



## The Bogotá Green Divide

by Mark Brown

### ABSTRACT

In this report I share findings from *The Bogotá Green Divide: Inequality in Street-tree Coverage across Estratos*, my MA thesis from May 2012 at the University of Chicago. The paper documents inequalities in the distribution of street trees across neighborhoods of differing socioeconomic level in Bogotá, Colombia and generates the first set of published data on street-tree inequality in any developing-world city. It conclusively demonstrates the ‘green divide’ in Bogotá and provides a basic model for street-tree equity studies in other cities around the world.

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### NOTES

Full paper and data available upon request

## INTRODUCTION

Trees, in the form of the street-tree canopy, are an important amenity for city dwellers. They not only provide aesthetic value, but environmental, economic and social benefits, as well.<sup>1</sup> The spatial distribution of this urban amenity, however, can be uneven. In many cities there are significant differences in the number of trees on streets in residential neighborhoods of differing socioeconomic levels.<sup>2</sup>

There is much discussion of how political economy and various other social processes often favor the higher socioeconomic strata in the construction of urban environments.<sup>3</sup> However, there is little research on the sociospatial inequities associated with the distribution of street trees, particularly in emerging-world cities.

Bogotá, the capital of Colombia, has a long history of social, political and economic inequality. The highly unequal distribution of street trees in this capital city is emblematic of this inequality. Recently, the city of Bogotá has begun to grapple with its green divide and is now in the process of clearly defining its urban forestry policies for the first time. Therefore, the time is ripe to document and analyze the spatial distribution of Bogotá's tree population, with a special emphasis on the oft-neglected topic of street trees.

## AIMS OF THE PAPER

*The Bogotá Green Divide* adds to the research on inequalities in public environmental amenities by examining the distribution of street trees, defined as right-of-way (ROW) trees, along residential lots in selected neighborhoods of Bogotá. The research goes beyond simply demonstrating a clear negative statistical correlation between neighborhoods of low socioeconomic level and density of street trees and investigates the social and institutional processes that have brought about the observed inequities.

Finally, the study discusses the need to address street-tree inequities, both in terms of Colombian law and environmental justice, and looks at how positive change might come about. It raises awareness of this critical issue and contributes to the

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<sup>1</sup> Nowak 11-22

<sup>2</sup> Cadenasso 80-82

<sup>3</sup> NyGren 767-8

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discussion on how to improve the urban environment for millions of Bogotáños. It may also have relevance for other emerging world cities facing similar problems.

The key questions this study addresses include:

- Is there inequity in the distribution of ROW trees across neighborhoods of differing socioeconomic levels in Bogotá?
- If so, what factors brought about this inequity and stand in the way of amelioration?
- Why is this issue important and what must change to begin addressing it?

## BOGOTÁ'S ENVIRONMENTAL PROBLEMS

Bogotá is the 5<sup>th</sup> largest metropolitan area in South America, with over 9 million inhabitants in 2010<sup>4</sup>. Due to its size and density of population (Bogotá ranks 9th globally<sup>5</sup>), the stresses inherent in developing world urban life are magnified. Urban environmental issues are exacerbated by rapid economic growth and mass migration into this city. As cities like Bogotá have become the home for a majority of Colombia's population, the issue of urban environmental quality becomes central to the goal of improving living standards and quality of life, a recurrent theme of government discussion.

Serious environmental problems facing Bogotá include increasing heat and solar radiation during the day, health-threatening levels of air and noise pollution<sup>6</sup>, flooding and landslides. Unfortunately, the benefits and positive environmental externalities that could be gained from parks and street trees are often not realized, as is the case in most developing-world cities. The lower socio-economic groups in society are most impacted by the burdens associated with these urban environmental problems.<sup>7</sup>

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<sup>4</sup> Some populations estimates are considerably lower.

<sup>5</sup> Citymayors.com (<http://www.citymayors.com/statistics/largest-cities-density-125.html>)

<sup>6</sup> Gaitán 82

<sup>7</sup> Swyngedouw 902-3

## THE BENEFITS OF TREES

In all my writing, the importance of trees in creating a quality urban life has been a constant theme. The benefits of trees, especially street trees, range from environmental improvements (urban cooling and cleaner air) to social benefits (stress reduction and neighborhood cohesion). Countless studies have documented the transformative power of urban trees. And what's more, most people would agree that trees are beautiful. But despite their importance, trees are not a resource shared equally in most cities of the world.

## A DIVIDED CITY

Fundamental to any understanding of the green divide in Bogotá is an awareness of stark social divisions of this city. Even the casual visitor will quickly note the dramatic change in the look of streets as one moves across socioeconomic lines in Bogotá. The change is not striking simply in respect to the style and quality of home and street construction, but equally dramatic in the almost complete lack of street trees and vegetation in neighborhoods at the lower socioeconomic levels, the majority of neighborhoods in Bogotá.

These structural differences are captured in the city's stratification system. Social stratification of Colombian cities is a public policy that was instituted in the 1980s and it creates an approximation of the socioeconomic differences between neighborhoods. Each block in the city is assigned to a particular *estrato* (stratum or level) ranging from 1 to 6. The lowest three *estratos* represent the poorest neighborhoods, which benefit in varying degrees from subsidies for public services, such as water and electricity. The top two *estratos* (5 & 6) represent the richest inhabitants, those who must pay an additional cost for public services (called *contribución*) to pay for the subsidies to the low *estratos*. *Estrato* 4, which is in the middle, pays no extra costs and receives no subsidies.<sup>8</sup> *Estratos* 3 and 4 are left out of this study for the sake of simplicity, and because of the more complex structure of their streets. In future studies, they should be included.

As you can see in *Figure 1*, the vast majority of Bogotá's population lives in the lower three *estratos*. (Map of *Estratos* follows in *Figure 2*.)

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<sup>8</sup> DANE

([http://www.dane.gov.co/files/geoestadistica/Preguntas\\_frecuentes\\_estratificacion.pdf](http://www.dane.gov.co/files/geoestadistica/Preguntas_frecuentes_estratificacion.pdf))

**Figure 1: Population by Estrato**

Percentage of Bogotá's Population Living in Each *Estrato*

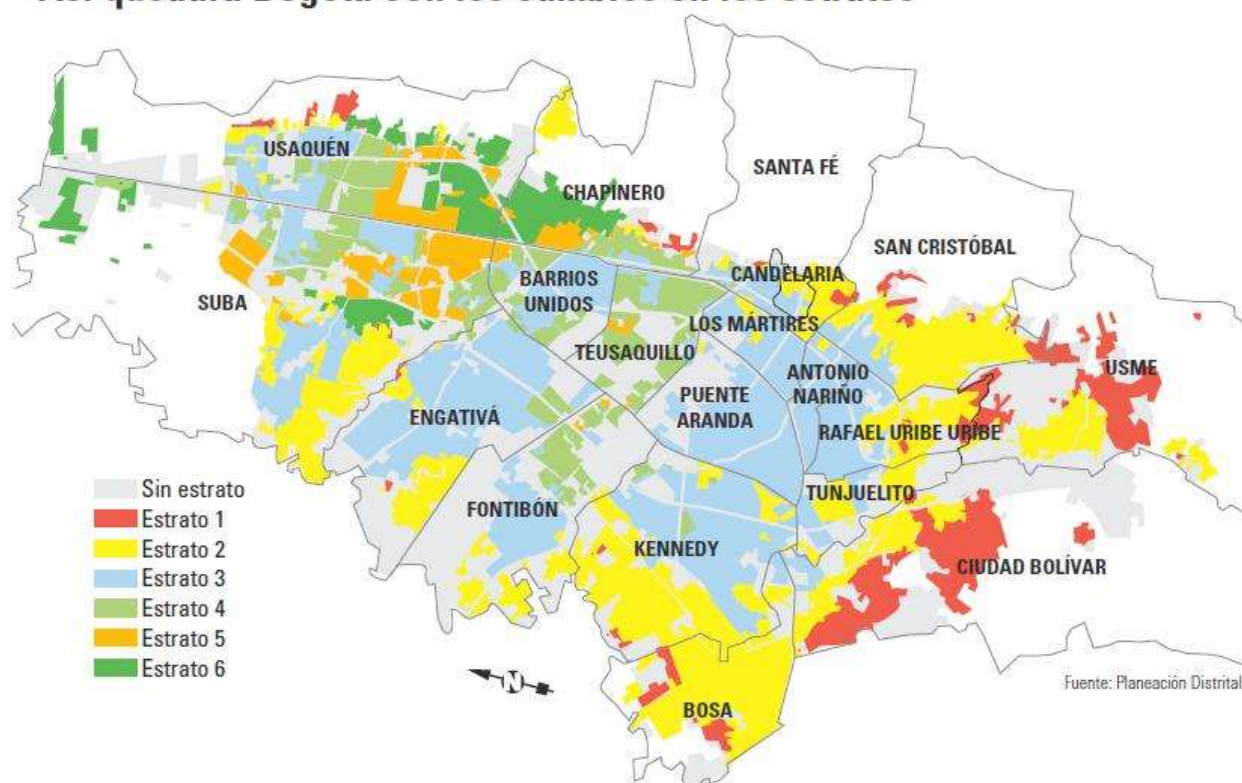
<b>Estrato</b>	1	2	3	4	5	6
<b>Percentage</b>	9.3	42.7	30.2	9.1	3.7	1.7

Note: total less than 100 because some residents live in unclassified areas

Source: MetroCuadrado, 1998

**Figure 2: Map of Bogotá's Estratos**

### Así quedará Bogotá con los cambios en los estratos



Source: Planeación Distrital

## STREET-TREE INEQUITIES

### *The Data*

Although the inequity in urban forest cover across *estrato* in Bogotá is readily apparent to any observer, there is no existing data on this specific problem.

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Therefore, a survey was conducted to collect the data required to conclusively demonstrate that stark inequalities in tree cover exist.

### *Approach*

As Bogotá is a huge city, it was not practical to make a comprehensive survey of all the city's streets. Instead 30 residential streets in each of two groupings were randomly sampled: neighborhoods of *estratos* 1 and 2, represented by the localities<sup>9</sup> of Bosa and Ciudad Bolivar (which contain only *estrato* 1 and 2 neighborhoods), and neighborhoods of *estratos* 5 and 6, represented by large portions of Chapinero and Usaquen (where the majority of the wealthy live).

Although not a comprehensive tree survey, this sampling was designed to confirm the observation that in the lowest *estratos* there are generally no trees on residential streets and that in the highest *estratos* trees are generally abundant.

### *Focus on Street Trees*

Although trees on private land and parks are of obvious importance to a city's environmental well-being, this study examines right-of-way (ROW) trees because these trees are the most visible to urban residents in their daily lives, they are generally the responsibility of city government, and they are the easiest to measure. A count of trees per street was performed, although this is not a good indicator of ROW trees per capita for an area. Population densities are highest in the lowest *estratos* of Bogotá<sup>10</sup>. Therefore, even a comparable tree cover percentage in lower *estrato* neighborhoods would indicate a lower per capita count of street trees.

### *Methodology*

The tree survey involved first superimposing a numbered grid over street maps of the two study areas. The grid over Bosa/Ciudad Bolivar contained 317 cells. The grid over the studied portion of Chapinero and Usaquen contained 209 cells. Each of these cells represents a few city blocks. Unique numbers were assigned to each cell. Using a random number generator<sup>11</sup> cells were chosen from each of the two groups until 30 suitable streets of roughly the same length (200-300 meters) from

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<sup>9</sup> Bogota has 20 *localidades* or localities

<sup>10</sup> Camara Comercio de Bogota

<sup>11</sup> <http://www.random.org>

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each group were selected. Street choices were made by starting in the top center of a cell and moving in a clockwise direction until an appropriate street was located. Wide commercial streets were eliminated, as were streets along parks and rivers, and streets that were undeveloped and without buildings.

By using aerial images, generally street images on the site Mapa de Bogotá, estimates were made of ROW tree count.<sup>12</sup> Other governmental aerial imaging services<sup>13</sup>, and Google Earth, were relied on, as well, when shadows and other imaging problems arose. These services offer a surprisingly clear picture of city streets, at quite close range. Using more than one service helped to ensure the best picture of each street.

### SURVEY RESULTS

*Figure 3* below shows the results of the aerial tree count. The difference between high and low *estratos* is profound. While streets in *estratos* 5 and 6 appear to have at least a few trees (and usually many), there are virtually no trees on any street in *estratos* 1 and 2. See *Pictures 1* and *2* below.

To test the accuracy of the aerial estimates, direct field observations were made for 1/3 of the streets (10 in each group), also randomly selected. The results of the field observations show that the aerial estimates generally underestimated tree count in *estratos* 5 and 6, but not in *estratos* 1 and 2. The undercount occurred due to the difficulty in distinguishing between bushes/small gardens and small trees in aerial images and conservatism in counting. An inflated count was obviously not desired. Some of the differences may also have been due to changes in the streets since the time the aerial images were made and the time of the field count.

*Figure 4* below shows the tree-count difference between the aerial survey and the direct field observation for 10 randomly selected blocks (out of 30) in *estratos* 5 and 6. A chart for *estratos* 1 and 2 has not been included because there were no observed differences.

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<sup>12</sup> mapas.bogota.gov.co

<sup>13</sup> sinupot.sdp.gov.co, geoportal.igac.gov.co

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Figure 3. Cross-Estrato Tree Count

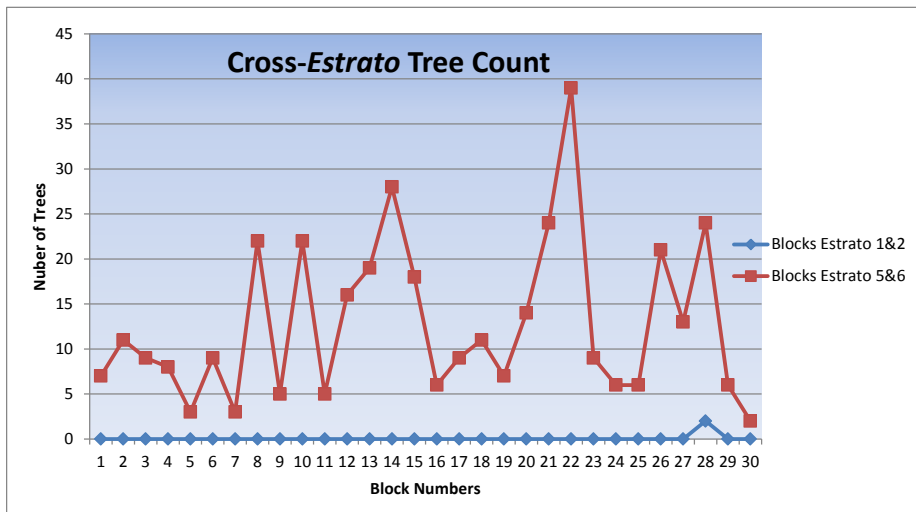
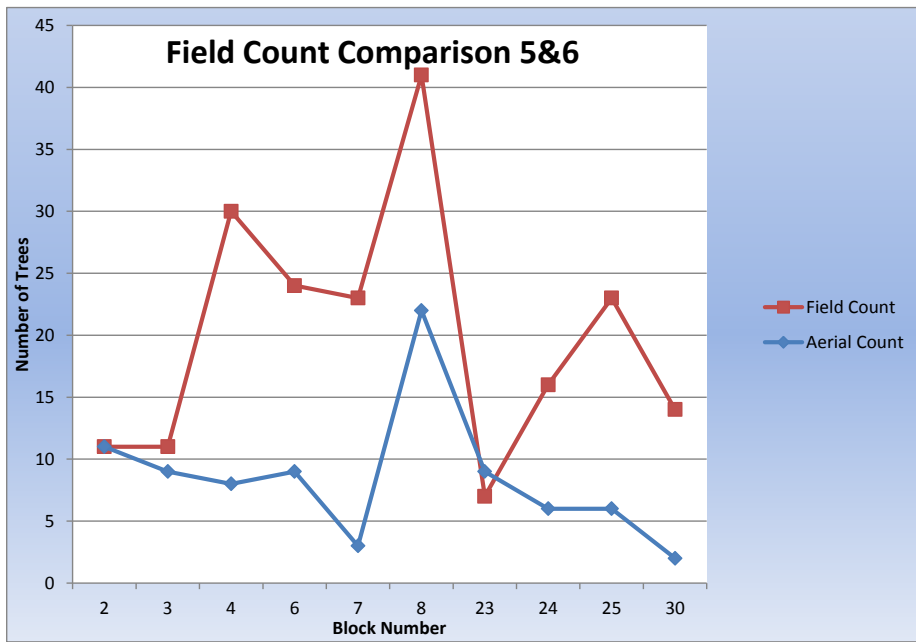


Figure 4. Field Count Comparison Estratos 5 & 6





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**Pictures 1 & 2.** Comparisons of Streets in *Estratos* 6 and 2.

1. Typical Street in *Estrato* 6



2. Typical Street in *Estrato* 2



## OTHER OBSERVATIONS

In addition to getting a more accurate count of ROW trees, the field observations brought some other features of the streets and neighborhoods into focus. In *estrato* 5 and 6 neighborhoods, it is impossible not to notice the lush green surroundings on all sides. Almost all streets have a built in green median between the sidewalk and the street (ranging from half a meter to two meters or more in width). Even streets without dense tree plantings tend to have bushes and grass, and all streets are edged by carefully tended gardens in front of nearly all buildings. The number of parks is also much higher in these neighborhoods, and these parks are well-tended with tall, canopy-forming trees and beautiful lawns and flowers. Where there are private houses, as opposed to apartment blocks, many yards have large trees which extend over the streets. A surprise came in seeing that some new buildings eliminated the green medians and planted nothing in their place. Sometimes there would only be a layer of cement, in violation of city codes<sup>14</sup>, with no trees or vegetation whatsoever. However, even these buildings would always include the standard garden between the sidewalk and the building itself.

In *estratos* 1 and 2, however, the bleakness of the street scene (from a green perspective) is uniform. There is no variation, with the rare exception of a potted plant here and there. The structure of the streets, whether paved or unpaved, just doesn't provide space for planting of trees or bushes. Although unpaved streets (about 30% of the total) could theoretically allow some weeds to grow in the gravel and mud, they remain free of vegetation.

Unlike in the wealthier *estratos*, there is little or no relief from neighborhood parks, which the field observations showed to be very poorly maintained and often nearly treeless. In fact, according to Bogotá's Chamber of Commerce, in neighborhoods of *estrato* 1, fifty percent of parks are in bad condition, as are thirty percent of parks in *estrato* 2. None of the parks in *estrato* 1 are considered to be in 'good' condition, and only 20% of the parks in *estrato* 2 are considered to be in good condition. This compares to 100% of the parks in *estratos* 5 and 6 being considered as in good condition.<sup>15</sup>

<sup>14</sup> <http://www.alcaldiabogota.gov.co/sisjur/normas/Norma1.jsp?i=339>

<sup>15</sup> Camara de Comercio de Bogotá:

[http://camara.ccb.org.co/documentos/871\\_2003\\_12\\_10\\_10\\_38\\_33\\_610\\_obsocial\\_10.pdf](http://camara.ccb.org.co/documentos/871_2003_12_10_10_38_33_610_obsocial_10.pdf)

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All the government and academic experts spoken with support the evidence gathered showing a profound difference in street-tree cover between *estratos* 1 & 2 and 5 & 6.

### WHY THE INEQUITIES CAME ABOUT

The observant visitor to Bogotá will notice that a formidable barrier to street-tree planting exists: the changing structure of the streets as one moves from the higher *estratos* to the lower. This change, just like the change in *estrato*, can be very abrupt. Simply crossing a single street can bring you into a markedly different environment, and one key to the difference is the structure of sidewalks and the allocation of a planting median between the sidewalk and street. This is one of the hallmarks of the lower *estratos* in Bogotá: not only are the structure of the houses different, but the streets in the lower strata almost always are without a green median between the sidewalk and the street, and hence are without room for trees. They are urban deserts by design.

Why did the streets of lowest-*estrato* Bogotá develop with what, from an environmental perspective, is an inferior design? Why do they provide no space for grass, bushes or trees? To get to the bottom of this, it's critical to understand the history of urban development in Bogotá, and one place to start is with the history of migration to this city and the role it played in the formation of the city streets.

### Mass Migration

Mass migration of the rural poor from the countryside to cities is a global phenomenon. Developed nations experienced this over the last two centuries, and the developing world is following in their footsteps. This process has been going on for decades in Colombia and the scale and speed of urban migration in Colombia is faster than most developed countries ever experienced. Adding to the flow of Colombians to the cities is the decades-long armed conflict particularly impacting rural areas. Bogotá is a city with a sizable population of displaced persons.<sup>16</sup>

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<sup>16</sup> According to Sebastián Albuja in 2010, there are 270,000 displaced persons living in Bogotá. (Albuja, 1)

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The chart below shows how Bogotá's population has increased since the 1920s from under 300,000 to nearly 10 million today.

Bogotá's Growing Population										
Year	1928	1938	1951	1964	1973	1985	1993	1999	2005	2010
Population	235,702	325,650	715,250	1,697,311	2,855,065	4,236,490	5,484,244	6,276,428	7,185,889	9,589,170
%Change	63.70%	38.20%	119.60%	137.30%	68.20%	48.40%	29.50%	14.40%	14.50%	33.40%

Source: Biblioteca Luis Angel

From the early 1960s the city has gone from a population of just over 1 million inhabitants to one approaching 10 million in 2012. An increase of 9 million inhabitants would seriously tax even the most efficient of governments. However, the institutions for regulating urbanization in most of the developing world have a long history of disorganization and dysfunction.<sup>17</sup>

### Government Failure

Colombia is no exception to the general record of poor regulation of urbanization in the emerging-world, and Bogotá's city government has simply been unprepared for (both in terms of organization, resources and focus) and hence overwhelmed by the influx of millions of immigrants and rapid natural population growth. The city administration did not, and still does not, have the finances or capabilities (nor the will, some would say) to manage it. In fact, for decades city government was virtually absent from the development of large swathes of this city.

### Barrios Piratos

As a result of government absence, and sometimes due to policies aimed at keeping the poor out of rich areas<sup>18</sup>, the development of most parts of this city (the low *estratos*) occurred in the form of 'informal settlements' in which the unregulated market took responsibility for urban design and construction, creating what are often called *barrios piratas*. In the *barrios piratas*, land transactions take place outside the formal housing market and without regard for planning and land-use regulations. This unregulated form of market urbanization is the standard form for the lower classes in Bogotá and is common in many Latin American cities.<sup>19</sup>

<sup>17</sup> Cohen 64-5

<sup>18</sup> Gilbert 658

<sup>19</sup> Foster, Introduction

### Other Barriers to Green Streets

While it's clear that the primary cause of the green divide in Bogotá is the decades of ineffective city government and the resulting unregulated development of most of the city's streets, other factors have exacerbated the physical limitations that poorly structured streets pose and impeded tree planting and growth. These factors include social and cultural attitudes and neighborhood dynamics. The following is a summary of some reasons for not wanting street trees:

#### ▪ *Social and Cultural Barriers*

- Security is a huge concern in Bogotá. Trees can be used by criminals to hide.
- When trees get large and are poorly maintained limbs can fall off, damaging houses or other property.
- Some people in poor neighborhoods believe trees are a common site for dumping garbage and that newly planted trees will simply attract garbage and pests.
- Some people believe that trees bring humidity that can damage their homes.
- Most residents are not aware of the health benefits trees bring.
- People prefer their residential streets to be bus routes (meaning no space for sidewalks or trees) because of convenience, despite the extreme air and noise pollution and danger for children these buses bring.

#### ▪ *Neighborhood Decline and Demographics*

- As the middle and upper classes of Bogotá moved to the north, leaving neighborhoods perceived to be dangerous (i.e., near areas of poverty in the center), there was a lower propensity for property owners to invest in upkeep and maintenance of properties in these now less-valued neighborhoods.
- Some studies suggest that the composition of residents, in terms of owners and renters, plays a role in urban tree planting.<sup>20</sup> The idea is that owners are more willing to take the time and make the investment to plant trees (in the absence of city planting), as they will be there to

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<sup>20</sup> Heynen, for example

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enjoy the tree for the long run and gain any financial benefit the tree might bring, such as increased property values.

- *The Impact of Microclimates*

- Climate may play a role in the differing densities of trees throughout Bogotá. The south and west of the city, the regions where most of the lower *estrato* neighborhoods are found, are significantly drier than the wealthy north and east.

## WHY THE GREEN DIVIDE REQUIRES ACTION

The green divide in Bogotá is undeniable. It is easy to see that the environmental and other benefits of trees are missing from poor neighborhoods in Bogotá. But why should action be taken to ameliorate this situation?

- *Colombian Law*

- According to the revised Colombian constitution of 1991, every Colombian is guaranteed the right to public space. This public space by Bogotá city government definition includes sidewalks with trees.

- *Environmental Justice*

- Environmental justice requires that there be an equitable distribution across all groups in a city of the benefits of environmentally beneficial resources. It also requires that people in all communities within the city are involved in decision-making processes in a fair way and that ultimately all communities within the city can function well and flourish in their environment.<sup>21</sup>

## CONCLUSION

The hurdles to a green future for much of Bogotá are high. The bulk of the city's population lives in structurally deficient neighborhoods where sidewalks are very narrow or nonexistent and there is no space at all for trees. The tree survey demonstrates that the poorest neighborhoods have no street trees at all. This has been caused by decades of informal development by the private sector, spawned by massive inward migration under the neglectful watch of a local government without the resources, capabilities or will to manage it. These poor settlements

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<sup>21</sup> Cutter 112-113

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stand in sharp contrast to the neighborhoods in wealthier parts of Bogotá, where tree-lined streets with wide sidewalks are the norm, and where well-tended parks are ubiquitous.

Colombian law and environmental justice demand that this inequality in green space and environmental health be addressed and the framework of environmental justice offers one of the most effective means by which poor local communities can organize and demand their fair share of quality public space.

A rebalancing of the tree population in Bogotá's streets will require strong and effective government and a commitment to focus on the streets that dominate the lives of more than half the population of this city. This will also require a commitment to public educational campaigns to change attitudes toward trees.

There are encouraging signs that more trees are being planted in many of the poorer localities of Bogotá (although not usually on the streets), and in the course of this study dozens of dedicated professionals in government, the private sector, and in the informal settlements have been encountered who are working for change. Yet as this is a country (and city) with among the highest levels of inequality in the world, change will come very slowly to the poorest localities and probably only as quickly as changes to the overall inequity in the society. This inequality, coupled with the ongoing mass inward migration and ineffective government, will present the city and its poorer neighborhoods with environmental quality challenges for a long time to come.

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