Urban Sprawl, Environmental Justice and Equity in the Access to Green Spaces in the Metropolitan Area of San Luis Potosí, Mexico

Adrián Moreno-Mata

Abstract The objectives of this research are: to analyze the effects of the urban sprawl on spatial distribution and social accessibility to green spaces in the metropolitan area of San Luis Potosí, México and to assess the level of environmental justice in the Metropolitan Area of San Luis Potosí, Mexico. The study evaluates the equity in the distribution of public green spaces and their accessibility. The research questions are: how accessible are public parks or green spaces to different social groups? and, which socio spatial areas need more public green spaces or parks? The methodology relies on the environmental justice approach, through a system of indicators which allows to assess the distribution, disposability and accessibility of the population to the green spaces. The analysis of this information allows to determine the extent to which the population of the metropolitan area of San Luis Potosí, benefits from equal access to the parks of the city, through its distribution, surface, disposability and accessibility. The paper concludes that the current distribution of green spaces in the city studied presents an unequal spatial distribution pattern, which benefits population of high-income brackets and excludes the population of lower income brackets. In Mexico there are few urban studies that analyze the problem of green areas and urban parks from the perspective of environmental justice and the connections between their spatial distribution and accessibility in time and distance, and the quality of life of the population. The contribution of this work is to advance in this line of research and to propose a methodology that could be applied in other Mexican cities. One of the limitations of the study is that it was not possible to analyze the interaction between the indicators and other concepts, like biophilic cities. This could be a line of future research that would allow to delve into the complex relationship between the human being and the environment.

Keywords Environmental justice · Equity in access to green spaces
Urban sprawl

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1 Introduction

Loss of natural landscape and green spaces due to rapid urbanization is occurring which might be detrimental to human health (Andrews 2014). The increase of the physical urban expansion is not produced in a balanced proportion between free areas, public spaces and green areas, concerning the areas urb**a**nized and the population needs. This can oppose the same urban development, since the presence of green areas represents one of the major actives of the social and individual welfare.

In addition, most public urban green space is not distributed equally and fairly. Access to public green space is often stratified based on class, socioeconomic status or income level. Many authors hypothesized that socioeconomically deprived neighborhoods or those areas with concentration of population with low income levels were underexposed to parks and green spaces as "environmental goods", testing the suitability of the environmental justice framework for positive environmental outcomes. Empirically, environmental inequality research has focused heavily on exploring disproportionate burdens on low-income and minority groups by residential proximity and exposure to environmental hazards, and less research has been conducted to investigate spatial inequalities of underexposure to "environmental goods," such as green spaces and urban parks (Miyake et al. 2010).

In Mexico there are few urban studies that analyze the problem of green areas and urban parks from the perspective of environmental justice and the connections between their spatial distribution and accessibility in time and distance, and the quality of life of the population. The contribution of this work is to advance in this line of research and to propose a methodology that could be applied in other Mexican cities. One of the limitations of the study is that it was not possible to analyze the interaction between the indicators and other concepts, like biophilic cities. This could be a line of future research that would allow to delve into the complex relationship between the human being and the environment.

With this aim, this paper, proposes an integrative theoretical framework to better illustrate the relationship between green spaces accessibility, and use, within the context of urban open space such as parks. The objectives of the research are: (i) to analyze the effects of urban sprawl on spatial distribution and social accessibility to green spaces in the metropolitan area of San Luis Potosí, México and (ii) to assess the level of environmental justice in the Metropolitan Area of San Luis Potosí, Mexico.

1.1 Theorical Approach and Analytical Framework

The environmental justice framework offers a useful conceptual paradigm for studying the spatial distribution of green spaces and urban parks. In short, the environmental justice framework embraces the principle that all people and communities, regardless of their sociodemographic background, are entitled to equal distributions of environmental amenities, and no group should be disproportionately affected by environmental hazards (Zhang et al. 2009). As in other social sciences,

inquiries related to place, class, socioeconomic status and income level occupy a central position in theoretical and empirical investigations of uneven distribution of environmental "goods" or "bads" across social groups (Boone et al. 2009).[1]

The approach to environmental justice constitutes a valuable analytic category to assess the conditions of equity in the access to green areas in cities. This line of thought considers that the distribution of the natural resources and therefore its benefits must be equitable among all of the groups in the society (Hervé Espejo 2010). Following this idea, the concept of environmental justice has been incorporated into the study of the urban green areas, with the same importance as the classic indicator of quality of life.

1.2 Data and Measures

In green spaces literature two classical measures are used: disposability and accessibility. The first is related with green area and vegetation covers (Shlomo et al. 2012). From a regulatory perspective, green space disposability refers to the international standards stablished by the World Health Organization (WHO), which recommends between 9 and 12 m^2 of green area by inhabitant (WHO 2012). But the urban green space coverage index is too general and not entirely consistent with the environmental justice framework. Other factors or variables commonly considered in assessing the equitable distribution of green areas are the size, the quality and the distance between the population and these spaces (Omer 2006; Sotoudehnia and Comber 2010).

For evaluating the green space disposability, a useful instrumental element can be the degree of accessibility that the population has to parks, understood as a public urban good (Omer 2006, 2005; Dai 2011). Commonly, green spaces accessibility refers to physical distance or travelling time from a residential house to green spaces (Sotoudehnia and Comber 2010). Some complementary measures to the classical concept, widely used in the researches of accessibility to green space, are the distance and travel time from the origin of the user to the parks (Boone et al. 2009).[2] The United Kingdom benchmark standard recommends that to make the best of

[1]An emphasis on class or socioeconomic status as possible antecedents of environmental inequalities is consistent with Weber's notion of "life chances" addressing race and class dynamics leading to individuals' life circumstances and social mobility trajectories (Weber 1946). In addition, this emphasis on class or socioeconomic status accords with a fundamental cause theory, which contends that race and class are both fundamental causes of health disparities because they are closely bound up with a wide range of resources that promote health and hazards that harm health (Phelan et al. 2010).

[2]In the case of Mexico the standard of green spaces accessibility was established in 1976 by the extinct Secretariat of Human Settlements and Public Works (1976), and updated by Social Development Secretary (SeSoDe 1999), regarding the location, equipment, coverage and size of urban green areas, which must not be found to a maximum distance of 500 m as regards the location of the areas of residence of the population.

green spaces, no-one should live more than 300 m from nearest green area of at least 2 ha in size.

Other authors (Sotoudehnia and Comber 2010, 2011) show the relationship between the distribution of green spaces and the spatial networks (road systems, travel routes, accessibility and economic importance linking them with residential neighborhoods) as well as how the ease of access to a particular site can be measured by the cost of the trip or its duration. De Vries et al. (2003) has focused on the ease of access to green spaces, researching residents' needs and their selection of a neighborhood which is close to services for easy access.

On the base of that criterion, several studies had applied different qualitative and/or quantitative methods to measure accessibility to green spaces (Barbosa 2007; Omer 2006). Their findings show inequality in the provision and access to green spaces for different social groups. This means, that another complementary indicator of accessibility to green spaces is the social distance, established by the spatial location of the population and its level of population income (Byrne et al. 2011). This indicator also considers the issue of differential density of the population at Metropolitan level, neighborhoods, districts and sectors.

Following the theoretical approach and analytical framework described, in this work evaluates the environmental justice depending on the accessibility differential of the residents in the different sectors or areas of metropolitan area of San Luis Potosí (MASLP) to the green spaces of the city depending on their spatial distribution, disposability and accessibility. In order to quantify physical access to green spaces, a network analysis was applied to measure -bias road distance-, in the hinterland or cover zone of the main green spaces. This was done within 3 distance constraints: (i) distance up to 300 m ("good access"); (ii) distance between 300 to 1000 m ("average access"), and (iii) distance more than 1000 m ("poor access"). Using the census tract information about urban marginalization levels (NACOPO 2010), also evaluates differentiated accessibility to urban parks by intra-urban distribution of the population according to socio-economic strata.

2 Results

The metropolitan area of San Luis Potosí (MASLP) is located in the Centre—West region of Mexico. It covers parts of the area of the municipalities of San Luis Potosí and Soledad de Graciano Sánchez (see Fig. 1). Recent studies locate the MASLP in the 14th place, within the classification of the more competitive cities at the national level, and the 207th at the global level, thanks to its capacity of attraction of investments in the industrial sectors—in special, because of its automotive industry—and services sector (Sobrino 2012; Moreno Mata and Parra Rodríguez 2017).

The city of San Luis Potosí was founded in 1592, in the colonial era. During the first three hundred years, the city grew under the classic urban model of the New Spain cities, practically unchanged in all that time, and in which the old Center established the limits of it city space. From the 20th century, this model began to

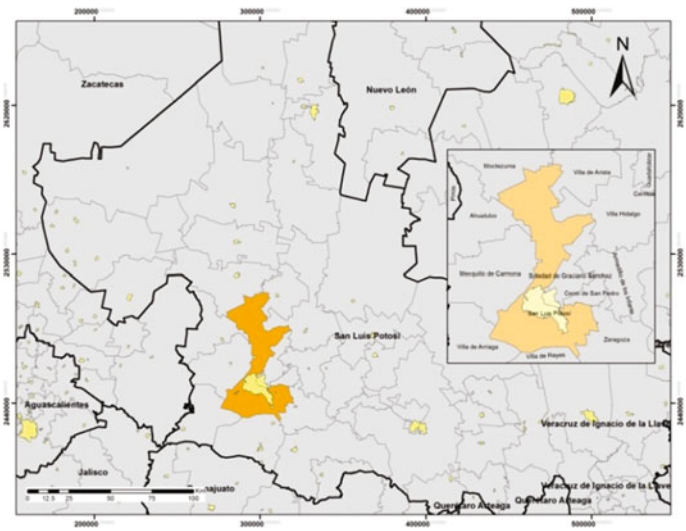


Fig. 1 State of San Luis Potosí: principal cities, 2010. *Source* Own elaboration based in Moreno Mata and Villasis Keever (2015)

turn slowly and in the middle of that century it adopts a growth pattern of the concentric type, combined with other sectoral radial patterns produced by the growing of the road system and the use of the automobile as the main way of transport (see Fig. 2). Since then, and particularly in the last five decades (1960–2010), this growth has become expansive, messy and unsustainable, either for lack of a planning system, or by the lack of respect to the reservation or mandated protected areas, and the ignorance of the effects that the prevailing urban models can produce. With an expansion of the space and the growing population, by 2010 the MASLP reached 1,040,443 inhabitants (NIEGI 2010).

Between 1960 and 2000 the MASLP multiplied four times its population and almost eight times its surface. The acceleration of population growth together with urban sprawl and fragmentation, occurred predominantly during the second half of the 20th century (see Table 1).

2.1 Urban Green Space Accessibility and Environmental Justice

Environmental justice and accessibility to green spaces in the MASLP the socio-spatial inequality described in the preceding paragraph is also expressed in a historical pattern of inequity in access to green spaces. Towards 1959, the unique urban parks, gardens or green areas of the city were concentrated in traditional neighborhoods and in the Central Alameda (1653), located in the historical Center,

Fig. 2 MASLP. Historical evolution & urban structure, 1959–2005. *Source* Own elaboration adapted from GCC/AHO/UASLP (2016), after modification by Alva (2017)

and the Juan H. Sanchez Park (1924) located to the West of the urban spot. Until 1972 the surface of green areas of the city was 33.4 ha (Leyva and Segura 1995; cited by Rodríguez Rangel 2010), see Fig. 3.

It was until 1982, during the State administration of Carlos Jonguitud Barrios (1979–1985), when on the expropriated land of the Garita de Jalisco, the most important urban parks of the city were built: the parks Tangamanga I and II with 450.0 and 215.3 ha, respectively (Rodríguez Rangel 2010). The first is located in the southern—west sector of the city and the second in the northern sector. Since the creation of these areas, so far there hasn't been built another city park of this dimensions (see Fig. 4).

Table 1 MASLP. Population and urban surface growth, 1990–2010; 2000–2010

Municipality	Population				Growth rate		Urban surface (ha)		
	1990	1995	2000	2010	1990–2000	2000–2010	2000	2010	2015
Central	429,238	586,585	638,533	772,604	1.70	1.43	–	–	–
Peripheral	123,943	147,188	212,294	267,839	4.16	4.04	–	–	–
Total	613,181	733,773	850,828	1,040,443	2.04	2.03	12,859	14,893	19,642[a]

Note [a]This data refers to the surface of the compact city. If the fragmented urbanized area is also considered, the total area of the MASLP reaches a total of 23,445 ha (Moreno Mata and Villasis Keever 2015)

Source SeSoDE (1999), NIEGI (1990), (1995), (2000), (2010), MI of Planning San Luis Potosí (2015), Moreno Mata and Villasís Keever (2015), Moreno Mata y Cárdenas Nielsen (2015)

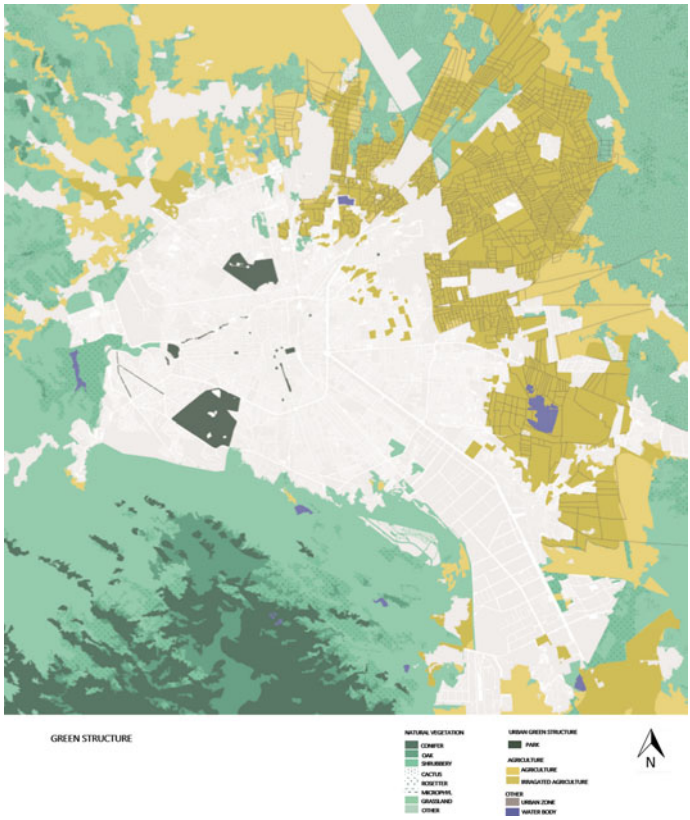


Fig. 3 MASLP. Green areas and historical evolution to the city, 1959–2005. *Source* Own elaboration adapted from GCC/AHO/UASLP (2016), after modification by Alva (2017)

Accordingly, at the beginning of the 1980s the total number of green areas in the MASLP reached a surface area of approximately 746.56 ha.

It is worth mentioning, that by 2012, the Mining Company Mexico began to rehabilitate contaminated areas by it's over one hundred years of operation, through the project of the urban Bicentennial Park, which is a small linear urban park with a surface of over 5.5 ha located in the vicinity of the company. However, this green space has little accessibility to the open population because its location and the private access control (see Fig. 4 again).

Also, there is a partially enabled linear urban park known as Paseo de la Presa located in the Western periphery, with a planned total area of 344.03 ha—(Sandoval Mendoza 2007) and several failed projects promoted during the states administrations of Fernando Silva Nieto (1997–2003) and Marcelo de los Santos Fraga (2003–2009), as the purported Parque Tangamanga III, started in 2000 that would had been be located on the eastern part of the city, and the urban park named Ejido of San Juan de Guadalupe referred in the Plan of Strategic Center of

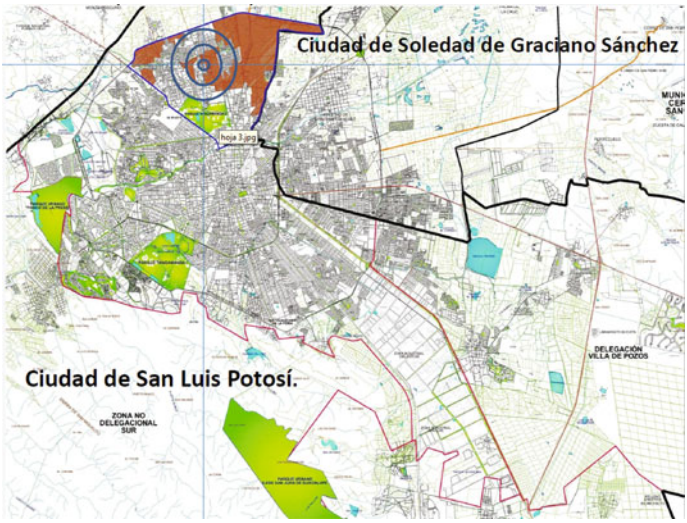


Fig. 4 MASLP. Green areas: metropolitan location, 2015. *Source* Adapted from Municipal Planning Institute of San Luis Potosí (2012)

Population San Luis Potosi—Soledad de Graciano Sánchez (PSCPSLP 2003), with a total area decreed from 1200.00 ha, and whose implementation has been slowed down several years by the interests of different groups -social, community and private-, who oppose his execution (see Fig. 4 again).

Thus, by the year 2010 the total area of urban parks and green areas has reached 1062.8 ha, and the projections to the year 2025, assuming the consolidation of the projects in process, would reach a total of 1623.7 ha (Rodríguez Rangel 2010).

2.1.1 Disposability to Green Spaces and Urban Parks

Finally, several studies on the inventory and coverage of green areas in the MASLP (Leyva and Segura 1995; Rodríguez Rangel 2010), reveal that, according to the international standard (9–12 m per inhabitant), at a general level, the rate of green areas per capita in the period 2000–2025 will range from 10.08, 11.78 to 12.83 m^2 by inhabitant, for 2000, 2010 and 2025, respectively (see Table 2).

In a retrospective of the historical evolution of the surface of urban parks and green areas in the MASLP, there can be seen a point of break in the trend of physical growth of green spaces built starting in 1982, with the construction of the urban parks Tangamanga I and Tangamanga II. Thereafter, the total surface has stabilized, and stays in a range that goes from 10.0 to 12.8 m^2 of green area per inhabitant, during the period 2000–2015. According to these data, in a first approximation, arguably the surface of effective green area per capita required to meet the international standard and the quality of green spaces and urban parks in the MASLP is satisfactory. However, if the area of areas is related to the total

Table 2 MASLP. Main green areas: spatial distribution, surface and green areas index, 2000–2025

Sector			Population			Surface green areas			Green areas index m^2/inhabitants)		
Num.	Name	Surface (ha)	Year			Year					
		2010	2000	2010	2025*	2000	2010	2025*	2000	2010	2015*
1	Centro	1625.1	138,065	156,329	239,396	33.4	41.8	41.8	2.4	2.6	1.74
2	Lomas—Tangamanga	1783.0	55,080	64,215	84,555	467.8	503.3	1047.0	84.9	78.3	123.8
3	Morales—Ind Aviación	1806.2	111,318	122,604	170,888	56.2	79.6	79.6	5.0	6.4	4.6
4	Saucito—Terceras	2234.7	59,939	78,554	92,015	215.3	221.4	221.4	35.9	28.1	24.0
5	Satélite—Progreso	2313.9	207,648	213,168	290,745	14.4	46.7	46.7	0.6	2.1	1.6
6	Zona industrial	2635.6	447	687	1033	0.0	86.4	86.4	0.0	1258.2	836.7
7	Delegación Pozos	3623.5	56,711	68,295	87,058	9.2	38.0	38.0	1.6	5.5	4.3
8	Soledad Norte	1508.1	50,268	57,183	88,845	1.6	16.2	33.4	0.3	2.8	5.8
9	Soledad Sur	1561.0	119,309	158,785	210,866	7.5	29.1	29.1	0.6	1.8	1.3
Total		19,091.5	798,785	901,902	1,265,055	805.6	1062.8	1623.7[a, b]	10.0	11.7	12.8
AGACI (Green area surface/Urbanized urban area) %	**2000**	12,859.0							**6.2**		
	2010	19,091.50								**5.6**	
	2015	27,319.1									**5.9**

Source Own elaboration

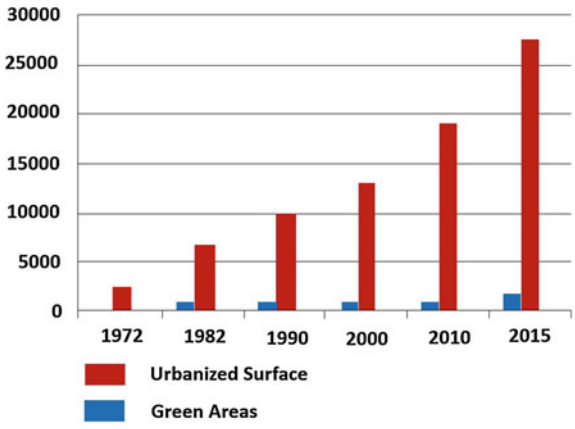
Note The supply parameter of green areas green it sets by the Social Development Secretary (Sodese 2000), in the Guide for the formulation of plans of development urban.[a]Considered the projections made for the horizon of long term. [b]In the projections to 2025 horizon (Rodríguez Rangel 2010) is possible to observe the consolidation of the linear urban park Paseo de la Presa

urbanized urban area, the actual green area coverage index (AGACI) is obtained, whose behavior is different from the traditional index established by the international standard. The AGACI goes from 6.2% in 2000 (the highest level) to 5.56% in 2010 and finally to 5.94% in 2015. If these values (in bold in Table 2) are compared with those of the traditional index for the same years (10.0, 11.7 and 12.8, respectively), the proportions obtained show marked differences (see Graphic 1). If this operation were carried out at the level of sectors, neighborhoods or Basic Geostatistical Areas (BEAs), the effective coverage of the green areas obtained would also be much lower than that established by the international standard.

2.1.2 Spatial Inequalities in Access to Green Spaces

On the basis of the information in Table 1, but analyzed at the level of each urban sector in a recent period, there are marked disparities in the rate of green areas per capita (see Table 1 again): in 2015, sector 2 named Lomas—Tangamanga, located at southwest of the metropolitan area, had the best rate of green areas per capita (123.8 m^2 by inhabitant), while the sector 5, named Satélite—Progreso, had the lowest rate with 1.6 m^2 by inhabitant. Thus, 85.9% of the total metropolitan population did not have great access to public green space, in respect that they have access to only the 16.5% of total green areas. Meanwhile, 14.1% of total population had access to 83.5% of total green spaces and parks of the MASLP.

The retrospective and prospective approaches of cover of green areas during the period of 2000–2025 confirms the observed tendencies: Sector 1 has a descending and well below the standard behavior (2.41, 2.67 and 1.74 m^2 per inhabitant in 2000, 2010 and 2025, respectively). The sectors 3 and 5, have a similar behavior



Graphic 1 MASLP. Greeen Areas Surface versus Metropolitan Surface, 1972–2025. *Source* Own elaboration adapted from Lárraga Lara et al. (2015), Leyva and Segura (1995), Rodríguez Rangel (2010)

(top-down and well below the norm); sectors 7, 8 and 9 have a slight increase, but in all cases and years fall below 6 m^2/inhabitant, far away from the national and international standards. Only sectors 2 (Lomas—Tangamanga) and 4 (Saucito—Terceras), presented a favorable behavior of the index, passing in the first case of 84.9, 78.3 and 123.8 m^2 per inhabitant in 2000, 2010 and 2025, respectively. In the second case, the index went from 35.91, 28.1 and 24.0 m^2 per inhabitant in those years. It should be noted that, in both cases, their closeness with the parks Tangamanga I and II, increase its index of coverage and accessibility to green spaces. Together, these parks concentrated 718.6 ha, representing 67.6% of the total number of green areas of the MASLP. It is also important to note that the sector 2 has concentrated the most affluent suburban population.

Now, if it is considered in the analysis the variable density of areas—that is the relationship between population over the urban surface- to level of BGAs), the existing differentials are even more notorious, regardless of the general level, in that the MASLP expresses a very low coefficient of the density of green spaces. We can appreciate how the bigger urban parks of the city—and almost the only ones-, are concentrated in the areas or sectors with the lower population density. So, while in Soledad Sur sector the green area per capita is 1.83 m^2 per inhabitant in 2010, in the Satélite—Progreso sector it is of 2.19 m^2 per inhabitant, even though both are urban settlements with the highest rate of urban marginalization in the MASLP. The same indicator of demographic density, in relation with the index of green areas by inhabitant, reveals that the areas with better coverage, sectors 2 (Lomas—Tangamanga) and 4 (Saucito—Terceras) correspond with two of the areas with lower population density: 36.8 and 35.1 inhabitants by hectare, respectively (see again the Fig. 5).

These variations and differences in the spatial distribution and disposability of green spaces and parks at the intra urban level of MASLP allows, in a first analysis, to note a great number of urban sectors that does not have the access to public green space than other sectors do. On this matter, 5 urban sectors are below of the international standard (12 m^2/inhabitant) while 2 urban sectors are above the standard. The measure of the physical disposability of public urban green space for the nine urban sectors reveals a certain level of spatial inequality on this metropolitan area.

2.2 Social Inequalities in Access to Green Spaces

To analyze the green areas and urban parks under the perspective of equity and environmental justice, there are some factors that must be known such as the distribution in the MASLP, its quality according to the vegetation cover and equipment presented and measure that caters to the population of these services; at the same time, it is necessary to know the relationship between the distribution of green spaces and: (i) residential location of socio-economic groups; (ii) physical distance or (iii) travelling time from a residential house to green spaces, and (iv) spatial networks (road systems, travel routes and spatial connectivity).

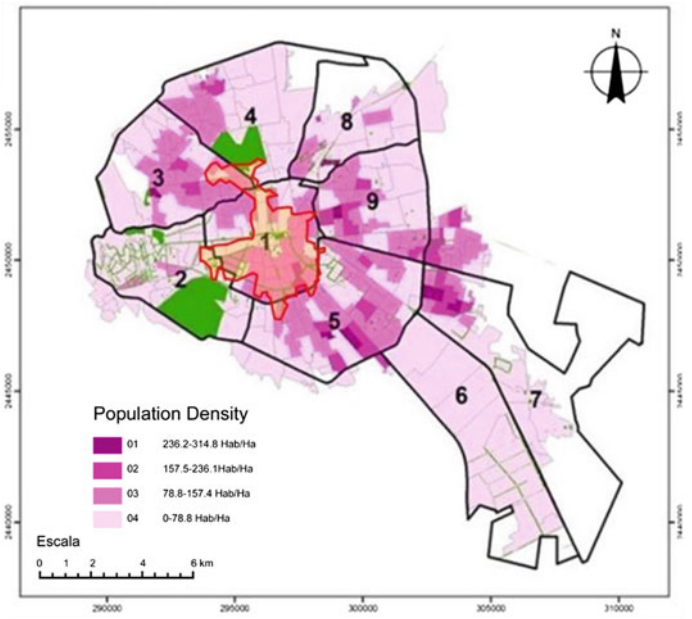


Fig. 5 MASLP. Spatial distribution of urban parks and demographic density by Basic Geostatistical Areas, 2010. *Source* Adapted from Lárraga Lara et al. (2015)

Using Basic Statistical Areas (BEAs), the analysis of income levels by socio-economic strata and average level of education, in relation with conditions of habitability (grade of overcrowding and deterioration of the housing), the endowment of basic services (water drinking and drainage) and educational levels (access to knowledge society and technologies) shows that practically none of sectors of the MASLP observed a complete homogeneity (see Fig. 6).

In some cases, this phenomenon produces a differential of residential consolidation, that reveals, to this time, at least five levels: very high, high, medium, low, very low (NaCOPO 2012).

Nevertheless, if analyzed, the pattern of spatial accessibility to green structure depending on the socioeconomic strata of the population and its physical distance over three distance constrains (good access, average access and poor access) in respect to the location of existing urban parks it is possible to observe a clear difference in the urban sectors of the MASLP. For example, for the Southern West sector (sector 2), the accessibility has a maximum of 3 km for the majority of population. The same situation is observed in the Northeastern, Northern and Central sectors (sectors 3, 4 and 1). In general, those urban sectors have a level of accessibility to green spaces between good and regular. However, the most notorious in this analysis is that the rest of the residents in the metropolitan area (about 421,702 inhabitants), that is, 53.24% of the population, have poor or no accessibility to green spaces, in terms of coverage radius or physical distance (see Fig. 6 again).

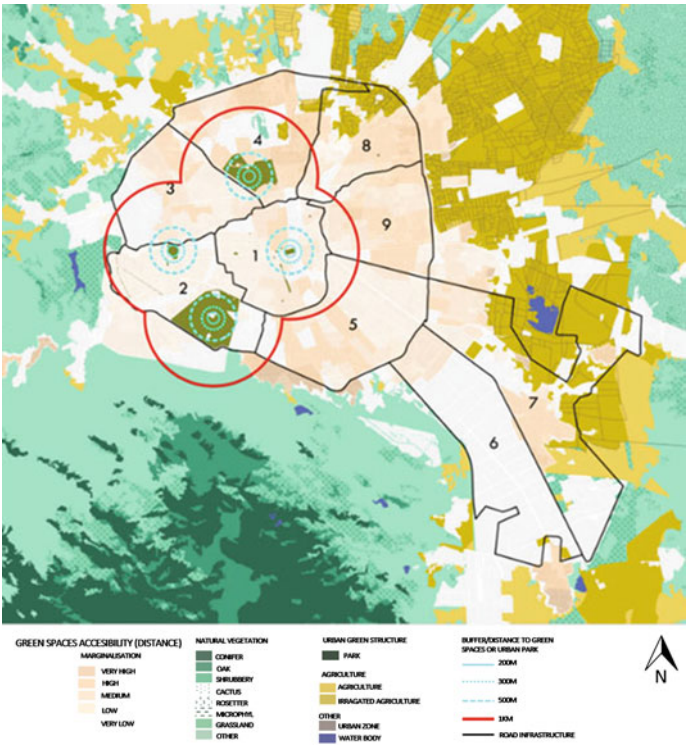


Fig. 6 MASLP. Residential stratification by income level and habitability and accessibility to Green Areas, 2010. *Source* Own elaboration adapted from GCC/AHO/UASLP (2016), after modification by Alva (2017)

Similarly, if you insert the time factor for the accessibility indicator, using the spatial networks and level of connectivity of road system (high, medium, low) it is possible to evaluate the accessibility of green spaces in the city, in terms of time and distances of traveled with respect to the location of the existing urban parks and residential location of social groups (see Fig. 7 again). For example, for the Southern West sector, the relative accessibility has a maximum of 15 min for the medium and high, socio-economic groups, in addition to availability to different means of transport. In contrast, much of the population of the city—especially the residents of the peripheral areas (located at Northwest, North, Northeast and Southeast) are located in a ratio that exceeds far from the norm of 500 m, with 1–5 km to distance and 20–45 min of travel time to be able to move to the few green spaces available (see Fig. 7).

It should be noted that accessibility based on ratio distance and travel times might also have to do with the differences observed in relation to the availability of public transport or the privilege of owning a private automobile. This situation reinforces the spatial disparities in the distribution of green spaces and urban parks in the MASLP. The urban sectors best served in terms of coverage and space

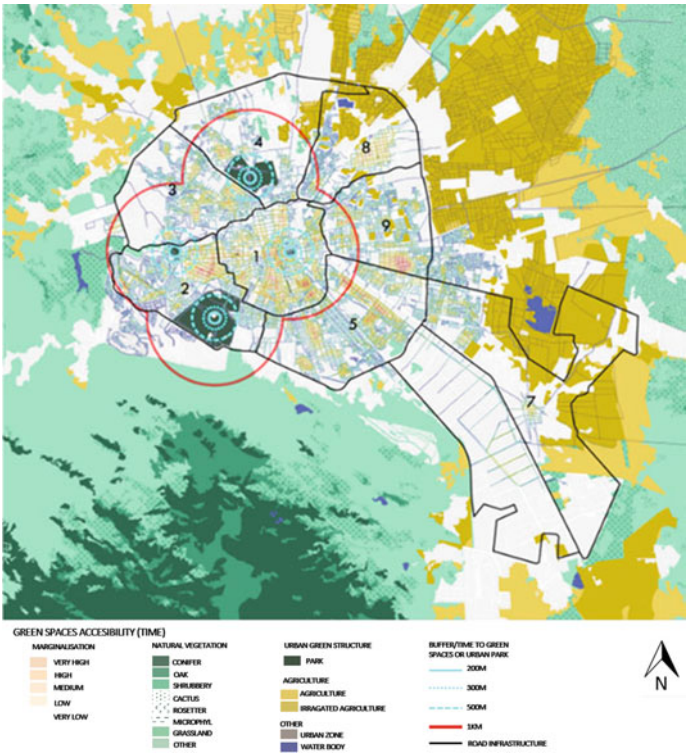


Fig. 7 MASLP. Residential stratification by income level, accessibility to Green Areas and connectivity of road system, 2010. *Source* Own elaboration adapted from GCC/AHO/UASLP (2016), after modification by Alva (2017)

accessibility are those that also have the best levels of connectivity of the mobility and transportation system, and greater availability of different modes of transportation. In contrast, much of the population of the city—especially the residents of the peripheral areas (located at Northwest, North, Northeast and Southeast)—are located in a ratio that far exceed widely the norm and these areas are also characterized by low connectivity levels of the mobility and transport networks and, therefore, the time and cost to move to green spaces and urban parks is greater.

3 Conclusions, Main Lessons and Future Prospects of Research

The analysis of this information allows to determine the extent to which the population of the metropolitan area of San Luis Potosí, benefits from equal access to the parks of the city, through its distribution, surface, disposability and accessibility. It´s concluded that the current distribution of green spaces in the city studied presents

an unequal spatial distribution pattern, which benefits population of high-income and excludes the population of low income.

On the other hand, the larger green areas are more accessible to a small sector of the population with high socioeconomic status. The social groups, which are located in the suburban residential areas over the peripheral urban fringe in the southwest of the city, are those who possess the best levels of endowment and accessibility to green spaces in their own residential spaces, and most of them are of the gated residential type.

In consequence, the indicators of environmental justice and equity in the spatial distribution and accessibility of the green areas are not satisfactory. In general, we see a significant shortage of urban parks and green areas in most of the sectors of the city. At the same time, an uneven distribution of green areas can be seen with marked differences in accessibility to them.

The preliminary assessment in this study is that the planning and creation of green spaces in the city should be a matter of public policy and urban land management. It recommends for the creation of more green spaces, the renewal and maintenance of the already existing ones under a vision of long term for the metropolitan development, and a strategic location of urban parks depending on its universal accessibility and social equity at the neighborhood scale. The more affluent social groups already have enough urban parks and green spaces; now it's up to the population with greater shortages far away—physically, socially and economically—of those spaces. A study in depth, with a finer scale, could provide additional elements to be exposed, such as strategic axes and criteria suitable for the planning of green areas in the case study.

One of the main lessons of the study refers to the need to use mixed indicators, incorporating the quantitative and qualitative dimensions in the measurement of equity in the spatial distribution of green spaces. A second aspect has to do with the complex character of environmental justice, so it is recommended the combined use traditional indicators such as surface, distance, time of transfer, with nature, social and demographic indicators, this would apply a more integrated methodological approach, and most attached to the urban reality analysis. A third aspect is related to the need to conduct deeper studies in urban space, with a more fine scale (as the bringing the basic geostatistical Areas), which generate information in greater detail, in order to support plans and strategies to improve the social and spatial equity in the allocation and distribution of green spaces in the city. These three elements constitute both the future prospects of research, which are considered indispensable support in future work on the topic.

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