

Nature: the Substrate of Urban Landscape - Proposal for an Index of Connections between Cities and Nature

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Abstract: In the context of functional interest in natural systems in cities, this article suggests adopting a landscape-based perspective approach and analysis. The objective of this paper is to recognize the role of nature as the foundation and framework of the urban landscape. To achieve this goal, we propose the Index of Connections between Cities and Nature (ICCN), which compares the potential of the natural-landscape substrate with its actual utilization during the urban experience. The ICCN is implemented in nine cities around the world, and the results are analyzed. Finally, we provide assistance to individuals who aspire to restore the natural foundations of their cities to increase efficiency, pleasure, and genuineness, using Medellín as an instance.

Key words: urban nature; urban experience; landscape perception; cities; nature; urban landscape

If there is anything eternal in a city... it is the existence of geographical elements, as an inseparable connection between the city and nature. Geographical elements contain explanations of the city origin, or the same thing, which constitutes the root of urban events.

Carlos Mattie Aris (2001)

1. The Meaning of Nature in Cities

Nature is the foundation of a city. Reflecting on its significance means approaching the determination of the origins of the first batch of settlements and understanding the process of defining their growth forms.

Geoffrey and Susan Jellicoe, in their book *The Landscape of Man*, review the processes of adaptation of civilization from 8000 B.C. to the present day. They state that the establishment of human beings was conditioned by geography and climate. They state that from 2000 B.C. onwards, there was a significant change on the surface of the earth "forests began to be cleared and the scenery gradually changed from natural to artificial" [1].

Thus, cultural landscapes arise as a result of the transformation of the natural landscape in search of adaptation, by modifying it with crops and food production processes; by exploiting its resources, or by building roads, dams, mining works and concentrations of buildings in settlements that we call cities. The latter constitute the human work with the greatest impact on the natural landscape, since they are the overall product of human creativity and construction

capabilities [2]. Gloria Aponte states:

[...] on a natural landscape that has initially shaped the character of its inhabitants, they intervene, modify and recompose the place with a fusion of their own and others' needs, aspirations, desires and experiences. In a random composition, their new appearance, or rather, their new landscape, will shape the character of the next generation...[3].

The city emerges and transforms the natural landscape where it settles, often ignoring its effects in functional terms and disregarding the loss of cultural values linked to its natural environment. As Lynch states, many cities are of evidently poor urban quality and this is mainly due to the fact that their exploitation and expansion processes overlook the diminution of their own natural landscape and its consequences [4].

The loss of cultural values is also related to the transformation of "reference" landscapes, which are increasingly distant from real landscapes, "they are becoming less "real" and more exceptional... because never before in recent decades have we witnessed such radical territorial and landscape transformations, which are rapidly changing the collective images, and in many cases without individual awareness of these changes"...[5].

To recognize nature as the basis of the city is also to value its support to the identity of citizens. In this regard, Aponte states that "the perception, appreciation, analysis and knowledge of the nature of places play fundamental roles in the realization of an identity, since it is necessary to know and understand one's own environment in order to appropriate it and finally identify with it [6]. This is also expressed in the European Landscape Convention, which states that "landscape contributes to the formation of local cultures and is a fundamental component of natural and cultural heritage, contributing to the well-being of human beings and to the consolidation of identity" [7].

Some of the sensations or preferences of human beings towards nature are related by Gómez, based on Edward O. Wilson, in the following ways: the taste for scattered patterns of trees with a wide and welcoming crown, the feeling of well-being/security experienced in front of clean water, the signs of productivity/fertility identified in it, among others, "all of them are beneficial aspects for perception, programmed in deep layers of our brain" [8]. In some cases, the aesthetic experience of nature also approaches the sublime, defined by Marchán [9], where as a beautiful and terrifying thing, one can perceive inexplicable, infinite, sacred, or hypersensitive things.

Lynch, in his book *Landscape Management*, proposes possible norms to increase citizen satisfaction with the urban landscape, as they value the natural components that underlie the city. The following stands out:

- The visibility of the natural processes at work.
- The availability of places to observe activities and people.
- The frequency with which water, plants, rocks, earth and large area of soil must be present.
- The preservation and enhancement of the existing relief and ecosystems.
- The right of groups and individuals to display symbols of their own values.

For this reason, it is necessary to harmonize the human-nature relationship, such as the "alliance strategies", or the "planetary garden" [10], among others, which mediate and soften the radical opposition between nature and artifice, promoting an "ecological aesthetics of nature" [11] or a humanist ecology, which, together with many other ideas, form an ideology that is no longer the minority thought of scientists, academics or intellectuals, but today's majority of thought. As Giraldo said in an interview, this is a speech for everyone and an ideology for everyone, where "we are starting to pay a lot of attention to species today regarding environmental and natural issues" [12] rather than individuals.

Recognizing nature in cities means understanding the initial reasons for their emergence and development. The urban form of the city is derived and structured from the natural processes of the place where it is located. Therefore, as Anne Whiston Spirn proposes, it is proposed to understand the "city as part of nature" [13] by finding the most profound

connection with human life and the entire organism [14].

2. Approach to a System for Analyzing the Link between Cities and Nature

The analysis of landscape responds to Madruello's call to "think about landscape" [15], to seek and develop analytical and comprehensive tools to understand its changes. Fihra stated that "in the landscape, everything has meaning" [16], and in order to achieve its content, it is necessary to separate from it and analyze and observe it.

There are two main approaches to landscape analysis: 1) the systemic and ecological vision and 2) perception, where visual quality takes precedence. The ecological perspective considers the landscape as a source of territory information; while the perceptual quality analyzes the aesthetics and the perception capacity of an observer from its different forms (auditory, visual, olfactory, tactile and gustatory) from a simplification process based on the image, which constitutes the process of abstraction and the basic tool for the various analyses [17]. As Campos states, "the image constitutes the fundamental instrument for reading a landscape, and the tool for proposing new models" [18]. It should be noted that the evaluation of the aesthetic appreciation of the landscape is complex and is conditioned by a high degree of subjectivity [19].

3. Methodology

In terms of this study, landscape potential and landscape (visual) quality were the main variables, and work was conducted from a perceptual perspective in a hybrid analysis system that directly evaluated representative subjectivity, followed by indirect comparison and subjective analysis of the natural potential and utilization of cities: [20]

- Direct method: direct assessment analysis with representative subjectivity of the urban landscape quality.
- Indirect method: comparative and subjective analysis of the potential and use of the nature components in cities [21]

The following categories of analysis are proposed:

- Visual quality of the landscape (CVP): integrated result of the quality of sensory stimuli, with greater incidence on visual stimuli.
- Landscape potential: understood as the possibility of an environment and its resources to increase its scenic quality and reception.
- Utilization: refers to the attitude and activity of society towards its landscape resources. Or, as Maderuelo puts it, "the landscape awareness" of society [22].

The objects of analysis are constituted by nine cities, selected from travel and research trips between 2006 and 2010, which, in their order of visit, are: Medellin, Bogota, Rio de Janeiro, Barcelona, Paris, Berlin, Barranquilla, New York and Chicago (fig. 1).

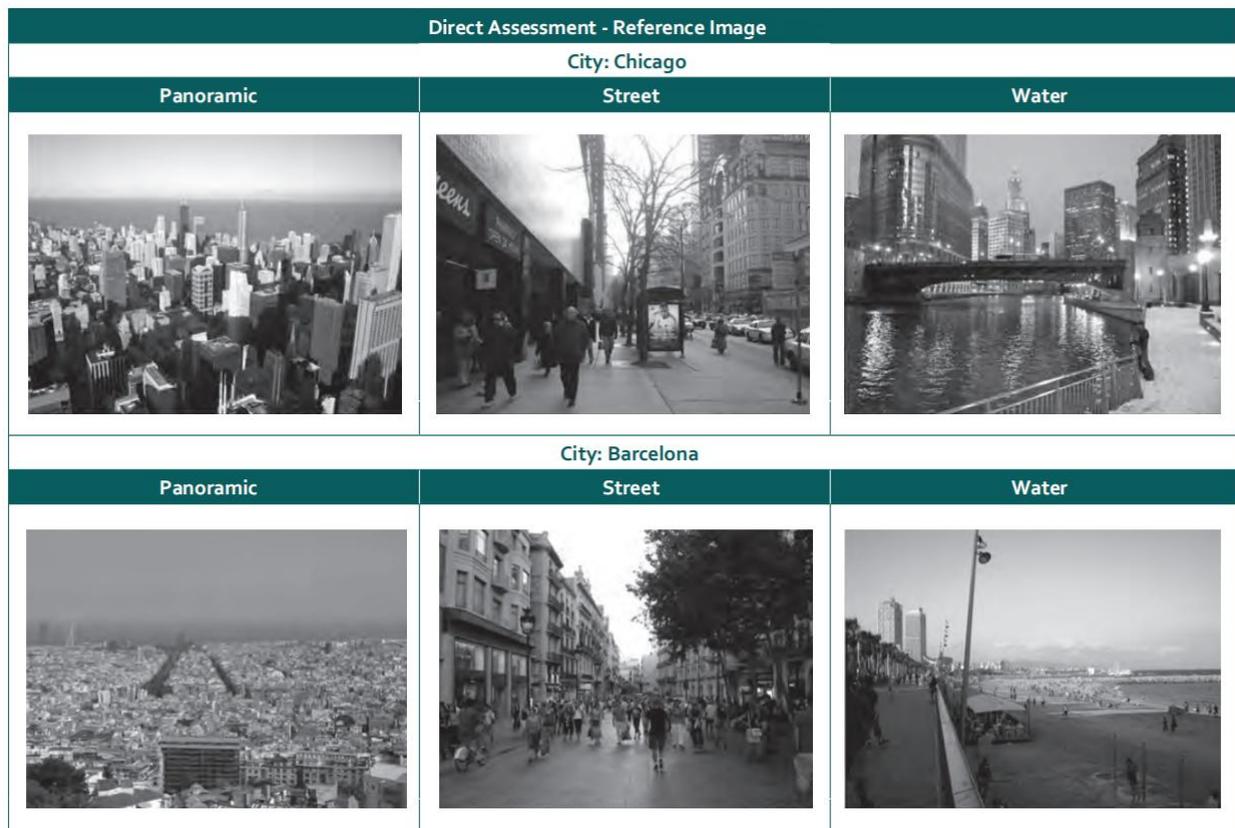


Figure 1. Reference images for the direct method for each city (panoramic, street and water).

Sources: panoramic: Google Earth; streets and water: Carlos David Montoya.

The primary sources of information came from visits and study trips to each city, using the "drift" observation technique [23], which are complemented and validated by secondary information and content analysis techniques. Likewise, a registry card was designed for the information organization of each of the cities, with images of field work, satellite images of location, general data, toponymy, climate and date of foundation [24].

4. Procedures

4.1 Direct method

For each of the nine cities, three scenes (fig. 1) were selected from the study tours and trips of one of the authors, and others, selected from secondary information, coinciding with the general perception of the same author during the visit. This selection defines, from the outset, a subjective framework for the analysis.

Eighteen adults (ten men and eight women), professionals (eight architects, six related to landscape architecture and natural sciences and four from independent planning or design professions), all residents of the city of Medellin and, for the most part, with some type of knowledge or experience in the selected cities, were consulted.

After a brief explanation of the exercise, each participant observed each of the images for ten seconds, and selected an adjective from the list [25], based on the proposal of Muñoz-Pedrerros [26]. The average time per participant for the elaboration of the test was fourteen minutes..

Subsequently, the equivalent values assigned to each adjective and the totals for each of the evaluators were summed. Table 1 ranked the cities by score, calculated the average quality of the urban landscape for each city, and plotted the results to identify general trends in the group.

Table 1. Indirect method: operational definition of variables and their numerical value

Category	Operational definition	Variables	Operational definition	Numerical value	Max.
Exploitation of landscape potential	Refers to the aspects that make it possible to recognize the natural landscape in cities	Air	Air quality	1 to 5, with 5 the best condition	5
		Relieve	Conservation and visibility of its geological form	1 to 5, with 5 the best condition	5
		Water	Conservation and visibility of naturally occurring surface water bodies	1 to 5, with 5 the best condition	5
		Vegetation	Exploiting the diversity of flora in the city area	1 to 5, with 5 the best condition	5
		Fauna	Exploiting the diversity of fauna in relation to the city area	1 to 5, with 5 the best condition	5
Total					25
Percentage of potential use of the natural landscape					100

4.2 Indirect method

Initially, the landscape potential of each component of the natural landscape was assessed. The components considered were topography, climate, water (from the abiotic), vegetation and fauna (from the biotic), each with equal weight in the evaluation. The anthropic or built component (land use, settlements, infrastructure, architecture, population, among others) was excluded, given the purpose of the research. Next, the use of the natural landscape components was evaluated, as observed in each city.

The information on each city's potential and use was then cross-checked to produce a comparative table, the Index of Cities' Link to Nature (IVCN), which recognizes, compares and classifies the quality of natural resources in each city. Finally, the results of the direct and indirect methods were cross-checked, analyzing the contribution of nature to the quality of the urban landscape of the cities.

5. Results

Initially, the results of the direct method are presented, followed by the results of the indirect method, and finally by the crossing of both results.

5.1 Results of the direct method

Table 2 presents the results of the direct method in the nine cities assessed.

Table 2. Direct method: results in percentage of satisfaction

Position	City	Adjective equivalence	Visual quality percentage
1	Paris	Beautiful	43.2
2	Rio de Janeiro	Beautiful	38.0
3	New York	Stimulating	34.7
4	Barcelona	Variable	30.0
5	Berlin	Variable	29.5
6	Chicago	Variable	28.0
7	Medellin	Pleasant	19.3
8	Bogota	Pleasant	16.3
9	Barranquilla	Regular	12.0

Paris receives the highest score, with 43.2 % for its visual quality of the landscape, followed by Rio de Janeiro and New York, with 38 % and 34.7 %, respectively. The three Colombian cities occupy the last positions, with Barranquilla obtaining the lowest percentage (12 %). It is noteworthy that none of the cities evaluated exceeded 50 % in the assessment of the visual quality of the landscape, which is significant in terms of observers' expectations of the urban landscape. In the future, it is proposed to apply the analysis to natural landscapes and to verify whether in these cases the collective assessment of visual quality exceeds 50 %.

Medellin ranked seventh, with a percentage of 19.3 %, and with the equivalent adjective: "pleasant". It should be noted that for several respondents the exercise revealed a lower level of quality than expected as a result of comparison with urban landscapes.

Respondents were asked to take the image as a bridge to retrieve the experience in cases where they had visited the cities at some point, or also as a link to a previous memory or interpretation. Therefore, the evaluation is not strictly based on the composition of the image presented, but rather on the perception of the place, and it is possible that this circumstance contributes to Paris being placed in first place, given its diffusion and offer as the world's leading tourist city.

5.2 Results of the indirect method

Fig. 2 presents the results of the analysis of the natural components for each of the cities, with equal weighting. Berlin is highlighted as the city where the potential of each natural element is fully exploited.

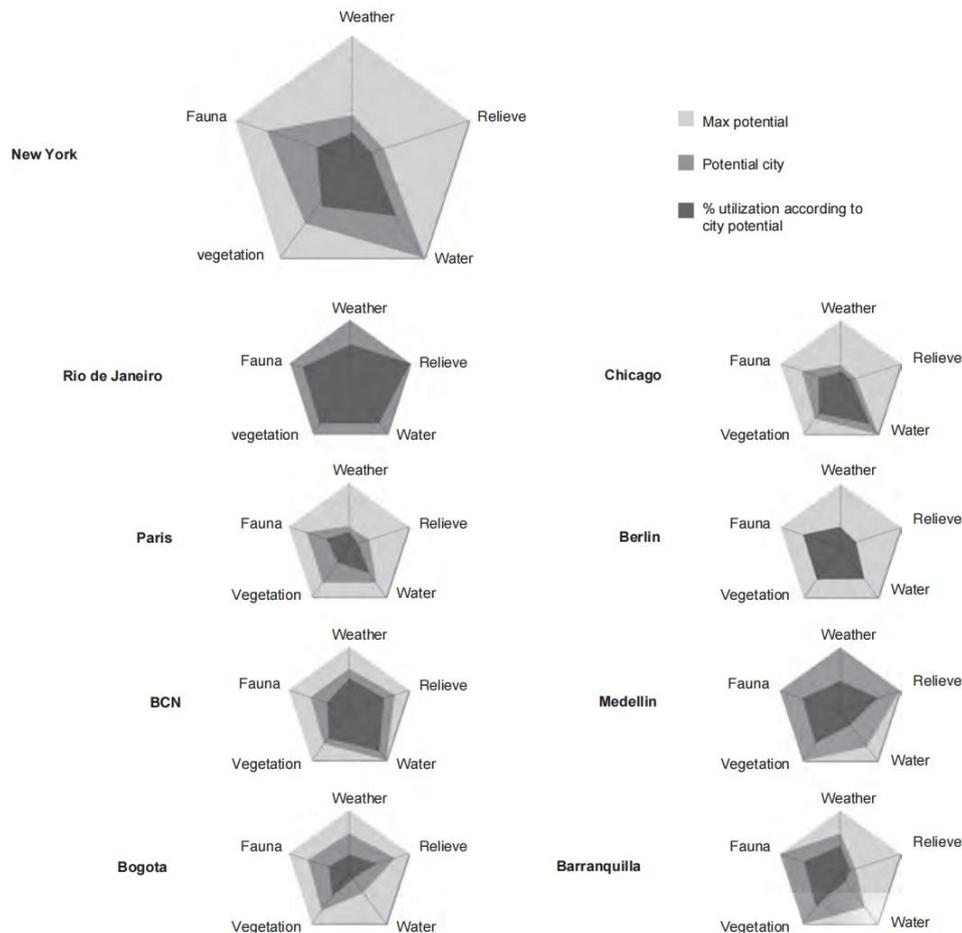


Figure 2. Indirect method: comparison of the potential (light green) with the use (dark green) of natural elements for each city analyzed.

Fig. 3 presents the consolidated results of the natural substrate potential for each city [27]. It shows that Rio de Janeiro, Medellin and Barcelona stand out for their high potential, while Berlin and Paris are rated as having low potential.

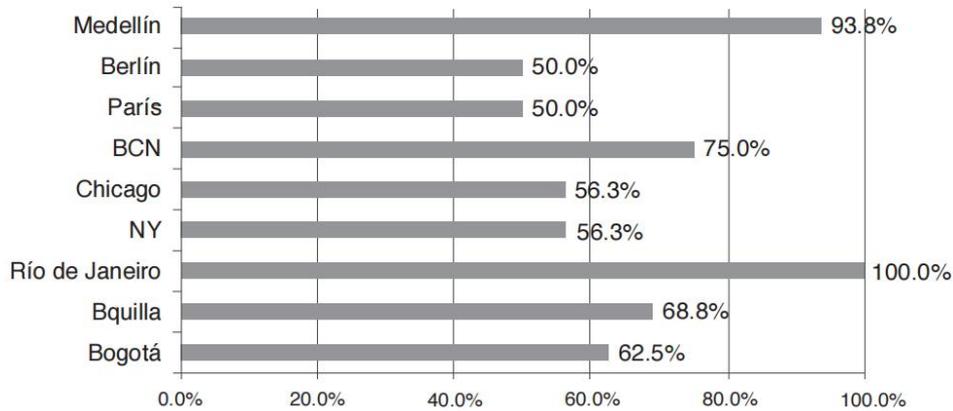


Figure 3. Indirect method: potential percentage of natural substrate per city.

Fig. 4 shows the consolidated results of the use of nature in each city [28]. Berlin stands out above the other cities as the one with the highest level, followed by Rio de Janeiro, Barcelona and Chicago; while cities such as Bogota, Barranquilla and Medellin reflect a low percentage of use of their natural resources.

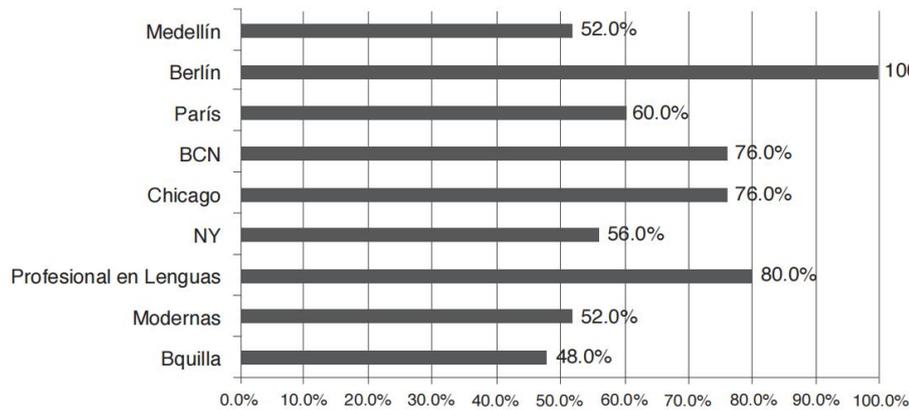


Figure 4. Indirect method: percentage of natural potential utilization per city.

Fig. 5 shows the results of utilization in relation to the potential of each city [29]. In this result, Berlin again stands out, although it exploits 100 % of its potential, in the total performance score it is below Rio de Janeiro, which exploits 80 % of its potential.

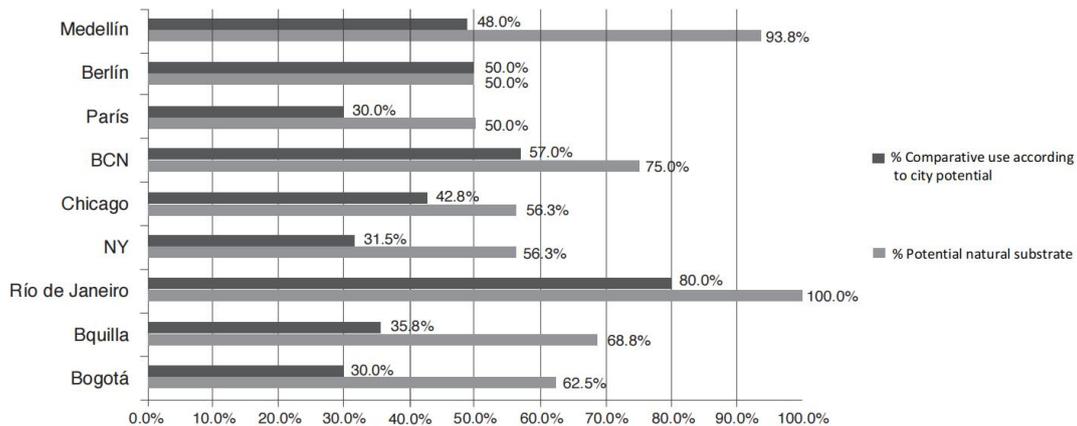


Figure 5. Indirect method: comparative use and potential of the natural substrate by city.

The results of the proposed IVCN are presented below for each of the cities according to their natural substrate potential and its use. For each city, a classification category is also defined according to the resulting index (table 3).

Table 3. Indirect method: results of the Linking Cities to Nature Index

Position	City	IPN	Category
1	Rio de Janeiro	0.80	Excellent
2	Barcelona	0.57	Optimum
3	Berlin	0.50	Optimum
4	Medellin	0.49	Good
5	Chicago	0.43	Good
6	Barranquilla	0.36	Regular
7	New York	0.32	Regular
8	Paris	0.30	Regular
9	Bogota	0.30	Regular

Rio de Janeiro stands out above the other cities with an index of 0.80 (although it did not reach the highest score of 1). Barcelona is 23 points behind, with an index of 0.57. Bogota, New York, and Paris have the lowest levels, around 0.30 and 0.32 respectively. Medellin, on the other hand, is at a moderate level with an index of 0.49.

Fig. 5 also shows the distance between potential and use, which shows the range of opportunities for each city to increase its IVCN. Medellin stands out among the other cities, due to its greater possibility of improving its IVCN; therefore, the focus of its landscape management should be directed towards recovery and restoration strategies. Meanwhile, the city of Berlin, which is already at its maximum level (potential and use are at the same point), would do well to apply policies aimed at conservation and protection.

5.3 Results of the mixed method

Once the direct and indirect analysis methods had been applied, the cities were ordered according to the average of both results, as shown in fig. 6.

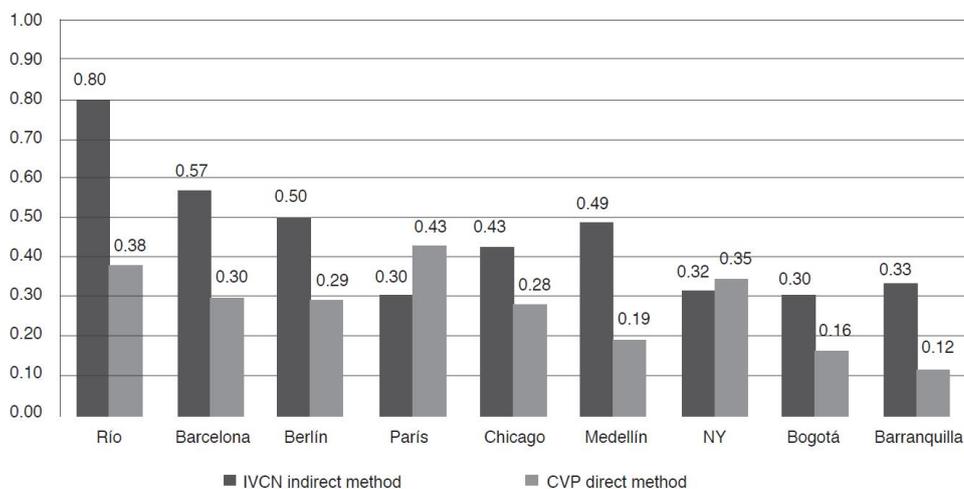


Figure 6. Mixed method: comparative results of direct and indirect methods.

The following is analyzed from the foregoing:

- Rio de Janeiro presents the greatest distance between the IVCN and the CVP level, which seems to question the effect of anthropic actions on the quality of the resulting urban landscape.
- Paris, on the contrary, is the only city in which the percentage of CVP exceeds its IVCN. In this case, it can be concluded that human intervention, rather than the potential and utilization of natural landscapes, has led to a good level of urban landscape.
- New York is also the only city in which the IVCN and the CVP coincide, which values the level of anthropic interventions, but leaves the use of its natural landscape in the medium-low range.
- Bogota and Barranquilla occupy the last positions in both analyses. This shows a low level of anthropic actions and a lack of use of the potential of its natural landscape.
- Medellin, on the other hand, has a medium-high IVCN, but its level of CVP is low. This suggests that, by increasing the use of its high natural potential, it will increase the IVCN, and this in turn will improve the level of quality of its urban landscape.

6. Discussion

During the research process, different concepts were identified around the human-nature relationship. It is emphasized that we are totally dependent on the natural environment, not only functionally, but also emotionally. Efforts to build an artificial world will always use nature and its resources as sustenance and food.

It was also revealed that our adaptation processes were transforming the environment, creatively altering it in search of greater benefits with the least possible effort. This process transformed natural landscapes into cultural landscapes, and from these emerged urban landscapes. Where roads crossed, human beings settled and built cities, the urban landscape emerged.

The urban landscape will therefore always be closely linked to the natural substratum from which it has emerged, and will be able to directly improve its quality to the extent that it increases the positive attitude towards it, recognizing and exploiting its inherent opportunities and limitations.

Taking Medellin City as an example, after a long transformation process of agriculture, mining, and urbanization expansion, the residents of the city live in a landscape that changes and alters the nature of their initial settlement. With growth, the current urban form is fragmented, which is not a necessary condition for the growth of metropolises as proposed by some authors, but a result of the natural background that supports it. On the other hand, this division can also be positively understood as diversity.

This is the IVCN proposed in this study as a tool for analyzing and comparing with other cities, which will enable leaders in urban planning and public management to have decision-making elements, enabling us to re-confront the natural substrate that supports the city.

In addition, it is concluded that Medellin and its metropolitan area can and should take advantage of the great natural potential they possess, integrating it into the urban landscape and recognizing it as the true structuring factor, since the system of analysis outlined shows that the general image of the urban landscape is not at a high level of quality, as it seems to be perceived before its comparison with other cities. In addition, the indirect analysis by component, which examines the potential and use of the natural substratum, found that Medellin surpasses many other cities in its potential, but is at a very low level of use.

Medellin, a city that has become a world reference, according to the awards it has received in recent years [30], still lacks true attention to its landscape quality. Perhaps, due to the abundant natural resources of which there is still evidence

in its urban landscape, the city has neglected to restore lost natural values, restore values that face imminent risks, and guide a comprehensive and landscape reconfiguration of all these values.

Important instruments in terms of diagnosis and planning, either from the environmental point of view: Management and Ordinance Plan of the Aburra River Basin, Integral Ordinance and Management Plans of the main streams; or from urban planning: Territorial Ordinance Plan still leave aside landscape values. Therefore, the research object of this article offers a well-founded orientation to involve landscape values in the configuration decisions of the city and, therefore, in its urban landscape (fig. 7).



Figure 7. Panoramic view of the city of Medellín. Source: Carlos David Montoya.

This confirms the action need to make the natural components of the city visible, recovered, restored, and reconfigured. Infrastructure, other built general systems, and all structured things can and must be reoriented to restore this natural substrate, thereby shifting towards cities where efficiency, democracy, and progress coexist harmoniously with their natural base; that is to say, without the support of the systems that shape the life of ecosystems, cities would not exist.

How gratifying it will be a future city that preserves and protects the values and meanings of the natural place where it is located, a city where its natural components are visible, close, accessible and represent, among many other resources, structure and signs of identity.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Note

- [1] Jellicoe, "El paisaje del hombre, la conformación del entorno desde la prehistoria". Pg. 11
- [2] Gastelumendi, *Arquitectura paisajista*.
- [3] Aponte, "Paisaje e identidad cultural" Pg. 155.
- [4] Lynch, *Administración del paisaje*.
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- [6] Aponte, "Paisaje e identidad cultural" Pg. 158.
- [7] Consejo de Europa, "Convenio Europeo del Paisaje" Pg 1.
- [8] Gómez, "La naturaleza en el paisaje" pg. 94.
- [9] Marchán, "La experiencia estética de la naturaleza".
- [10] Clément, *El jardinero trabaja para el futuro*.
- [11] Marchán, "La experiencia estética de la naturaleza" pg. 48.
- [12] Montoya, *Una conversación sobre el hombre, la naturaleza y la historia*, pg.70.

- [13] Whiston Spirn, The Granite Garden. Pg 4.
- [14] Lynch, Administración del paisaje.
- [15] Maderuelo, "Introducción: Pensar el paisaje" pg 5.
- [16] Delfina, "Paisaje natural, paisaje humanizado o simplemente paisaje" pg. 115.
- [17] Muñoz-Pedrerros, "La evaluación del paisaje".
- [18] Campos Reyes, "Del paisaje a la ciudad" pg 48.
- [19] Bosque et al., "Valoración de los aspectos visuales del paisaje".
- [20] Muñoz-Pedrerros, "La evaluación del paisaje".
- [21] En la memoria de investigación se presenta el procedimiento de análisis desde cada uno de los métodos.
- [22] Maderuelo, "Introducción: Pensar el paisaje".
- [23] Debord, "Teoría de la deriva".
- [24] En la memoria de la investigación se incluyen las fichas de registro para cada una de las ciudades, así como los soportes a las tablas y figuras que se presentan en adelante.
- [25] En la memoria de la investigación, se incluye el listado de adjetivos de referencia para la evaluación directa.
- [26] Muñoz-Pedrerros, "La evaluación del paisaje".
- [27] En la memoria de la investigación se pueden consultar los resultados del potencial paisajístico por cada una de las variables y por cada una de las ciudades.
- [28] En la memoria de la investigación se pueden consultar los resultados del aprovechamiento de la naturaleza por cada una de las variables y por cada una de las ciudades.
- [29] En la memoria de la investigación se pueden consultar los resultados del comparativo de potencial y aprovechamiento de la naturaleza por cada una de las ciudades.
- [30] Ciudad más Innovadora del Mundo, marzo de 2013. Premio Nobel a las ciudades Lee Kuan Yew a la Transformación Urbana, marzo de 2016. Premio Oscar de la Industria del Turismo, julio de 2016. Premio Liderazgo de Destino, mayo de 2017. Mejor Destino Turístico de Sudamérica, enero de 2018.