CHAPTER 3: DISTRIBUTION OF GREEN AREAS IN CITIES

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3.1. Introduction

Climate change is one of the main problems affecting the entire planet, and there seems to be no end to it in sight, as it is produced mainly by human activity (Aguilar, 2020). Among its causes is the trend towards urbanization of surfaces, due to the development of cities to meet the needs of the population. Urban areas are so large and diverse that it is expected that by 2050, more than 70% of the population will be living in cities (Habitat, 2016).

The poor planning of cities due to the rapid increase in population and the criteria of urban planners about the importance of green areas have led to the loss of large natural areas despite the fact that green areas are the lungs of cities and encourage community integration (MacHarg, 2000). With this growth, environmental, social and economic issues may arise, such as overcrowding, stress, air pollution, noise and various health problems, so green areas appear as a balance between the city and nature. Among the most prominent experts on this subject are Ebenezer Howard, who between 1903 and 1920 built the first garden cities; Frederick Law Olmsted, who developed open spaces such as Central Park around 1910. These works were the starting point from which concepts related to green areas, planning and distribution were developed, such as sustainable design and urban ecology, which guarantees a better quality of life for the community by reducing the pollution that is a natural element of cities.

In cities, we are faced with artificial environments that are inefficient in handling their components and products. An example is the high parameters that are observed when analyzing air quality, such as NOx, SO4, CO2, noise or temperature, all of them the result of poor management of cities in terms of growth, organization, mobility and public space (Rivers, 2015).

The 2018 Paris Agreement reached the conclusion that it is necessary to reduce global temperature as a way of mitigating the impact resulting from human activities. This translates into the way cities develop from the world's various policies tailored to their local needs. Likewise, this means that many cities in the world are working on plans to mitigate environmental pollution while others are working on plans to adapt to climate change, without this meaning that one should follow the other or that they are independent, and both agree that green areas in cities must be included, improved, and adapted (Reckien, 2018).

When cities are planned, they often are from developmental approaches for urban growth. These spaces are often assigned in an organized way and the growth occurs within the plans of the urban planners. In other cases, a city's growth follows the needs of the community, normally settling in risk areas or in areas close to production sites, whether commercial or industrial, in order to be close to sources of work. This increases the need for living space, and also reduces green areas for these communities.

Within cities, green areas can be understood as representations of nature in the middle of the urban setting, where people find recreation, relaxation, meditation or a connection with nature, preventing it from becoming a strange element with which they have no relationship. Without this contact, people develop a distorted sense of nature, under the false belief that it is a shared and inexhaustible resource (Oliveira, 1996).

In the development and growth of cities through territorial planning, a portion of the space must be assigned for green areas. However, the rapid and disorderly growth of many cities in the world, particularly in Latin America, has resulted in these spaces not being respected, amid pressure and competition for habitability. A clear example is Ecuador, where only 10% of housing developments is dedicated to green areas. This is low in relation to the needs of the community, especially if we consider that green areas are used by urban planners for other purposes but are still considered as such (COOTAD, 2019).

The purpose of this work is to understand how the green infrastructure is integrated into the gray matrix. Knowing the forms of growth of the cities and how they distribute green areas allows us to suggest alternatives for integrating green areas within the spaces already consolidated.

3.2. Cities

Cities are structured around three axes: 1. the road network, which changes according to mobility needs, tending to favor vehicular traffic over pedestrians or alternative means of transport, thus increasingly reducing the width of sidewalks or reducing mass transportation; 2. housing units that, depending on the characteristics of population density can be dispersed or mega structures; and 3. public spaces where, according to the needs of the community, they are considered spaces for cultural exchange or sports, rather than for contact with nature (Hermida, 2015; Cortes, 2015). This is where the urban green areas stand out, as they are considered spaces for the conservation of the natural forestry of the area, although many consider them merely landscapes and introduce foreign species to the area, which can cause damage to the land and economic loss.

However, men have built cities for their benefit. Whilst being completely artificial, however, they are "living entities", where everything within them is constantly modified according to the needs or requirements of the environment. The dimensions of this exchange are produced based on the city's size and population density, which in turn determines the levels

and quality of life of that population based on elements such as the environment, public health, urban economy and innovation, producing an inclusive society that results in the growth and development of cities (Maldonado, 2012; Scorza, 2021).

Although cities are considered ecosystems, their functioning is rather atypical, since it produces a series of elements that are not considered when studying natural ecosystems. These elements, all products of human activities, affect their quality of life (Vergara-Romero & Moreno Silva, 2019). Green areas offer the opportunity to improve people's quality of life by offering places to connect with nature, as community and recreational alternatives. In addition, it offers a space for urban biodiversity that is enriched by the presence of species from the surrounding ecosystems, which increases the variety outside of the domesticated species humans keep as pets, and lowers the concentration of greenhouse gasses, captures carbon, and reduces temperature and noise (Liordos, 2021).

The social parameters are those that mark the development of cities in terms of expansion, infrastructure, superstructure, movement, among others. There is a tendency towards two types of city growth: 1. compact, or those that, in a single area, group together all the services people enjoy, reducing the need for mobility, but have a negative effect at the economic level as they are densely populated; and 2. Dispersed, or those that tend to spread in an area with low population density and a high demand for resources. In neither case is the effect and weight on the natural systems that surround it considered (Artuduanga, 2017).

3.2.1. The development of the city

Cities are developing in favor of commercial, industrial, cultural, economic and housing purposes. This development forms poles that become increasingly unsustainable due to space and demand for resources, especially in Latin American cities, where the community and its characteristics favor small cities over mega structures that optimize land use (see table 1). Many times, these forms of growth are copied from other places in the world where there's little respect for the community's traditional lifestyle, the area's climate (which could have effects on the forms of mobility), energy management and consumption, distribution of public space, among others (Cortes, 2015; Hanclova et al., 2021: Schlack, 2007).

Table 1.

City development approaches

TYPE	MAIN FEATURE	POSITIVE ASPECTS	NEGATIVE ASPECTS	URBAN GREEN AREAS
Authoritarian	Government and public interests.	Management of basic services and high-concentration infrastructure.	Population overcrowding, unplanned settlements in risk areas.	The minimum, less than 10%, without conservation of natural resources.
Developmental	Centralized in concentric axes with horizontal and vertical growth.	Organized by zones. The inner zone brings together the social and political areas, the economic strip surrounds it, along with small living spaces.	Irregular settlements used primarily for sleeping and exclusive residential areas.	Conservation of natural resources near the urban areas, reducing pressure on resources and reducing imports.
Neoliberal	Economic interests, with industrial poles.	Concentration of housing with horizontal growth, areas far from residential areas.	Low coverage of basic services, mono-structured growth.	Green areas not prioritized as they are not productive, and areas for productive services or businesses are prioritized.

Sustainable	Based on quality of life in balance with natural resources in a lasting way.	Planned with consideration for the environment, communication routes, sources of employment, land use, recreation areas; all within sustainable parameters.	Reduced mobility, losses, vertical growth.	Green areas are developed for public use and as a source of conservation, linking the city with external natural areas.

Source: Cortes (2015) y Scchlack (2007).

These approaches determine the direction in which the city grows. However, they do not determine the way in which the movement of people is supported, which follows industrial and commercial growth, and thus contributes to the development of irregular settlements, as regular ones are financially unattainable. This can be seen in the organization of the city's growth when the spaces are planned, the community has the opportunity to have all the elements that could guarantee a good quality of life. When the city's growth is unplanned, conditions hampering the community's quality of life appear (Ramos-Leal et al., 2021).

3.2.2. Disorganized cities and their unconsolidated growth

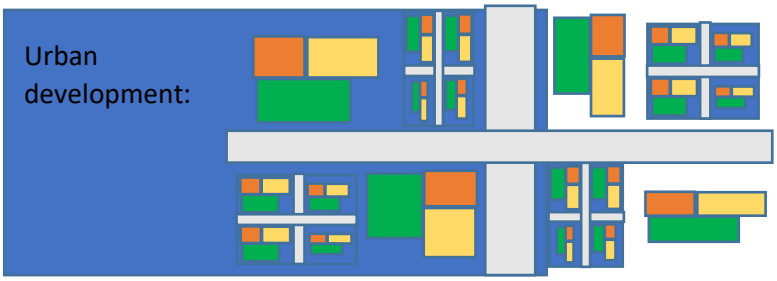
The shape of the growing city is based on the change in land use towards activities other than those of conservation and agricultural production, such as industrial or service areas. When these areas start to grow, areas that do not make any kind of profit are reduced. This is how a city grows by absorbing other small communities, increasing their population and putting pressure on the surrounding ecosystems.

When cities have proper planning and territorial organization, communities have access to all resources and services, making it unnecessary to leave their usual areas. Here, the space for the development of the community is promoted as a unit, prioritizing pedestrianization over vehicular movement, with the appearance of super blocks and an equitable distribution of spaces for cultural development and green integration areas. This contrasts the

environmental challenges that arise with cities, bringing innumerable benefits such as good air quality, climate regulation, absorption of pollutants, among others, which will overcompensate the negative effects that green areas have in the city. One of these negative effects is that these areas are usually not equally distributed, which promotes environmental inequalities (Rueda, 2011; Hérivaux, 2021; Vergara-Romero, 2021).

Figure 1.

Organized growth scheme.



Super blocks as a way of organized growth.

Source: Rueda (2011) y Hérivaux (2021).

As we can see in Figure 1, cultural spaces are integrated with green areas or spaces for physical activities. If alternative forms of transport such bicycles or walking are added to this scheme, residents could experience a healthier environment within a city.

On the other hand, when a city's growth is disorganized, as they move away from the development poles, irregular zones appear for low-income citizens with few green areas due to the need for habitable space.

Figure 2.

Disorderly growth scheme.

Disorderly urban development.

As can be seen in Figure 2, habitable areas are prioritized, which creates inconveniences affecting the quality of life of people, mostly in terms of mobility. Also, the distribution of green areas does not allow for people to have spaces to meet and enjoy communal activities, which is an important part of community life. These settlements are usually found in marginal areas, which affects ther natural peri-urban areas, interrupting connectivity. To reduce these obstacles, it is important to incorporate green areas into the urban environment.

3.3. The incorporation of the Green areas

One of the most important parts in a city's development is in the incorporation of green areas. This is often considered in the planning stages for organized sectors and overlooked for unorganized sites. (Is any surface that has at least five square meters considered as green area?) Urban forestry pertains to the trees found on the sidewalks (Carvalho, 2017).

For the planning of cities, three levels are taken into account: 1. the underground, or all those who manage urban services; 2. surface, or water, landscape, biodiversity, use of public space; and 3. elevated, where habitability, energy, mobility are considered, generating spatial segmentation and changes in class structures based on social guidelines. The integration of green areas has been an issue at the surface and elevated levels, due to how limited they are in urban areas in terms of size and distance, and therefore unable to meet the growing demands of residents to interact with nature (Rueda, 2011; Zhang, 2021).

Without the integration of green areas, the community and the city lose their sense of unity. In the case of consolidated spaces, the integration of green areas is difficult because human beings cannot be displaced from their dwellings in order to develop an area that would improve the quality of life of those who will remain. But in areas that are in development and growing unconsolidated, the necessary changes can be made in order to guarantee the presence of sufficient green areas for the community.

The green areas that should be integrated into the development of the city, for the benefit of the community, are described below, classified into three large groups which, properly managed, can lead to other types of solutions that benefit not only the community but also urban and peri-urban diversity associated with mitigation or adaptation plans, according to the development policies of each region.

3.3.1. Superstructures

Superstructures can serve as representative areas of the surrounding ecosystems of the city and allow resting, feeding and protection sites for urban fauna. They are usually medium to large in size and are within accessible distances for the community both on foot and by other means of transportation. They are usually called urban parks, community parks, plazas and squares, linear parks, playgrounds or gardens (Hermida, 2015; Farinon, 2020).

Figure 3 shows an example of a green superstructure in the city of Guayaquil. This shows us the richness and flora diversity a city can host if the planning is handled in an organized manner. Note that most of the vegetation is introduced without taking into account native or endemic species, which could grow even further and connect with other surrounding green areas.

Figure 3.

Example of Green superstructure in Guayaquil

Normally, the design of superstructures takes into account landscape criteria, or parameters established for the exclusive use of green and communal areas. This allows for the appearance of communal spaces in new housing plans that are accounted for as green areas, but do not comply with transforming the area for human use. However, they have a function that is related to some type of activity carried out by the people. These superstructures contribute to the reduction of dust, temperature, noise and filtration of pollutants, which has a positive effect on climate change.

These superstructure-type areas can comprise the bulk of the city's development. However, it should be emphasized that all of these must be connected to each other in some way, as well as with the natural spaces that surround the urban area, reducing the environmental impact resulting from anthropogenic activities.

3.3.2. Infraestructure

Infrastructures can serve as interconnection areas between the ecosystems that surround populated areas and the green superstructures inside the city, turning them from isolated spaces into a whole with the environment. They are not traditionally used by humans, normally going unnoticed (see figure 4). Examples of infrastructures are flowerbeds, roundabouts, tree-lined avenues and pathways, cycle paths, panoramic routes and trees planted on the sidewalks (Ramírez, 2016; Horváthová, 2021).

Figure 4.

Green infrastructure in Guayaquil.

An example of what is considered green infrastructure can be seen in Figure 4, in the urban road of the city of Guayaquil. Note the presence of vegetation accompanied by landscape structures; This plant diversity found here is not always native, which is what should be promoted, but rather meets the criteria of urban planners.

These areas comprise part of the city's growth and architectural style while also fulfilling landscape development by complementing what is found in traditional green areas. They mitigate the harmful effects of the gray area, they serve as a link between the green areas inside the city when they are well distributed, and if they have the right flora they can contribute to climate change.

3.3.3. Transition areas

Transition areas connect the vegetation inside cities with the natural areas that surround them. They are usually found on the outskirts, as protection and conservation areas. They are negatively affected by man-made projects in rural areas, such as nurseries, plantations, agricultural plots, national parks, nature reserves, protective forests, recreation areas, fauna or flora production areas, fragile areas and conservation zones (see figure 5).

Figure 5.

Transition áreas in Guayaquil.

In short, green structures within a city can be grouped in various categories according to the city's needs for growth, and can be superstructures, infrastructures and transition areas. What's interesting about them is that, by connecting them to the natural areas that surround the city (and thus favor urban biodiversity), reinforces the sense of community and mitigates the effects of climate change.

3.4. Alternatives for cities with consolidated disorderly growth

Cities that have disorderly growth or that are developed irregularly do not have the elements that guarantee the quality of life of the community or the tools to face current environmental challenges. In these cases, the pressure for habitable areas exceeds the demand for green areas that can unify the community.

When talking about locating a green area, we can analyze certain parameters, such as diversity, landscape integration, lighting, accessibility, security, activities it allows, infrastructure, environmental contribution (shade, CO 2 capture, oxygen levels, noise reduction, visual pollution, and more. (Rivers, 2015). This is easy to do in organized cities, but it's more complicated in irregular areas, especially when they are already consolidated areas:

3.4.1. Vertical gardens

Figure 6.

Trabsition áreas in Guayaquil.

Vertical gardens are walls turned into gardens. This is a way to turn spaces into green areas. Among the most common are hydroponic systems and green walls. They purify the air, reduce and regulate temperature and promote biodiversity in the city (see figure 6).

3.4.2. Green roofs

These are roofs of buildings that are partially or totally covered with vegetation. They help mitigate carbon emissions, reduce heat island effect and noise, since they also act as acoustic insulation. They can be classified as intensive, semi-intensive and extensive (see figure 7).

Figura 7.

Áreas de transición en Guayaquil.

3.4.3. Green corridors

Green corridors are strips with abundant vegetation that joins outstanding natural areas of the city, increasing the amount of green areas offered to the citizens. They increase biodiversity, help mitigate heat island effect and prioritize both pedestrians and vegetation (thereby reducing noise and pollution). Balconies, windows, roof terraces, patios or dividing walls can be used in order to increase vegetation (Parodi, 2013; Liordos, 2021).

These alternatives are compatible with the environmental and social challenges that arise in cities. Elements of the natural landscape, such as natural watercourses or disused train tracks, among others, can be transformed into corridors through restoration or construction processes, which also leads to an increase in the value of the assets and properties in nearby areas, which benefits the economy (Jiménez, 2013; Li, 2021).

They are multipurpose and multifunctional, as they can also have use in sports, culture, recreation, aesthetics and more. They are oriented towards sustainable development, acting both as biodiversity protectors and a socioeconomic boost. They favor movement, flow and exchange, and also connect landscape elements at different scales (Espinel, 2021).

These are some of the most renown green corridors:

- Manhattan Waterfront Greenway (New York): 51.4 kilometers in length around the island of Manhattan. Today, it has three distinct parts: Hudson River, East River, and Harlem River.
- Parque Lineal Ferrocarril de Cuernavaca (Mexico City): 4.5 kilometers. Contributes to the balance between economic development, heritage preservation and sustainability
- Cheonggyecheon (Seoul): Linear Park of over 400 hectares that managed to lower the average temperature of the area by 3.6 ºC.

In many cases, green corridors are a solution for fragmented cities attempting sustainable development, urban ecology, connection of urban parks with roads, urban forestry, transition areas, gardens and green roofs; they increase the density of species, connect human beings with their natural environment, increase the benefits of natural areas in the city, favor urban biodiversity. In some cases, they can even be used to delimit a city, or as a way to integrate unused spaces. They contribute to use of alternative means of transport and favor many types of activities.

3.5. Conclusions

The growth of cities can affect the implementation of green areas according to the criteria with which the city is developed. It should be noted that development can invariably attract the community outside the planned areas and that these disorderly settlements can bring an increase in the distribution of resources, land use and basic services. They can also affect the transition areas in urban environments or risk areas.

It is important to take into account the organized, disorganized, compact, dispersed, developmental, neoliberal, sustainable city models; the types of displacement (including floating population), mobility with all its alternatives, cultural, sports, meditative recreation and population without forgetting or underestimating the area's climatic, ecosystemic and adaptive characteristics; ecosystemic services that green areas should have, alternatives of size, distribution and connection that promote a union between natural areas and urban green areas.

Regardless of the objective for which green areas in cities are planned, they will vary according to the policies of each region, and the needs of the community or the city, so the planning and development strategies of cities must be improved in order to overcome the

current environmental challenges. Alternatives for irregular areas with little planning can help improve the quality of life of these communities by reducing environmental inequalities, thus reinforcing the sense of community.

Cities, as a result of the activities carried out inside them, require a structure with connected green areas in order to to balance the increase in temperature, reduce runoff in the rainy season, and recover the symbiotic relationship with the natural landscape, which allows the flow of urban biodiversity and human beings. It is important to point out that this is the building block of progress and development that focuses on the objective and subjective well-being of territorial planning, taking into account that public policies are oriented to the delimited geographical space that integrates cities and it responds to particular characteristics of said territory.

One of the solutions that are presented as an alternative to the environmental problems arising from urbanization are green corridors, which lead to interconnection of urban green areas of different types, including spaces that have fallen into disuse due to the changes inherent to the city's growth, which would give added value to forgotten spaces, and improve the quality of life of nearby areas. All these elements are being studied in landscape ecology, in order to improve the aesthetics of urban spaces.

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