GREEN CITIES AND SUSTAINABLE DEVELOPMENT: METROPOLITAN SUSTAINABILITY INDICATORS IN LATIN AMERICA

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INTRODUCTION

Today, urban sustainability indicators have an increasing influence over territorial and environmental planning and management of cities in Latin America. Global initiatives such as the UN Millennium Development Goals, UN-Habitat and the Post-2015 Agenda for Sustainable Development Goals (SDG), among many others, have encouraged metropolitan governments to adopt or develop sustainability indexes. Concurrently, an abundant literature regarding applied public policy, filed under terms like *sustainable cities* (Rees & Wackernagel, 2007), *intelligent cities* (Marsal-Llacuna, *et al*., 2015; Valentine & Spangenberg, 2000) and *resilient cities* (Milman & Short, 2008; Brand, 2009), incorporate sustainability indicators as part of their reference frameworks –all of these focused on a city's sustainable management–. Furthermore, international initiatives like UN-Habitat recommend the inclusion of sustainability indicators in different intervention instruments such as Urban Observatories and the City Prosperity Index (UN-Habitat, 2013).

The more structured way to incorporate a set of sustainability indexes into the process of public policy is through a monitoring and assessment system adapted to the environmental problems of metropolitan areas (Shahidur & Koolwal, 2010). In spite of the global expansion of sustainability indicators and monitoring and assessment systems –like methodological and management instruments, potentially effective and sustainable for metropolitan areas–, not much has been explored in specialized literature regarding the process for selecting indicators itself and the properties of a good monitoring and assessment system should function like an urban observatory, with a better influence

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over the environmental policies of a metropolitan area –which sustainability problems are more complex–.

The present article examines the international tendencies in the process for selecting environmental indicators for metropolitan areas. First, based on the existing literature on the subject, it presents an examination of global good practices, criteria selection and sustainability indicators for metropolitan areas, emphasizing the design problems of public policy. In this section, and all through the article, the importance of environmental indicators is underlined as one of the three basic axes for sustainability (the other two being the social and the economical), under the context of metropolitan governance in Latin America. The discussion in the second section examines the main findings on selecting sustainability indicators, underlining ecological indicators and their context in relation to the more recurrent environmental problems among the metropolitan areas of Latin America. That is why the diagnoses and problems of the environmental situation of 12 Latin American cities with similar characteristics are exposed, using the Green City index, developed by *The Economist Intelligence Unit* in 2012, as reference.

The third section analyzes the specific environmental problematic in Mexico's Guadalajara Metropolitan Area (GMA), as well as the convenience of developing and selecting a group of sustainability indicators at a metropolitan scale, through instituting Urban Observatories as a platform for deliberating towards environmental governance, as suggested by UN-Habitat. A study of the GMA is developed, including a suggestion of sustainability indicators, based on international good practices on the matter, emphasizing the alignment with the Post-2015 Agenda and UN-Habitat (*Sustainable Development Solutions Network,* 2015; UN-Habitat, 2015). And lastly, in the fourth section, there is a draft for public policy alternatives for the possibility of introducing sustainability indicators, based on the prior definition of a government's strategic objectives, under the premise that the existence of indicators "in a vacuum", without considering a government's strategic objectives, will never become public policy. This article focuses on the environmental indicators that form an essential part of the triple dividend broader paradigm that also encompasses the economical and social aspects (Sachs, 2015).

Sustainability Indicators in Metropolitan Areas

How can you improve the sustainable development/environmental performance within metropolitan areas of Latin America, such as Guadalajara and Mexico City, through sustainability indicators? What are the adequate criteria for selecting and developing such indicators? And what tensions exist in the selection of management indicators and environmental performance in present

day cities? These are the three fundamental questions that must be answered when designing and implementing a sustainability index at a metropolitan scale.

A first precaution for using sustainability indicators in metropolitan areas is the use of internationally accepted ones, such as the Green City Index. Global experiences show preference in using sustainability indexes to measure environmental performance in an integrated manner at any given metropolitan area. Unlike other sustainability indicators, an index integrates the deliberation of multiple variables to measure sustainability in cities, in matters related to specific public policy objectives like prosperity, development, equity or resilience. In spite of the methodological advantages that indexes present, they do not capture the local diversity and heterogeneous nature that can be found on their level. Mori & Christodolou (2014) examined 14 international indexes for measuring sustainability in cities, concluding that the omissions that can be made in terms of sustainability and integration, under the triple dividend approach –environmental, social and economical– are significant.

The second aspect to assess preliminarily during the design stage is the bias on the creation of sustainability metropolitan indexes for contexts within developed countries, whether in their development or in their relative importance. One of the main reasons that explains such biases is the correlation between the income level and some variables related to environmental performance like, for example, education, deforestation or the emission of certain polluters.[1] Additionally, the economy's informal sector and its interactions within the social and environmental arena also play an important part in the causal map of sustainability indicators in the context of emerging or developing countries[2]. Kemmler and Spreng (2007) summarized this bias by pointing that, while developing countries center this discussion on environmental subjects, countries in transition give equal importance to equity and poverty topics. In fact, "topics related to sustainability have been attacked differently in different parts of the world, depending of the environmental and public policy priorities of cities and countries" (UN-Habitat, 2006). Because of these selection biases, there is a need to incorporate a barrage of indicators/indexes that control –or at least consider– the context differences between different types of countries.

1 In essence, Kuznet's curve expresses an inverted U-form that reflects the increment in the levels of pollution and/or environmental deterioration –measured through a standardized variable like, for example, the carbon dioxide emissions in relation to the increments in the levels of economic growth, which are usually measured through the GDP–. There is a turning point –that must be empirically estimated by country and by time period–, after which, according to this Russian economist, the inequity in income distribution, or the levels of environmental deterioration or pollution begin to fall. During the past decade, diverse articles have taken the task of proving the empirical validity of Kuznets's curve in spite of the skepticism that the relation between the inverted U stated on text books could an empirical reality (Stern, 2004).

2 For example, brick factories and burnt tires are a significant source of Greenhouse Gas emissions in metropolitan areas like Guadalajara and Mexico (SEMADET, 2015).

Finally, the third preliminary aspect to be considered when designing a system of sustainability indicators at a metropolitan scale is the source of *expertise input* that goes into the development of the indexes and indicators. In this realm, the debate is torn between *models guided by experts* vs. *models integrated by citizens*. Turcu (2012) suggests that the integration of both models would lead to establishing several levels of knowledge around the notion of sustainability, therefore implying a better way to assess it. If the model is completely "top-down", guided by experts and with very little social inclusion in its design and assessment, it can lead to implementation problems and not very effective results. On the other hand, the "bottom-up" approach –in some countries known as "the urban sustainability model"– is characterized by initiatives rooted in communities. Generally, once you have the urban sustainability indexes, a natural "top down" bias, they are ideally complemented with the population's perceptions regarding their immediate environmental surrounding, particularly when passing from a global to a local scale. However, Turcu (2012), analyzes 5 lists of urban sustainability indicators at a communal level, focused mainly on the United Kingdom and the United States, where the most accurate indexes are obtained –but not necessarily because they include local participation, which is why they must be constantly calibrated in their essence–.[3]

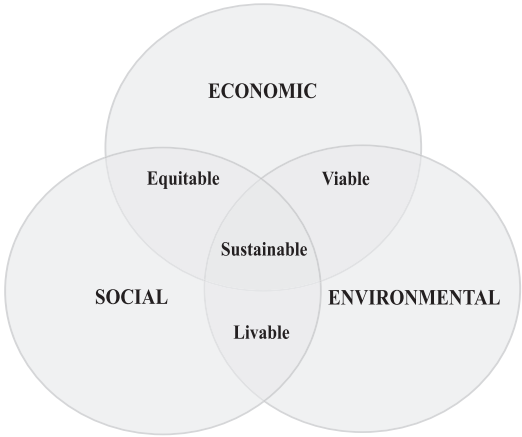
INTEGRATION OF INDICATOR SYSTEMS AND SELECTION CRITERIA

Most initiatives for metropolitan indicator systems foster adjusting a universe to a sample of indicators of convenient handling. But, in order for this process to be effective, one just doesn't take an indicator sample from the wide array of existing options, but a careful confection with a systematic approach. As Turcu points out, "the challenge lies not in the absence of indicators, but on the existence of so many of them and the question of how to achieve the better adjustment that is cost-effective in its handling, methodologically robust and socially inclusive in its perception and design to cover all the local differences that reflect the problematic at hand". Munier (2011) points that there is a practical difficulty in working with large number metrics. The goal is to achieve a manageable group of basic indicators that attack several different

3 *Securing the Future* is a list of 39 indicators for sustainable communities; the *Egan* list with 46 indicators for sustainable communities; *Housing Corporation Toolkit* a barrage of 49 indicators; *Four Capital's* a list of 18 indicators and the *Sustainable Seattle's* list of sustainability indicators. The sole definition of a better system of indicators is a matter of context and based on a "top down" model. However, this article holds that a selection of comparable indexes developed within the global discussion around the environmental problem within cities is a good complement, though not a substitue, for the local and participatory approach based on the context.

topic areas. Eventually, as long as the available information becomes more complete –which usually is not very realistic in the Latin American context, like we will see below–, a transition must be made, not only towards a selection of indicators, but towards the development of base lines, thresholds, values, goals and deliberation. Zvadskas *et al.* (2007) include the criterion of cost-efficiency in the selection of indicators. In a sense, the exercise of selecting sustainability indicators for a metropolitan area implies a cost-benefit logic, placing the marginal value of information above all, in order to reflect a specific environmental problematic.

Under the international comparative approach, the selection of the sustainability indicators, suggested by different initiatives, usually is also a problem. Tanguay *et al.* carried out a meta-evaluation of 17 validated and globally accepted studies with a total of 188 indicators of sustainable development to suggest a strategy for selecting sustainable development indicators under the *parsimony principle*, aiming to cover the sustainable development components and the categories that constitute them as widely as possible, while the number of retained indicators is minimized. The authors use the relative sustainability indicator frequencies that repeat the most in all 17 studies. This repetition is grouped in three categories that define sustainable development: economical, social and environmental. Subsequently, these are sub-classified in the integrated sub-dimensions of those three axes, though Venn diagrams.



Source: Tanguay, *et al.*, 2010[4]

4 As a starting point, with certain level of arbitrariness, to emphasize the indicators aforementioned falls on the environmental aspect of the diagram, looking for the intersection with the sustainable area. Naturally, any design intention in public policy sends a value judgment over which of the three groups –social, environmental or economical– must be left out, considering other variables such as local context or public election. However, for conceptual purposes, any of the three starting points accomplishes the goal for exposition purposes.

The main areas of intersection were on the "sustainable" (21.7%) and "fair" (30.4%) interfaces of the cases. The identification of frequencies in this field is not trivial if used as a resource for designing environmental public policies, since the concentration in the diagram could very well be an additional preliminary indicator regarding the marginalized sectors of socioeconomic and environmental politics that require greater attention.[5] All three categories –environmental, social and economic–, seen independently, offer scarce added value to the design of environmental public policy, since they leave out the effects of interaction, displacements, overlapping and synergy. That is why, under Targuay's grouping approach, the "optimal" amount of sustainability indicators was reduced from 188 to 17 sustainability indicators. On the other hand, Shen examined 9 processes or practices for selecting sustainability indicators for decision-making at a metropolitan scale, based on a joint selec-tion of 9 cities in developed and developing countries. This selection took the urban sustainability indicator database, known as the *International Urban Sustainability Indicator List* (IUSIL), as a reference universe –or pool–. From it, two main lessons were reached regarding the selection criterion for a barrage of indicators: i) the comparative method is essential to guide the discussion on the adequate selection of indicators at a local scale and to avoid any endogenous effects[6] and ii) the addition of environmental governance as a category is relevant within the analysis of the triple dividend approach (economical, social and environmental) (Shen *et al.*, 2011).

System Indicators Effectiveness

The *cost-benefit analysis* and *the calculation of the ecological footprint* have been the two methods to measure the return of sustainability indicators, even if this is not always possible. The risk of developing a sustainability indicator system –without any methodological justification or adequate selection criteria– is the development of *ad hoc* verification lists. In other words: "to measure what's measureable instead of what is important" (incorporate quote). A second risk is to develop an indicator system that is methodologically justified at a base-year level, but without the adaptive mechanisms, the flexibility or the feedback chains sufficient to evolve through time with the problems of the object in question's sustainable development –in this case, the metropolitan area being analyzed–. Some international experiences have followed this approach. Following Zeijl-Rozema and Martens, frameworks for adaptive indicators were developed in Holland, or regional sustainable indicator ranges.

5 Of course this is not a sufficient criterion for designing public policy –however, it is one criterion more for deciding, for example, the cost-benefit analysis.

6 The first lesson implies the need to differentiate local sustainability indicators through methods of communal participation with global indicators with a greater level of generalization and duplication.

In fact, *the Post-2015 Agenda*, unlike the *Millennium Development Goals*, sees the national and regional scales as the most important ones in the development of sustainable development indicators, using international tendencies as reference, but only as parameters (Zeijl-Rozema & Martens, 2011, *Op. cit.*).

The cost-effectiveness criterion is useful to maximize the optimal number of indicators to be considered as an objective function subject to budgetary restrictions. Under this logic, some empirical estimations have been developed at international scale through applying linear programming methods to estimate "the reduced number of indicators that represent the greatest quantity of possible areas, while providing the greatest amount of information from the original database" (Munier, 2011). The use of this kind of analysis provides important elements for prioritizing in the cases of establishing a system of sustainability indicators when the public budget is limited. As an example, Munier used focus groups in a US city to evaluate a group of 16 variables, 7 criteria and 7 topic areas related with the sustainability indicators' possible universe. After the process, it selected 8 indicators that basically reflected the same environmental information. This process took place through 13 decision stages to obtain an optimal level of environmental variables. The starting point or status quo were the environmental public policy and its objectives, which differ from the intervention of committee of experts.

Selection criteria for indicators in metropolitan environments

Considering the use meant for sustainability indicators, there is no exclusive frame of reference for applying all the environmental topics or issues. One of the main problems of selecting indicators is that there is no consensus over each environmental topic regarding the minimal sufficient amount of indicators needed for its measurements to be representative, given the complexity and multidimensionality of its nature.[7] Two of the main criteria used internationally in most sustainability indicator systems in urban areas –either explicitly or implicitly– are: i) the concept of strong sustainability and ii) the triple dividend approach (social, economical and environmental).[8] The international evidence shows that both criteria, although desirable, imply a tension or *trade-off* by including them on the design. That is why none of the environmental international indexes in urban areas were assessed for

7 Let's take air quality for example. At an international level, the most frequent air quality indicator for comparison purposes is the PPM at 2.5. However, there are many air quality indicators, relevant for analysis but left out of monitoring and assessment systems in many parts of the world for reasons of practicality, communication and diffusion for groups of large populations.

8 The concept of strong sustainability places the natural capital at a higher hierarchy and deliberation level in relation to other forms of human, physical and technological capital that, in turn, explain economic growth. In this sense, it gives a higher relative importance to natural capital in comparison with the concept of Earth used by David Ricardo and the classic school of thought in economics.

complying to strong sustainability and triple dividend criteria simultaneously (Mori & Christodoulou, 2012). Furthermore, half of the indexes do not include any of the abovementioned criteria (strong sustainability). Generally, in international urban sustainability indicators, there is a tendency to use criteria related to the triple dividend approach. The most recurring problem among this type of indexes is the non-inclusion of external possible impacts in each of the sustainability indicators. To affront this limitation, in recent years, criteria have been incorporated; criteria capable of covering the external effects of the main environmental variables related to each urban sustainability indicator, explicitly and methodologically. In this sense, the most important effort is the development of the ecological footprint. That is why, metropolitan approaches tend to consider more and more indexes or indicator systems that take the external effects of public policy into account, in spite of the methodological challenges that this implies.

Theoretically, an environmental sustainability index that is able to capture both criteria simultaneously –strong sustainability and triple dividend– could eliminate all biases and potential omissions, constituting an ideal methodological goal that shouldn't be avoided in the design of an urban sustainability indicator system for cities in Latin America. This article follows the line suggested by Mori & Christodolou (2012) in the sense of aspiring towards a group of indicators or indexes for sustainable cities that is efficient, comparative, cost-effective and that maximizes the capture, as much as possible, given the available information, the triple dividend line, without biases, omissions or leaks at a metropolitan scale. In conclusion, and following all 4 desirable properties for an integrated group of indicators or metropolitan indexes for sustainability according to the revision of the literature on the subject, the following four principles are suggested: 1) It should capture external effects, 2) it should cover all the central aspects of the triple dividend politics, 3) it should be created under the environmental premise at its core –following the strong sustainability concept– and 4) it should include comparable variables –as much as possible– for different contexts: developed countries / developing countries.

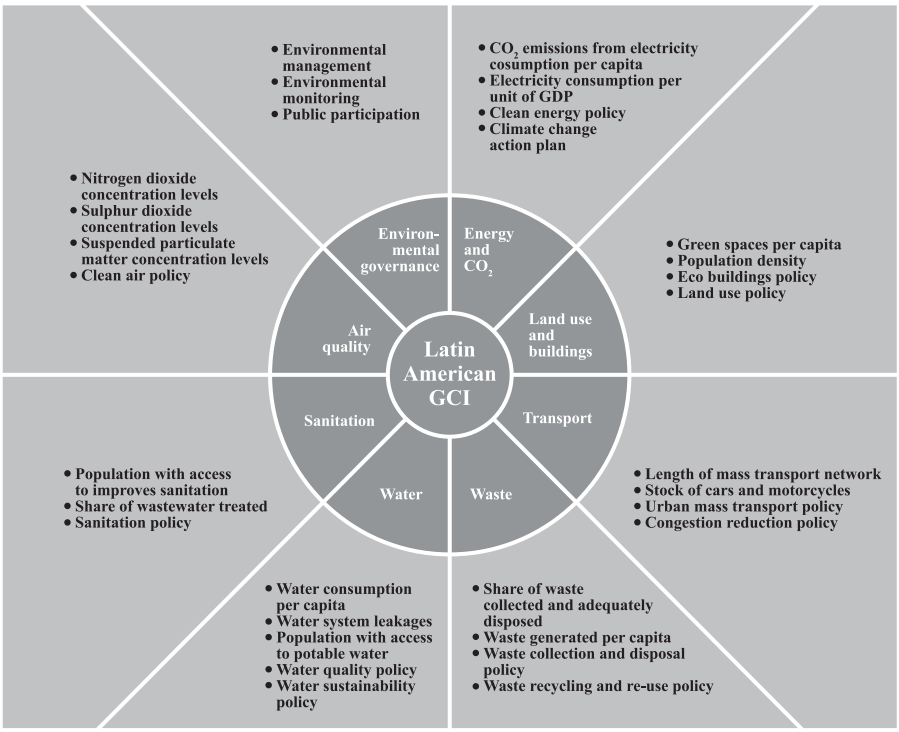
Basically, the sustainability criterion holds that natural capital is not simply another explanatory variable of economic growth that can be substituted by other forms of capital, like human, physical or technological. On the contrary, it is the base of all other forms of capital and, therefore, it should be considered as a focal or prevailing point. Likewise, the concept of weak sustainability establishes a perfect situation between different types of capital according to its cost of opportunity and scarcity. Clearly, the concepts of strong and weak sustainability are at the core of the theoretical debate between environmental and ecological economies (Daley & Farley, 2004).

The environmental problem of the Guadalajara Metropolitan Area in the context of Latin America

Guadalajara, economically the second most important city in Mexico, presents a set of complex environmental problems, some of them caused by the loss of natural capital, others by the exponential growth of its urban settlements and population in the last decades. The selected environmental subjects to be analyzed are shown on graph 1. To begin with, the selection of Latin American cities for the development of the Green City Index was carried out due to its similarities in terms of population, size, income level and the relative economical importance for its country (*The Economist Green City Index*, 2010). This index is an extension of the *European Index of Green Cities*, with some minor adaptations made for Latin America. Clearly, the least developed axis is the one for environmental governance at a metropolitan scale. In spite of the considerable growth of literature about environmental governance in recent years, its transformation into indicators is still to be developed. The analysis of the main models of international sustainability indicators –urban and general– indicate that the topic of environmental governance still is the vaguest in terms of measurements, diffusion and –as we will argue– since it is based on a local context, its comparison and treatment are complicated, considering the diversity of institutional frameworks for different countries. In spite of these empirical limitations, the understanding of the dynamics of environmental governance dynamics in cities becomes a necessary condition to comprehend the environmental performance of cities.

In this sense, the Green City Index represents a good exercise in comparison and the establishment of baselines. However, 5 years from its creation, important areas of opportunity have been found for a sustainability indicator system in the GMA (Rockstrom & Klum, 2015), according to the findings within the specialized literature. Particularly –and as a first step for improving the selection of sustainable indicators for the GMA–, a stronger inclusion of the environmental governance axis is suggested. Also suggested is the viability of the axis/topic of climate change as a cross section that could become a catalyst for the rest of the indicator topics. These two modifications are consistent with the observation of preliminary documents of the Post-2015 Agenda (*Sustainable Development Solutions Network,* 2015). From the Green City Index, we take the information about the environmental performance comparison of Guadalajara and other Latin American cities. Table 1 describes the main 6 environmental items evaluated in 2012 for the GMA as well as its comparison with the average of similar Latin American cities: Puebla, Monterrey, Mexico City, Lima, Bogotá, Santiago, Buenos Aires, Curitiba and Sao Paulo (*The Economist,* 2010).

FIGURE 1. SELECTION OF TOPICS AND INDICATORS THAT FORM THE LATIN AMERICA GREEN CITY INDEX



Source: The Economist Intelligence Unit (2010). Latin America Green City Index.

Overall, the environmental assessment showed relatively low results in the GMA in comparison with other cities of Latin America, finishing behind them in most categories –particularly on the topics of water, residues and air quality. On the other hand, there are some comparative advantages in the GMA in relation to other metropolis in the subject of green areas and population density. Recent studies, however, show that the tendency in deforestation and forest service in the GMA, as well as the important increase in the motorization and urbanization indexes, has reduced the natural capital drastically in the municipalities of Guadalajara and Zapopan and increased the pressure environmental indicators (*Jalisco a Futuro*, 2013).

TABLE 1. RADIOGRAPHY OF MAIN SUSTAINABILITY INDICATORS ACCORDING TO THE STUDY BY THE ECONOMIST INTELLIGENCE UNIT, 2010.

Factors	Description	Average	Guadalajara	Year
Energy and CO_2	CO_2 emissions caused by electrical consumption (kg/person)	202.2	332.9 1,e	2008
	Electrical consumption (megajoules for every 1,000 dollars of GDP)	760.7	631.6 2, e	2008
Use of land and buildings	Population density (people/km^2)	4,503.0	1,596.6 3	2009
	Green areas per person (m^2/person)	254.6	423.3 3	2005
Transport	Total extension of public transport networks (km/km^2)	5.0	2.3 3	2009
	Total extension of superior public transport networks (km/km^2)	0.13	0.26 4	2010
	Stock of cars and motorbikes (vehicles/people)	0.30	0.37 4	2010
Waste	Proportion of adequately collected and disposed waste (%)	96.2	100.0 1,e	2008
	Waste generated per person (kg/person/year)	465.0	472.7 5	2008
Water	Water consumption per person (liters per person per day)	264.3	651.2 6,e	2008
	Water system leakage (%)	34.6	37.0 4	2008
	Population with access to drinking water (%)	97.5	89.17	2005
Sanitation	Population with access to sanitary installations (%)	93.7	94.5 8, e	2005
	Amount of treated residual water (%)	51.5	24.7 1, e	2008
Air quality	Annual average of nitrogen dioxide concentration (ug/m^3)	37.8	41.4 3	2008
	Annual average of sulfur dioxide concentration (ug/m^3)	11.4	11.4 3	2008
	Annual average of particle material (ug/m^3)	48.0	41.5 3	2008

Source: The Economist Intelligence Unit (2010). Latin America Green City Index.

According to the analysis in the first section of this article, the environmental assessment of the GMA –summarized in Table I and carried out by *The Economist Intelligence Unit*– is a useful diagnosis to set baselines in specific

indicators such as air quality and water management. They also allow the comparative analysis between similar Latin American cities with common set of problems from the standpoint of a sustainability indicator system previously established an recognized in Europe. In spite of these advantages, the index doesn't include relevant indicators in relation to the environmental agenda for the coming years –specifically, on the topic of environmental governance and climate change adaptation–, two transversal axes whose incorporation explains more and more about the global environmental performance of Latin American cities for the coming years. Given the local contextual nature that implies an increment in the aspect of environmental governance, climate change and resilience to a system of sustainability indicators such as the *Latin American Green City Index*, a lot is won in depth, but lost in comparativeness. That is why, in order to complement the first order information that resulted from the Latin America Green City Index indicators, *ad hoc* methodologies have to be created to capture, for example, the measures of the adaptation to climate change that cities in Latin America are carrying out. Thus, the explicit and detailed incorporation of measures that, in matters of climate change adaptation and environmental governance, are being taken –or not being taken– in metropolis such as the Guadalajara Metropolitan Area, looking towards the environmental agenda of the coming years. Table 2 shows an alternative list of sustainability categories and indicators for the GMA, typically not found on the sustainability boards, but particularly important for the GMA, according to the problems and prioritization of the city's environmental problems.

Although they are useful for diagnostics, the urban sustainability indicators that constitute Table I shouldn't be applied directly with environmental policy purposes. If, for example, one takes the indicator of green areas per capita, one would find a very favorable result for the GMA. Internationally, it is a highly used indicator for the indexes of sustainable cities. However, in order to strengthen this base indicator, additional information should be incorporated to measure the quality of the environmental services that the GMA's tree stock receives. Recent GMA samples show a low level average for forest services in their trees, 30% of which have a plague known as mistletoe (*scientific name*) which, considering recent tendencies, can cause a decrease in the green areas per capita in the coming years, considering the propensity to knock down trees during rain season (Programa de Acción ante el Cambio Climático (PACMUN), Guadalajara 2013). For the purpose of avoiding the effects of displacement from one indicator to the other, currently, indexes are being developed to take this kind of leaks into account. For example, the Singapore Biodiversity Index –which binds together several indicators for environmental

services that provide directly and indirectly to city forests and stems from the Post 2015 Agenda– would be the most adequate to measure the state of green areas in the GMA. Overall, the desirable tendency would be to migrate basic indicators towards a more holistic version of them to include their leaks and possible externalities towards other indicators. Unfortunately, there are no indicator menus available at all times in the specialized literature to face their unintentional consequences. In such cases, these should be designed.

TABLE 2. URBAN SUSTAINABILITY INDICATORS ADAPTED FOR THE POST-2015 AGENDA, EMPHASIZING CLIMATE CHANGE AND ENVIRONMENTAL GOVERNANCE.

Topic	Name	Definition	Type	Scale	Source
Environmental Governance	Risk and Climate Change Resilience Management	Implementation of strategies to reduce risks, as well as locally spread and accepted resilience endorsed by international frameworks and protocols (like the Hyogo-2 Protocol).	Qualitative	Metropolitan	Post-2015 Agenda
Environmental Governance	Third Generation Human Rights	Participation in local communities for improving the management of water and salubrity.	Qualitative	Metropolitan	Post-2015 Agenda
Environmental Governance	Environmental Conflict	Conflict growth rate regarding Property Rights in terrains near Urban Natural Areas.	Quantitative	Metropolitan	Post-2015 Agenda
Environmental Governance	Environmental education	Percentage of children that acquire the necessary abilities and values for global citizenship and sustainable development.	Qualitative	Metropolitan	Post-2015 Agenda
Environmental Governance	City's biodiversity index	City's biodiversity index in relation to the Singapore index.	Quantitative	Metropolitan	Post-2015 Agenda
Environmental Governance	Compliance and application of environmental laws and regulations	Institutional Framework Effectiveness Index.		Metropolitan	Post-2015 Agenda

Continuation of table

Topic	Name	Definition	Type	Scale	Source
Environmental Governance	Environmental compliance by private sector	Percentage of companies valued at more than 1 billion whose integrated monitoring system adopts sustainability information as part of its report cycle.	Quantitative	Metropolitan	Post-2015 Agenda
Environmental Governance	Implementation of Assessment Instruments of Environmental Policy	Strategic assessments of environmental and social impact.	Qualitative	Metropolitan	Post-2015 Agenda
Environmental Governance	Institutional Framework for Urban Policy Management	Existence and implementation of public policy frameworks for urban areas and population centers.	Qualitative	Metropolitan	Post-2015 Agenda
Climate Change	Incentives for the generation of low-carbon energy	Implied incentives for the generation of energies with low-carbon emissions in the electrical sector (measured in dollars/ WWh or Dollars per avoided CO^2 ton).	Quantitative	Metropolitan	Post-2015 Agenda
Climate Change	Public Policy Related to Addressing Climate Change	Availability and implementation of a detailed deep strategy for decarbonization, that is consistent with the 2 Celsius Degrees Projection –or less– by the Global Carbon Fund and the GEI's emission goals for 2020, 2030 and 2050.	Qualitative	Metropolitan	Post-2015 Agenda
Climate Change	Sustainable buildings	CO2 intensity in the construction and new construction sector ($kgCO^2/m^2$/year)	Quantitative	Metropolitan	Post-2015 Agenda
Climate Change	Mobility	Percentage of people that live at a distance of 500 meters from a public transport line that runs, at least, every 20 minutes.	Quantitative	Metropolitan	Post-2015 Agenda/ UN-Habitat

Continuation of table

Topic	Name	Definition	Type	Scale	Source
Climate Change	Mortality and morbidity in relation to heat strokes, dengue, acute diarrheal illness or respiratory infection	Deliberation index that measures the affected population by the increment in average temperatures related to climate change.	Quantitative	Metropolitan	OMS/OPS
Land Use	Improvement of illegal settlements or "shacks"	Percentage of total urban population that lives in shacks or informal or irregular urban settlements.	Quantitative	Metropolitan	Post-2015 Agenda/ UN-Habitat
Land Use	Urban Density	Relation between the rates of land use and population growth.	Quantitative	Metropolitan	Post-2015 Agenda/ UN-Habitat
Air Quality	Suspended Particles	Average contamination of urban air due to matter particles (PM10 and PM2.5).	Quantitative	Metropolitan	Post-2015 Agenda

Source: Personal elaboration based on *Indicators and a Monitoring Framework for the Sustainable Development Goals: Launching a Data Revolution*. New York, 2015.

CONCLUSIONS AND RECOMMENDATIONS

The development of urban sustainability indicators for monitoring and assessment is a growing tendency among the cities of Latin America. In spite of the wide array of sustainability indicators in the international realm, the process for selecting criteria for developing city-scale sustainability indicators requires and patient and careful exercise, since they can have great implications on public policy. On the other hand, the better selection of indicators under solid criteria will not be insufficient if it doesn't include strategic objectives for public policy. The design and assessment of sustainability indicators is not merely a technical exercise, but also about public policy. After reviewing the literature, at a technical level, the concluded and recommended suggestion is to develop indicators as fluxes, not heritage, and to integrate the right balance between qualitative and quantitative indicators. According to the triple dividend approach, the prioritization of the socio-environmental and socioeconomic viability interfaces is also recommended. The sole-sphere indicators, that do not consider leaks, displacements or external factors, although useful as ele-

ments for analysis, are insufficient for the correct design of metropolitan environmental public policies in the context of Latin America.

At a public policy level, the incorporation of sustainability indicators in public policies must be done, firstly, through a prioritizing process of the problem and the public agenda. The aforementioned environmental problems like air quality, bio-diversity, territorial development, climate change and integral water management fit, by definition, in the category of insufficiency and trans-territoriality, which necessarily implies the definition of public policy arenas based on local and regional governance. Literature on these topics is quite extensive and the binding the selection of indicators and their implementation together through public policy is above this article's objective. However, the window of opportunity, and the corresponding environmental public policy subsystem, that could be configured or reconfigured through the existing groups surrounding the international agenda, the Goals for Sustainable Development and UN-Habitat, in their local and regional implementation mechanisms, constitute a new public policy arena in sustainability –urban sustainability in this case– which is already permeating previously existing institutional arrangements on the matter. Historically, the most important influence for sustainability indicators in political arenas has come from public administration, urbanism and environmental sciences studies (Hezri & Dovers, 2006). However, the present "window of opportunity" opening for the consolidation of a subsystem of public policy that implements indicators lies in environmental governance.

By their very nature, internationally speaking, environmental governance indicators are not very comparable, which usually drives to its omission or inclusion, in very broad terms, like the case of the Green City Indexes. Besides, environmental governance indicators usually carry relatively less weight in developed countries than in developing countries, which is cause for one of the more common selection biases, as explained in this article's first section. None of the indexes revised by Mori and Chistodoulou (2014) include a category for environmental governance. Even though many hypotheses could justify the absence of environmental governance indicators among specialized indexes, it is true that these are essential to understand the environmental performance of Latin American cities.

In a very similar way, another selection bias happens among measures for climate change mitigation and adaptation. Generally, due to its natural conditions and its level of economical development, countries such as Mexico present urban settlements that are readier to the adaptation rather than the mitigation of climate change –which doesn't mean that the second aspect is lesser in any way– (Piguerón, 2011). On average, however, the international

sustainability indicator bias towards mitigating measures against climate change is quite clear.

While it's true that the essential sustainability indicators are focused on environmental topics (such as air quality, land use and water management), it is equally important to capture, as a separate and transversal category, the role that institutions –seen as the formal and informal rules that determine social interaction– play in environmental governance and metropolitan management, as well as the adaptation measures to climate change that, in matters of mitigation but particularly adaptation, face the environmental Post-2015 Agenda and the breadth of the Goals in Sustainable Development.

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