	97,418	20.41	0.21	**1.04**	Toluca
172	05022	Nava	33,129	22.60	0.24	**1.04**	Piedras Negras
173	08004	Aquiles Serdán	24,344	3.93	0.04	**1.02**	Chihuahua
174	24035	Soledad de Graciano Sánchez	332,072	39.26	0.39	**1.00**	San Luis Potosí

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	CVEGEO	Municipality	Population	A_U (Km²)	A_{OPS} (Km²)	A_{OPS} (%)	Metropolitan Zone
175	30014	Amatlán de los Reyes	46,955	9.22	0.09	**0.97**	Córdoba
176	15092	Teotihuacán	58,507	14.17	0.14	**0.96**	Ciudad de México
177	12029	Chilpancingo de los Bravo	283,354	48.46	0.46	**0.95**	Chilpancingo
178	29028	Teolocholco	25,257	12.76	0.12	**0.94**	Puebla-Tlaxcala
179	15025	Chalco	400,057	59.42	0.55	**0.93**	Ciudad de México
180	29001	Amaxac de Guerrero	11,403	7.70	0.07	**0.93**	Tlaxcala-Apizaco
181	09009	Milpa Alta	152,685	27.76	0.25	**0.90**	Ciudad de México
182	30048	Cosoleacaque	130,903	27.24	0.24	**0.89**	Minatitlán
183	21041	Cuautlancingo	137,435	30.54	0.27	**0.88**	Puebla-Tlaxcala
184	17030	Yecapixtla	56,083	10.02	0.09	**0.88**	Cuautla
185	13083	Zempoala	57,906	19.12	0.17	**0.87**	Pachuca
186	29027	Tenancingo	12,974	6.96	0.06	**0.86**	Puebla-Tlaxcala
187	30074	Huiloapan de Cuauhtémoc	7,293	1.44	0.01	**0.82**	Orizaba
188	21106	Ocoyucan	42,669	15.92	0.13	**0.80**	Puebla-Tlaxcala
189	21132	San Martín Texmelucan	155,738	43.06	0.34	**0.79**	San Martín Texmelucan
190	20350	San Sebastián Tutla	16,878	3.41	0.03	**0.77**	Oaxaca
191	30133	Pueblo Viejo	57,909	14.22	0.11	**0.76**	Tampico
192	17008	Emiliano Zapata	107,053	25.12	0.18	**0.72**	Cuernavaca
193	15031	Chimalhuacán	705,193	48.21	0.34	**0.70**	Ciudad de México
194	13016	Cuautepec de Hinojosa	60,421	21.44	0.15	**0.69**	Tulancingo
195	20375	Santa Cruz Amilpas	13,200	2.28	0.01	**0.65**	Oaxaca
196	16088	Tarímbaro	114,513	9.61	0.06	**0.64**	Morelia
197	31041	Kanasín	141,939	30.43	0.19	**0.62**	Mérida
198	29049	San Damián Texóloc	5,884	2.85	0.02	**0.62**	Tlaxcala-Apizaco
199	15005	Almoloya de Juárez	174,587	27.58	0.17	**0.61**	Toluca
200	31013	Conkal	16,671	8.63	0.05	**0.59**	Mérida
201	17028	Xochitepec	73,539	17.09	0.10	**0.57**	Cuernavaca
202	29017	Mazatecochco de José María Morelos	11,592	3.71	0.02	**0.57**	Puebla-Tlaxcala
203	15091	Teoloyucan	65,459	16.32	0.09	**0.57**	Ciudad de México
204	29029	Tepeyanco	13,328	4.57	0.02	**0.53**	Puebla-Tlaxcala
205	20087	San Agustín Yatareni	5,521	4.60	0.02	**0.53**	Oaxaca
206	13056	Santiago Tulantepec de Lugo Guerrero	39,561	9.01	0.05	**0.51**	Tulancingo
207	13077	Tulancingo de Bravo	168,369	44.87	0.22	**0.50**	Tulancingo
208	29025	San Pablo del Monte	82,688	16.97	0.08	**0.47**	Puebla-Tlaxcala
209	29038	Tzompantepec	18,006	17.29	0.08	**0.46**	Tlaxcala-Apizaco
210	29042	Xicohtzinco	14,197	7.74	0.04	**0.46**	Puebla-Tlaxcala
211	29035	Tocatlán	6,294	3.76	0.02	**0.43**	Tlaxcala-Apizaco
212	15023	Coyotepec	40,885	10.46	0.04	**0.39**	Ciudad de México
213	29043	Yauhquemehcan	42,242	23.34	0.08	**0.34**	Tlaxcala-Apizaco
214	21143	San Salvador el Verde	34,880	11.65	0.04	**0.34**	San Martín Texmelucan
215	20083	San Agustín de las Juntas	11,391	2.49	0.01	**0.34**	Oaxaca
216	29058	Santa Catarina Ayometla	9,463	7.42	0.02	**0.33**	Puebla-Tlaxcala
217	20107	San Antonio de la Cal	26,282	4.09	0.01	**0.32**	Oaxaca
218	29060	Santa Isabel Xiloxoxtla	5,443	6.00	0.02	**0.30**	Tlaxcala-Apizaco
219	20157	San Jacinto Amilpas	16,827	4.06	0.01	**0.30**	Oaxaca
220	30175	Tihuatlán	92,726	10.36	0.03	**0.28**	Poza Rica
221	15093	Tepetlaoxtoc	32,564	11.61	0.03	**0.27**	Ciudad de México
222	20227	San Lorenzo Cacaotepec	18,339	10.32	0.03	**0.26**	Oaxaca
223	29050	San Francisco Tetlanohcan	11,761	6.20	0.01	**0.23**	Tlaxcala-Apizaco
224	21034	Coronango	46,836	23.32	0.05	**0.22**	Puebla-Tlaxcala
225	05006	Castaños	29,128	19.06	0.04	**0.20**	Monclova-Frontera
226	20553	Tlalixtac de Cabrera	12,067	12.24	0.02	**0.19**	Oaxaca
227	29018	Contla de Juan Cuamatzi	38,579	14.15	0.02	**0.13**	Tlaxcala-Apizaco
228	29039	Xaloztoc	25,607	17.02	0.02	**0.11**	Tlaxcala-Apizaco
229	29048	La Magdalena Tlaltelulco	19,036	11.76	0.01	**0.09**	Tlaxcala-Apizaco
230	21090	Juan C. Bonilla	23,783	10.79	0.00	**0.04**	Puebla-Tlaxcala
231	21125	San Gregorio Atzompa	9,671	6.09	0.00	**0.03**	Puebla-Tlaxcala
232	20399	Santa María Atzompa	41,921	5.75	0.00	**0.03**	Oaxaca
233	20293	San Pablo Etla	17,116	7.98	0.00	**0.02**	Oaxaca

Table 3: Data on urban public open spaces for all metropolitan municipalities.

	CVEGEO	Municipality	Population	A_U (Km²)	A_{OPS} (Km²)	A_{OPS} (%)	Metropolitan Zone
234	20174	Ánimas Trujano	4,564	1.32	0.00	**0.00**	Oaxaca
235	20091	San Andrés Huayápam	6,279	2.46	0.00	**0.00**	Oaxaca