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Economic Benefits of the Territorial Strategy
in the Zapopan Municipality, Mexico[1]

Historical city, Mexico @Shutterstock

The Territorial Strategy of Zapopan 2030 (ETZ2030 in Spanish), issued in 2015, is the output of the technical assistance provided by UN-Habitat's office for Mexico and Cuba to the municipal government of Zapopan, Mexico. ETZ's diagnostics identified three main challenges in the municipality: i) the pressure of urban expansion on areas of high environmental value; ii) the fragmentation of urban areas with the proliferation of closed neighborhoods; and, iii) rising economic and social inequality. A subsequent ETZ Implementation Plan, which is being finalized in 2018, quantified the costs of Zapopan's urban sprawl and the benefits of controlling expansion as proposed by the ETZ. Key findings are presented in this paper.

Main findings

- Population growth projections in Zapopan's urban planning instruments overestimate the number of inhabitants in 2030 by almost half a million people. That is a third of today's population. Consequently, more urban land was allocated for housing, encouraging urban sprawl.

- The implementation of the ETZ2030 would induce a reduction of costs associated to urban sprawl which is estimated at USD 476.3 million at present value from 2018 to 2030.

- An increase of density in consolidates areas would reduce the expenditure on public infrastructure by USD 4.4 million.

- The implementation of ETZ2030 would contribute to a reduction of the opportunity cost of travel time to work and school of around USD

57.9 million at present value, accumulated from 2018 to 2030. Savings on transportation expenses were estimated at USD 28.72 million for transport to work.

- The opportunity cost of urban reserves with agricultural potential is estimated at USD 43.32 million in the same period. This would be the loss in the value of crops if land is urbanized.

- ETZ2030 implementation would increase annual productivity in USD 28.11 per worker by 2030. This estimation would generate an economic gain in the region of USD 342 million for Zapopan.

Main learnings for policy

- Urban sprawl generates economic costs in the short, medium and long term for the society and for local governments, which is why urban planning oriented to control it is necessary.

- Municipalities can encourage urban sprawl through inadequate urban regulations and the allocation of resources to dispersed housing in peripheric locations.

- The lack of expertise in demographic estimations could have negative consequences for the city.

- Municipalities could design comprehensive public policies that combine an increase of density and the protection of areas with high environmental value and agricultural land.

**Reviewed by:** The Urban Economy and Finance Branch

I. Background

Zapopan is a municipality in the State of Jalisco, Mexico, located west of Mexico City. It is part of the second largest metropolitan area in Mexico, the Guadalajara Metropolitan Area (GMA). It is one of the wealthiest and most unequal municipalities in Mexico. GMA's urban sprawl has been taking place mainly in Zapopan due to its large urban land reserves.

According to the Intercensal Survey 2015, the population of Zapopan was 1.33 million. As the National Population Council (CONAPO) estimates that Zapopan's population will reach 1.54 million by 2030, the expected population growth is 203,000 people or 15.2% in 15 years.

Zapopan's urban planning instruments, approved in 2012, overestimated the 2030 population by almost half a million people, therefore allocating more than necessary urban land reserves. The excess of land has triggered a significant increase in housing supply, which together with other factors such as location and access to services, has resulted in abandoned or empty houses in other municipalities of Mexico. Since the population growth trend is lower than projected, if all urban land reserves are urbanized by 2030, Zapopan's population density will decrease.

The municipality is divided in twelve urban districts, each with its own dynamics. The population in Districts 1, 5 and 6, located next to the municipality of Guadalajara, is declining. Districts 2, 3, 4, 7 and 8 are urbanized but they are very uneven in terms of quality of public services and infrastructure. Districts 9, 10, 11 and 12, which are on the periphery of the urban area, have the largest amount of urban land reserves and are under pressure from urban sprawl. These districts also contain agricultural land and natural areas that need protection.

Population of the municipality of Zapopan, 2000-2030
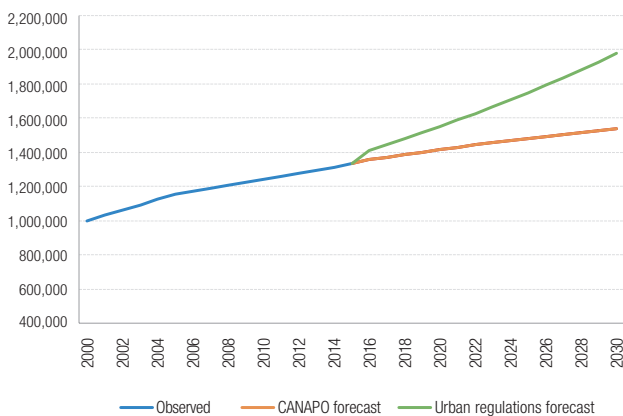
Source: *Data from the Population and Housing Census 2000, Population and Housing Count 2005, Intercensal Survey 2015, population projections from the National Population Council (CONAPO), and projections from Zapopan's plans for urban development.*

Note: The intermediate annual values between 2000-2005, 2005-2010, and 2010-2015 were calculated by the author using the average annual growth rate of those periods.

Urban districts in Zapopan
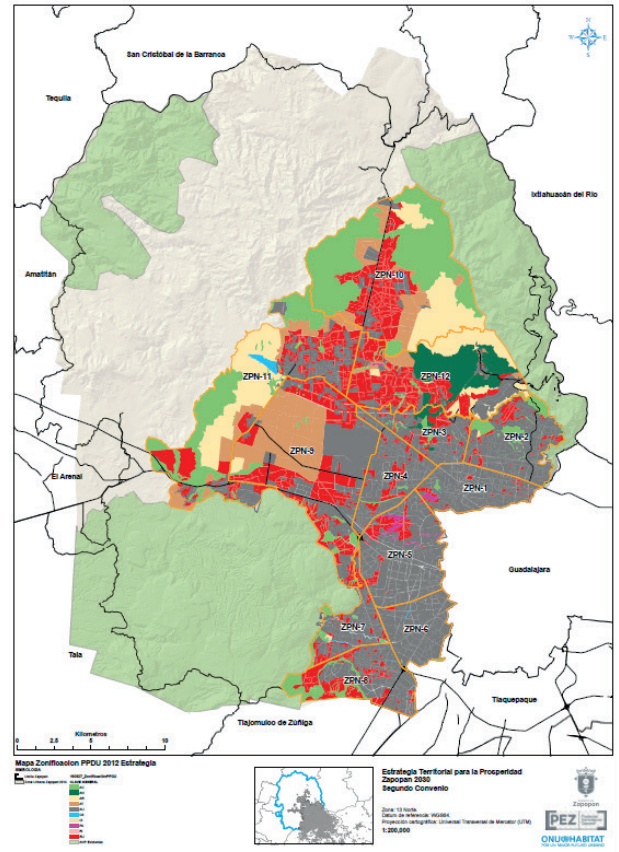
Source: *GIS Consultant, ETZ2030.*

Note: Gray area: urban area; red area: urban land reserves; green areas: natural areas and conservation areas; brown and beige areas: agricultural land and farms.

Urban sprawl is generated not only by dynamics in the housing and labor markets, but also by public policies and regulatory frameworks that may promote it. Such expansion generates costs for residents, governments and the society at large, which need to be born in the short, medium and long terms.

The role of territorial public policy is to design a scheme of incentives to restrain urban sprawl, while increasing the prosperity of the city. In this context, the ETZ2030 not only seeks to identify a series of projects, but also to define a comprehensive policy to improve the sustainability of Zapopan.

Within the framework of the technical assistance of UN-Habitat to the Municipality of Zapopan, some of the economic costs of urban expansion were identified, estimated, and analyzed. These costs are expected to decline with the full implementation of ETZ2030.

The identified costs are: i) cost of municipal public infrastructure; ii) opportunity cost of transport time to work and school; iii) transport expenditure to work and school; iv) opportunity cost of urban reserves with agricultural potential; and, v) opportunity cost of the effect of population density on the productivity in Zapopan. The estimations indicate an overall expected benefit of the implementation of ETZ2030, through cost reduction, amounting to USD 476.3 million at present value for the period 2018-2030.

II. Methodology

The ETZ2030 proposes, among other important measures, the reduction of urban land reserves in urban Districts 9, 10, 11 and 12, as well as a redensification program for Districts 1, 5 and 6, which are losing population. A precondition to carry out the analysis was to estimate the population and population density by urban district both with and without taking into account the implementation of ETZ2030.

In the scenario with the implementation of ETZ2030, an 80% reduction of urban reserves in Districts 9 to 12 was assumed as well as a redensification program to keep unchanged the population density in Districts 1, 5 and 6 for 2030. In the scenario without the ETZ2030, it was assumed that all land reserves will be urbanized by 2030.

The reduction of urban reserves and the redensification programme proposed by the ETZ2030 would result in an increase in the municipality's population density of 4.7% by 2030, while the current trend -without the measures of the ETZ2030- is expected to result in a reduction of the density by 14.5%.

Population densities by Urban District with and without ETZ2030

District	Population density 2010	Expected population density without ET2030		Expected population density with ET2030	
		Density	% Change	Density	% Change
District 1 Zapopan Centro	89.5	73.8	-17.6%	89.5	0.0%
District 2 Aroyo Hondo	85.9	99.8	16.2%	99.8	16.2%
District 3 Los Robles	72.9	96.2	31.9%	96.2	31.9%
District 4 La Tunzanía	74.9	75.9	1.3%	75.9	1.3%
District 5 Vallarta Patria	42.4	36.6	-13.8%	42.4	0.0%
District 6 Las Águilas	82.8	58.5	-29.4%	82.8	0.0%
District 7 El Colli	97.0	122.0	25.8%	122.0	25.8%
District 8 Santa Ana Tepetitlán	48.4	48.8	0.8%	48.8	0.8%
District 9 Base Aérea-El Bajío	8.8	12.5	42.0%	10.0	13.9%
District 10 Copala	58.2	11.0	-81.1%	19.1	-67.1%
District 11 Tesistán	51.3	49.2	-4.2%	48.8	-4.8%
District 12 Nixticuil	12.4	4.5	-64.0%	8.2	-33.4%
TOTAL	**61.7**	**52.7**	**-14.5%**	**64.5**	**4.7%**

Sources: *Own calculations.*

II.1 Expenditure on public infrastructure

The cost of municipal public infrastructure was obtained from the list of public infrastructure contracts that the current municipal administration has executed since December 2015, including those that are financed with federal, state and municipal resources. This information was grouped by urban district, which allowed to establish the per capita expenditure for each district.

On average, the per capita expenditure of Districts 9 to 12 is greater than that of Districts 1 to 8, as expected; it is more expensive to provide infrastructure to the peripheral districts. For the calculations, it was assumed that infrastructure per capita expenditure by district would remain constant in real terms from 2018 to 2030 with and without the implementation of ETZ2030, so that the total expenditure was obtained multiplying the amount by the district population in both scenarios.

Box 1. Expenditure on public infrastructure

- Annual per capita infrastructure expenditure in Districts 1 to 8 was around USD 37.6, while in the peripheral Districts 9 to 12 it was USD 52.3, 39% more.
- These per capita expenditures were assumed to be constant in real terms from 2017 to 2030.
- Total infrastructure expenditure was obtained by multiplying these per capita costs by the annual population forecast from 2017 to 2030.
- The implementation of ETZ2030 would slow down population growth in peripheral districts by reducing urban reserves and a density increase program in intra-urban districts.
- The strategy will reduce the pressure of public spending on urban infrastructure.

II.2 Cost of transportation to work and school

The calculation of the opportunity cost of the travel time to work and school and the expense on transportation was a challenge because there is no origin-destination information between urban districts. Therefore, the travel time had to be estimated indirectly with the Intercensal Survey 2015, the National Statistical Directory of Economic Units (DENUE) of the National Institute of Statistics and Geography (INEGI in Spanish) and the list of schools of the Secretary of Public Education (SEP).

Regarding transport to work, the analysis with the Intercensal Survey 2015 and the DENUE allowed to determine which urban districts are net attractors of work (if the employed population that works in the district is greater than the one that lives in it), as well as those who are net expellers of work (if the employed population that works in the district is smaller than the one that lives in the district). Therefore, it was assumed that, on average, the districts that export workforce have longer transfer times.

In terms of transport to school, the percentage distribution of the transfer and type of transport were obtained by educational level from the Intercensal Survey, observing that the highest travel times are for college and high school students. Based on SEP's list of schools by education level, it was observed that districts 10 and 12 have less coverage, so it was assumed that students in those districts have longer travel times.

To calculate the opportunity cost of travel time to work and school, special surveys are usually used to establish the amount of money people are willing to pay to reduce their travel time. In Mexico, there are no surveys of this type, but the Center for Studies for the Preparation and Socioeconomic Evaluation of Projects (CEPEP) recommends the value of MXN 41.54 per hour (USD 2.03), calculated with a methodology endorsed by the Ministry of Finance. That amount was used in this study.[2]

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[2] CEPEP, Valor social del tiempo a nivel nacional en México para 2016. Available at http://www.cepep.gob.mx/work/models/CEPEP/metodologias/VST2016.pdf.

To calculate the transport expense for people who move in public transport a unit cost of MXN 7 per trip (USD 0.24) was used. For those who use private vehicles, gasoline expenditure was considered.

II.3 Opportunity cost of urban reserves with agricultural potential

There are 3,848 hectares of urban reserves with agricultural potential in the municipality. Zapopan's annual average value of crops per hectare was obtained from the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA). The annual opportunity cost is the number of hectares with agricultural potential multiplied by this value per hectare.

II.4 Effect of population density on productivity

Finally, to obtain the effect of urban density on productivity, a productivity-density elasticity calculated in a study carried out by Abel, Dey, & Gabe (2011) was used.[3] The authors used information from 363 metropolitan areas in the United States to estimate the elasticity with different econometric models. The elasticity is a measure of the percentage change of a variable as a function of the percentage change of another variable. For example, the elasticity of productivity-population density of 5% means that, if the population density increases by 100%, productivity will increase by 5%. The authors found that the value of the productivity-population density elasticity is in the range of 2% to 4%. For Zapopan, the lower value of this range was used to estimate the effect of the change in the density in productivity with and without the implementation ETZ2030.

The change in population density with and without the ETZ2030 was multiplied by the elasticity of 2% to obtain the percentage change in the productivity of the municipality. Because population density without strategy will decrease by 2030, ceteris paribus, then productivity will also decrease. In contrast, productivity will increase with the implementation of the ETZ2030 due to the growth in population density.

Box 2. Effects on productivity

- Density plays an important role in the productivity of the cities.
- Studies as Abel, Dey, & Gabe (2011) have found that the productivity-density elasticity is between 2% and 4%.
- The elasticity measures the percentage change in productivity if the density increases by 100%.
- Without intervention, density will decrease 14.5% by 2030 so, everything equal, productivity would fall by 0.29%, assuming a 2% elasticity.
- That means, the annual production per worker will fall 87.7 USD in the Municipality.
- The implementation of ETZ2030 would increase population density in 4.7% by 2030, therefore, an increase of productivity by 0.09% would be expected.
- The implementation of ETZ2030 would increase annual productivity by USD 28.11 per worker by 2030.

III. Costs of urban expansion in Zapopan and benefits of the implementation of ETZ2030

The estimations show a reduction of urban sprawl costs of USD 476.3 million from 2018 to 2030 prompted by the implementation of ETZ2030.

Public infrastructure expenditure would be reduced by USD 4.4 million, by increasing density alone. The estimation does not include additional savings that would be accrued by tackling early the infrastructure deficit in peripheral districts, as deficits will be more expensive to address over time.

The reduction on the opportunity cost of travel time to work and school was estimated at USD 44.98 and 12.92 million at present value, respectively, accumulated from 2018 to 2030. In addition, savings on transportation expenses were estimated at USD 23.32 million for transport to work, and at USD 5.41 million for transport to school.

The opportunity cost of urban reserves with agricultural potential amounts to USD 43.32 million in the same period. This is the loss in the value of crops if the land is urbanized. The analysis does not include the value of urbanized land. It includes only the loss in agricultural value.

Finally, the estimated impact of ETZ2030 on productivity, due to the increase in population density, is about USD 342 million at present value in the time horizon analyzed. This is the item that contributes most to the accumulated benefits that the implementation of ETZ2030 2030 will bring to Zapopan's inhabitants and its government.

[3] Abel, J., Dey, I., & Gabe, T. (2011). Productivity and the Density of Human Capital. Federal Reserve Bank of New York Staff Reports.

Costs of urban expansion and benefits of the implementation of ETZ2030 in USD at Present Value, 2018-2030

	Without ETZ2030	With ETZ2030	Benefits of the ETZ2030 (difference)
Cost of municipal infrastructure	453,099,839	448, 759,882	4,339,957
Transportation cost to work	3,483,649,232	3,415,352,846	68,296,386
Opportunity cost of travel time	2,149,265,237	2,104,285,302	44,979,935
Transport cost	1,334,383,995	1,311,067,544	23,316,451
Transportation cost to School	2,119,191,287	2,100,865,154	18,326,134
Opportunity cost of travel time	1,384,752,687	1,371,834,448	12,918,239
Transport cost	734,438,600	729,030,705	5,407,895
Opportunity cost of urban land reserves with agricultural potential	43,332,510	–	43,332,510
Opportunity cost in economic growthdue to loss in productivity	342,047,365	–	342,047,365
TOTAL	6,441,310,234	5,964,977,882	476,332,352

Source: *Own calculations.*

Note: A 10% social discount rate was used to calculate the present value. This is the official rate for cost Benefit Analysis in Mexico established by the Ministry of Finance.