

METROPOLITAN PROFILE: GROWING SCENARIOS AND URBAN CARRYING CAPACITY

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Abstract

As part of the research we carry out about Sustainable Cities and on the framework of Urban Modeling projects, the Metropolitan Profile study for 37 metropolitan areas in Mexico was developed in order to solve two key questions: 1) To what extent, municipal urban development plans promote efficient land management at a metropolitan scale in Mexico? and 2) What are the priority problems that metropolitan areas should attend? This study includes, first, an analysis of different patterns of land use through the generation of three scenarios: business as usual, planning, and vision, as well as an estimate of environmental, economic and social impacts related to each scenario. On the other hand, the urban carrying capacity is evaluated in each metropolitan area to identify priority problems that should be attended. Since the study is aimed at providing useful information for decision-making, we generated in parallel a tool for quick query results. Gathering information was one of the main obstacles to an analysis of this magnitude. Of the 367 municipalities that make up the 59 metropolitan areas, two out of three submitted complete information and with this data we were able to complete the analysis for 37 metropolitan areas. Likewise, we found that only 15% of Municipal Urban Development Plans (PMDU) included geospatial information, which emphasized the lack of technical capacities of the municipalities' that make up the metropolitan areas. To ensure that the methods proposed were easy to replicate and update, the report assigns special emphasis to describing the sources and employs calculation procedures. The results and tools developed as part of the Metropolitan Profile can be used by decision makers to numerically evaluate their municipal urban development plans, or recognize improvement opportunities in current land management mechanisms

1 INTRODUCTION

As in other Latin American countries, Mexican cities have experienced rapid population growth and urban expansion, resulting in 78% of the population now living in cities [1]. This entails major challenges for governments and society. However, this condition also offers unique opportunities for making proactive decisions that promote sustainable urban development.

Proper land management promotes a more efficient and equitable use of government resources, minimizing environmental impacts and increasing welfare of its population. To conduct a land policy that promotes the above, it is important that cities extend beyond administrative boundaries; and therefore, urban planning should be carried out at the metropolitan level.

Municipal Urban Development Plans (PMDU), especially, are instruments that have the greatest impact on cities' urban growth patterns, however many municipalities lack the technical and financial tools to generate such plans according to local and metropolitan needs.

Based on the above, the Mario Molina Center, with support from the World Bank and the National Council of Science and Technology, developed the concept of Metropolitan Profile. This study aims to identify urban planning instruments in Mexico limit or facilitate the expansion of cities and therefore if they contribute to improve environmental, economic and social conditions. Since PMDU are the main urban planning instruments in Mexico, this study gives special importance to evaluating them with regards to their contribution on making cities more efficient and equitable.

On the other hand, to ensure that planning instruments are generated according to the actual capacity of municipalities, the study was complemented with an analysis of urban carrying capacity, consisting of the evaluation of growing limits or thresholds that a city could achieve without compromising the welfare of its inhabitants, environmental impacts and economic strength of the municipality.

2 OBJETIVES

The main objective of this study is to facilitate decision-making, on both a metropolitan and municipal levels, that contributes to sustainable urban development.

Likewise, it seeks to communicate the associated impacts to different patterns of urban expansion in Mexico's metropolitan zones. In this perspective, the present study aims to answer the following research questions:

- To what extent do PMDU promote efficient land management at a metropolitan level in Mexico?
- What are the priority problems metropolitan zones should attend?

3 METHODOLOGY

With the intention of solving the questions above, the methodology for the development of this study can be described in two main parts: the development of growth scenarios and estimation of urban carrying capacity.

Growth scenarios show three alternatives of how the city could expand in 2020. The first is the "business as usual" which shows the most probable city expansion according to historical behavior. The second, "planning" is projected according to the growth approved in PMDU, interposed to 2020. And third, "vision", which is estimated according to the optimum use of land already developed, including variations between different saturation levels of the maximum density allowed in their PMDU. These levels can be 30%, 50%, 70% and 100% of saturation and its objective is to identify the capacity of each city to accommodate its expected population.

For each alternative calculation we carried out estimates of its potential impact in terms of: land consumption, costs associated with the construction of new infrastructure, percentage of the population in proximity of their employment centers and public transportation, household spending on transportation, energy consumption, emissions of greenhouse gases (GHG) and criteria pollutants.

Since, in all cases, the scenarios contemplate a process of increasing population in metropolitan areas, it's important to complement the analysis to identify urban growth thresholds that a city can achieve. Based on this, the second part of the methodology includes estimating the urban carrying capacity (ULC).

The ULC was estimated by defining three dimensions: infrastructure, environment and social, institutional and economic. The infrastructure dimension includes decisive factors: water and drainage, electricity, municipal solid waste, public transportation and urban infrastructure. The environmental dimension includes: accessibility to green areas, air quality and land management. The social, institutional and economic dimension includes: demographic and housing data, availability of municipal resources, sensitivity to natural phenomena and land values.

Finally, a reporting tool was generated allowing the user to choose each of the 37 metropolitan areas studied, visualize its three scenarios as well as the results of their metrics and finally analyze the urban carrying capacity compared to other metropolitan areas, as well as between the municipalities in the same city.

It is important to mention that there are some limitations in the methodology used. Regarding the generation scenario, the main limitation that the vision scenario entails, is that it provides only the densification potential of each city, which does not necessarily represents the actual occupation condition of the place. To achieve a more accurate analysis we require having cadastral information of each municipality, which is beyond the scope of this study.

Regarding urban carrying capacity, despite being a very useful concept for urban planning it is still in an initial development stage [2]. In many cases, the lack of information does not allow to properly estimate the carrying capacity but simply the coverage of

services.

Regarding the issue of information availability this study focused on as far as possible, in using public databases that facilitates their replication and updating in the future. Such bases include demographic partner information of the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía)¹, National Water Commission (Comisión Nacional de Agua)², the National Commission on Population (Comisión Nacional de Población)³, among other public institutions.

4 RESULTS

Gathering information was one of the main obstacles when carrying out an analysis of this magnitude. Out of the 367 municipalities that make up the 59 metropolitan [3] areas only 235, ie 64%, sent complete information. The remaining 36%, 14% sent information on obsolete formats, 10% do not have PMDU, 9% did not reply and only 3% were in the process of renovation.

Also, only 15% of the PMDU were in GIS⁴ format, which emphasizes the lack of space capabilities of the municipalities of metropolitan areas. In terms of content, only 13% of PMDU are part of a metropolitan plan, which shows that municipalities have great opportunities to improve their coordination. In addition, when comparing the authorized densities against the current population we found that most PMDU could accommodate a population increase greater than 3.8 times the projected for 2020 by the National Population Commission [3].

To summarize, we gathered sufficient information to analyze 37 metropolitan areas as case studies to obtain metrics according to the three scenarios: business as usual, planning and vision. It's interesting to note, in terms of land consumption, results show that under the vision scenario, no metropolitan area

requires expanding its current territory (2010) to accommodate future population (2020) with a 70% saturation density allowed. Even with a saturation of 50% of the maximum density allowed it achieves to contain all the cities within its existing urban area. Only by reducing 30% saturation we observe that seven metropolitan areas require some expansion⁵.

This shows, on one hand that the territory is being poorly occupied; that is, the capacity of the existing urban area to accommodate population is underestimated. On the other hand, it also demonstrates that current planning instruments overestimate the real needs of urban land.

Furthermore, we analyzed the ULC of municipalities and metropolitan areas under their current conditions. Because of the type of indicators we used, it was possible to perform the analysis for the 59 metropolitan areas nationwide. It is noteworthy that two types of indicators were generated: the ones that define limits or thresholds that directly describe the carrying capacity and those that, in the absence of available information to estimate the first, were used to establish indirectly performance benchmarks.

As mentioned above, the analysis of ULC has the main objective to identify the main challenges that cities might face with population growth. Although the outcome of ULC is specific to each city, we identified factors that consistently involve a challenge in metropolitan areas. These are: access to green areas, access to public transportation and municipal resource availability (economic). The results of metrics, analysis of urban carrying capacity can be consulted in the study's full report.

The study was complemented by a web visualization tool; this facilitates the visualization of results, and allows comparisons between metropolitan areas and among municipalities that comprise it. With the second one, the query is simplified to identify weaknesses or opportunities that metropolitan areas have and not only municipalities in isolation. Currently the tool is available at: http://apps.centromariomolina.org/perfil_metropolitano.

¹2000 and 2010 Population and Housing Census, Directory of 2015 National Economic Units, 2012 National House Income and Expense Survey, 2012 National Housing Inventory, among others.

²Provision of drinkable water by climate and number of habitants, Mexico's Water statistics and the National Inventory of Municipal Plants.

³Mexico's Population forecasts in Municipalities and Delimitation of Metropolitan Areas 2010.

⁴Set of tools designed to obtain, store, retrieve and deploy real-world spatial data. [4].

⁵Including the metropolitan areas of Tijuana, Mexicali, Puerto Vallarta, Toluca, Morelia, Queretaro and Tianguistenco.

5 CONCLUSIONS, RECOMMENDATIONS AND PERSPECTIVES

As mentioned above, this study focused on solving two fundamental questions. The first: to what extent, PMDU promote efficient land management at a metropolitan level in Mexico? The answer is not simple. PMDU of some metropolitan areas do work as instruments of urban containment. However, most of them pose no limit for expansion. From the above we can conclude that PMDU do have the potential to contribute shaping better cities, but it is necessary to develop technical skills in municipalities and coordination in metropolitan areas for it.

With this perspective, a series of public policy recommendations were proposed focusing mainly on the state of the PMDU.

1. We recommend, first, to standardize the process for generating PMDU, including the use of GIS for easy review, validation and calibration.
2. Secondly, we suggest emphasizing the obligation in PMDU congruence with those of metropolitan areas.
3. Finally, we propose to use the carrying capacity as a calibration instrument for PMDU as well as for defining urban containment policies and to justify investments in infrastructure.

The second question was: What are the priority problems metropolitan areas should attend? We found that each city presents specific challenges that require independent analyses. However, three key factors stand out: 1) access to green areas, 2) access to public transportation and 3) the availability of municipal resources (economic).

From the above, we can offer as specific policy recommendations:

1. To create and maintain an inventory of green areas, that allows assessments on quality and accessibility of public spaces, as well as user's satisfaction.
2. Develop a system of urban information containing -at least-, demographic, land use (PMDU) and access to public transportation (including type of transportation, timetables and frequency

of each route). This will allow a more effective coordination to ensure access to public transportation.

3. Strengthening tax collection instruments and land management of local governments. This can be achieved with the implementation of land banks and transparent property tax schemes.

The Metropolitan Profile study highlights the current situation in which metropolitan areas are in terms of land use and urban carrying capacity. Through the study, basic elements are generated for designing public policies that encourage more efficient land use. These solutions will depend on each metropolitan area in terms of its socio-economic context, state law, legitimacy and strength of its institutions, among many other aspects.

The shortcomings are emphasized when performing an analysis at a metropolitan level like this, since the metropolitan areas are often shaped by different jurisdictions with exclusive powers in urban development, so they can independently approve areas for growth disconnected from a comprehensive metropolitan vision. While some local laws state that PMDU must be consistent with those in conurbation areas or metropolitan areas, weak institutions and lack of sanctions have prevented the full implementation of this principle.

The results and tools developed as part of the Metropolitan Profile can be used by decision makers to numerically evaluate their PMDU, or recognize opportunities to improve current land management mechanisms through the concept of ULC.

As for future prospects we propose a more detailed study on generating PMDU processes as well as the reasons why most lack a metropolitan approach. On the other hand, the concept of ULC should be further explored and promote the generation of indicators that directly address the measurement of carrying capacity limits. Finally, it's necessary to search tools or incentives to help in the implementation process of municipal urban development plans, and thus sustainable urban development is encouraged.

6 REFERENCES

[1] Instituto Nacional de Estadística y Geografía (2010). Censo de población y vivienda 2010.

[2] Wei, Yigang and Huang, Cui and Lam, Patrick T.I. and Yuan, Zhiyang (2015). Sustainable urban development: A review on urban carrying capacity assessment. *Habitat International*, pp 67-71, vol. 46. <http://www.sciencedirect.com/science/article/pii/S0197397514001532>

[3] Consejo Nacional de Población (2010). Delimitación de las zonas metropolitanas de México 2010.

[4] Instituto Nacional de Estadística y Geografía (2010). Sistema de información geográfica, <http://www.inegi.org.mx/inegi/SPC/doc/internet/sistemainformaciongeografica.pdf>

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