



## THE URBAN SPRAWL: A PLANETARY GROWTH PROCESS? AN OVERVIEW OF USA, MEXICO AND SPAIN

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**Key words:** urban sprawl, diffuse city, sustainable city, land consumption.

### Abstract:

It is a fact that the urban sprawl, known as the process of gradual spread out of urbanization has become a worldwide phenomenon. The growing consumption of land, as a result of the extension of highway networks, open up vast space of territory, which seems to have become an unstoppable cancer, and affects virtually all the contemporary metropolis.

The expansion of the cities had its origin in the model of suburban life, which began with the generalized use of the automobile. A lifestyle based on the "american dream", one single family-home, one (or more) car (s)." But it has been since late 70's of the last century, when it has had a more dramatic development, as a consequence of the crisis of metropolitan areas linked to what, it is called Post-Fordism economy and some authors have characterized as counter-urbanization (Berry) desurbanization (Berg), edge-cities (Garreau) metapolis (Asher) or diffuse city (Indovina). Despite the diversity of urban development, the increasing consumption of land, the excessive use of land as a scarce resource, it is a constant in the urbanization process in the early twenty-first century.

The object of our contribution is to make an overview about urban sprawl in USA, Mexico and Spain. The use of technologies related to satellite imagery (remote sensing) allow the characterization of the phenomenon of consumption, pathological or not, of land. And this analysis suggests some hypothesis about the plurality of the contemporary urbanization processes. Roughly two models stand out: On one hand, urban development based on low densities, where the unsustainable consumption of land is presented as a paradigm of economic development and, on the other hand, an urban development with a compact city model, where recycling land, and not just increasing the consumption of land, is one of the key objectives of urban policies. The work presented here, suggests that in the second model seems to appear a change in the paradigm towards a more efficient and sustainable use of the territory.

## 1. - Introduction

The second half of the twentieth century was undoubtedly the time with a faster urban growth worldwide. The urban population has grown from 750 million in 1950 to 2860 million in 2000, and now represents over 50% of the world population. Spain and Mexico have been no exception. The urban transformation generated in both countries is a phenomenon of great magnitude. In the mid-twentieth century, both Spain and Mexico were basically countries with an agricultural profile. Over 50% of the two countries population worked in agriculture. At the beginning of the twenty-first century, however, less than 20% (10% in Spain) of the employed population is engaged in agricultural activities. Industry but above all, services represent the majority of jobs.

Following the great ecologist Ramón Margalef, there has been a real inversion in the topology of the landscape. Highway networks, which only a few decades before were isolated elements throughout the countryside, are now present throughout the territory, setting a new "landscape", in which the rural become "islands" throughout the highly urbanized land, and this change has occurred in the course of one generation. Women and men born in 1950 have been witness of the extent of the changes, that from the 70's have been characterized not only by the progressive development, but by the continue increase in the per capita consumption of land: this process has been called urban sprawl<sup>4</sup>.

It is true that the urban sprawl, the process of gradual spread out of urbanization has become a worldwide phenomenon, especially in the developed world and its environs. The growing consumption of land, as a result of the extension of highway networks in urban areas, seems to have become an unstoppable cancer and affects virtually all the contemporary metropolis worldwide.

The expansion of the cities was originated in the model of suburban life, which began with the generalized use of the car. A lifestyle based on the "American Dream: one single family-home, and one (or more) car (s)", that means mobility and homeownership. However, it is not until the late 70's when it has a more dramatic development, as a consequence of the crisis of metropolitan areas linked to what is called Post-Fordism economy.

Some authors have characterized it as counter-urbanization (Berry) desurbanization (Berg), edge-cities (Garreau) metapolis (Asher) or diffuse city (Indovina). Despite the diversity of urban development, the increasing consumption of land, the excessive use of land as a scarce resource, it is a constant in the urbanization process in the early twenty-first century.

Our contribution is to make some reflections about the urban sprawl process in Mexico and Spain. The use of technologies related to satellite imagery (remote sensing) allows the characterization of the phenomenon of consumption, pathological or not, of land. And this analysis suggests some hypothesis about the plurality of contemporary of urbanization processes. Roughly, two models stand out: one based urban development at low densities, where the unsustainable consumption of land is presented as a paradigm of economic development and, in another hand, an urban development with a compact city model, where recycling land, and not just increasing the consumption of land, is one of the key objectives of urban policy. The work presented here suggests that, in recent years, a change in the paradigm towards a more efficient and sustainable use of the territory appears.



## 2. - The origins of urban sprawl.

The low density and diffuse forms of urbanization have their origin in the improvement of urban transport systems that emerged throughout the nineteenth century. The appearance of subways was especially a key element that led to the gradual separation of residential and work, causing the incipient process of suburbanization that took place during the last third of the nineteenth century.

As it is well known, the generalized use of the car as a way of private transportation in the early decades of the twentieth century reinforced the trend towards the dispersion of the population, generating new forms of suburban development and the construction of the ideal of "mobility and homeownership", which soon spread from the United States to the world.

According with Dematteis (1997), the urban development between the XIX and XX centuries, brought to the western world, the coexistence of two models of expansion:

- In the traditional Mediterranean until the nineteenth century, the city is not beyond the medieval walls. It is not until the industrial age when the countryside is colonized by high-density suburbs.
- In northern Europe, the city expands with the "Civita", the urban landscape replaces the previous rural and recreates them in some of its elements, the garden city emerged as one of the paradigms of urban development of late nineteenth and early twentieth century.

It was up to the last decades of the last century, when the process of urban sprawl had reached high levels, getting practically the entire planet. The crisis of the so-called "Fordist-Economy", based on the predominance of the industry and its concentration, to an economic system characterized by the dominance of the services and the gradual dispersion of the industrial production processes, has generated new patterns of urbanization characterized not only by the dispersion of residential activities, but also by the progressive suburbanization in the outskirts of the city of economic activity and employment.

The "counter urbanization", reported by Berry (1976), has made presence not only in countries with a longer history of suburban growth, but also in cities characterized by a compact model, as the Latin Mediterranean. In this sense, the majority of authors have recognized the worldwide generalization of the urban sprawl process.

The territorial model has a significant evolution in the recent decades, becoming from an urban continuum model with medium and high densities, to a diffuse and dispersed city, driven by technological innovation processes, separation of functions and finding proximity to nature. This redefinition of the territorial model was based on the new highways and communication networks, and has as a result a dispersed and unsustainable city, thus, a city with high consumption of land.

**Table num. 1: Population Density of urban areas over 500,000 inhabitants (2007).**

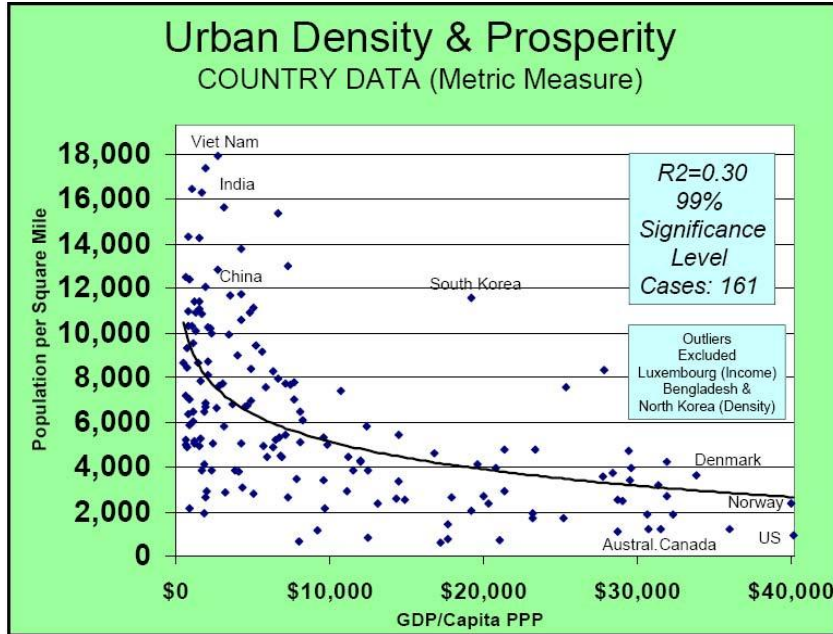
Area	Cases	Population (Millions)	Average population per Square Mile of Urban areas	Average population per Square kilometer of urban areas	Density Compared to United States Urban Density
<b>HIGH INCOME WORLD</b>					
Western Europe	61	101.5	7,700	3,000	2.75
Western Europe: Outside UK	51	82.4	7,200	2,750	2.57
Western Europe: UK	10	19.1	10,600	4,100	3.79
United States	65	142.1	2,800	1,100	1.00
Canada	8	14.0	3,900	1,500	1.39
Western Hemisphere Except Canada & US	1	2.2	2,500	950	0.89
Australia	5	10.4	3,700	1,450	1.32
New Zealand	1	1.1	5,500	2,100	1.96
Japan	23	79.1	10,700	4,100	3.82
China (Hong Kong & Macao)	1	6.5	76,200	29,400	27.21
China: Taiwan	6	14.9	17,900	6,900	6.39
Asia: Outside China & Japan	21	53.2	17,200	6,650	6.14
<b>Total/average</b>	<b>192</b>	<b>424.9</b>	<b>7,800</b>	<b>3,000</b>	<b>2.79</b>
<b>MIDDLE AND LOW INCOME WORLD</b>					
Europe Except Russia	29	41.6	10,900	4,200	3.89
China	100	153.4	17,400	6,750	6.21
India	69	134.5	40,600	15,700	14.50
Russia	38	46.6	12,900	5,000	4.61
Asia except China, India & Russia	97	191.7	20,900	8,050	7.46
Africa	81	134.3	21,300	8,200	7.61
South & Central America	101	195.3	16,500	6,350	5.89
<b>Total/Average</b>	<b>515</b>	<b>897.3</b>	<b>20,900</b>	<b>8,050</b>	<b>7.46</b>
<b>Urban Areas Total: Threshold Population</b>	<b>707</b>	<b>1,322.3</b>	<b>17,400</b>	<b>6,700</b>	<b>6.21</b>
<b>WORLD URBAN POPULATION ( 2002)</b>		<b>2,985.0</b>			
Share of World Urban Population in Threshold Urban Areas		<b>44.3%</b>			
Urban Areas Below Threshold	595	131.9	8,000	2,050	2.86
<b>TOTAL: ALL LISTED URBAN AREAS</b>	<b>1,302</b>	<b>1,454.2</b>	<b>8,700</b>	<b>3,350</b>	<b>3.11</b>
Share of world Urban Population		48,7%			

Source: Demographia World Urban Areas (2007)

Table N° 1 suggests a clear differentiation of the consumption of land patterns, depending on socio-economic status of the population. Countries with high and middle income tend to sprawl more than low-income countries. For example, if we limit ourselves to urban areas over 500,000 inhabitants, the urban density in the USA (1,100 inhabitants per km<sup>2</sup>), Australia (950 inhabitants/km<sup>2</sup>), Canada (1,500 inhabitants/km<sup>2</sup>) or Western Europe density (3,000 inhabitants/km<sup>2</sup>) is lower than the density of cities in Russia (5,000 inhabitants/km<sup>2</sup>), rest of the Americas (6,350 inhabitants/km<sup>2</sup>), Africa (8,200 inhabitants/km<sup>2</sup>), China (6,750 inhabitants / km<sup>2</sup>), India (15,700 inhabitants/km<sup>2</sup>) or the rest of Asia (8,050 inhabitants/km<sup>2</sup>).

Growing consumption of land, therefore, while being a worldwide phenomenon is concentrated in the developed world and its environs. The graphic 1 displays how the countries with high income, with few exceptions, are the geographic areas characterized by higher consumption of land.

**Graphic num. 1: Density & Prosperity**



Source: Demographia World Urban Areas (2007)

The new metropolises of the developed world, of which Atlanta is only the most noticeable example, show the infinite development of the built-up spaces, the vouch for the car as almost the only form of transportation, as well as the exponential growth of the energy consumption that the dispersed urbanization entails. The environmental unsustainability is an inseparable consequence of the model of sprawl. As a result, the agencies and institutions responsible for the regulation of the urban and territorial planning, intend to generate alternatives that imply to return to the order of the sustainable compactness. The debate on the limits of the urban sprawl has carried to alternative approaches like the proposal of the compact as new paradigm, the "smart growth" or the "new urbanism" in which the control of the indiscriminate process of consumption of ground appears as one of the fundamental objectives of the new urban politics.

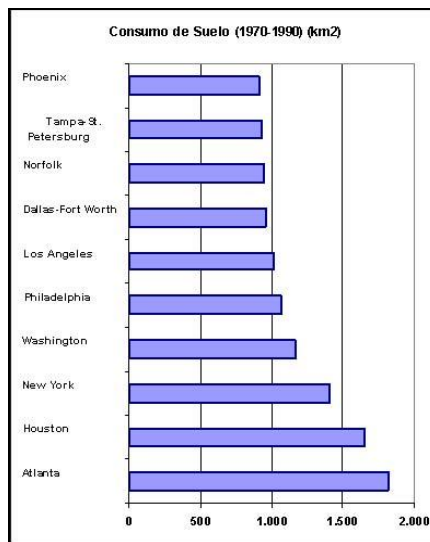
### 3.- The Sprawl in the USA

In the USA land consumption has gone from 161 square miles per 1,000 inhabitants in 1950 to 243 in 1970, and 293 in 1990 in the metropolitan areas (SMA) of more than one million inhabitants.

It has represented an increment of 384 square miles per each new 1,000 inhabitants between 1950 and 1970; figure that has increased to 527 in the period 1970-1990. The land consumption has been accentuated, therefore with the post-fordism, arriving at its paroxysm between 1970 and 1990. Graphic number 2 shows us the metropolitan areas with greater growth between 1970 and 1990.



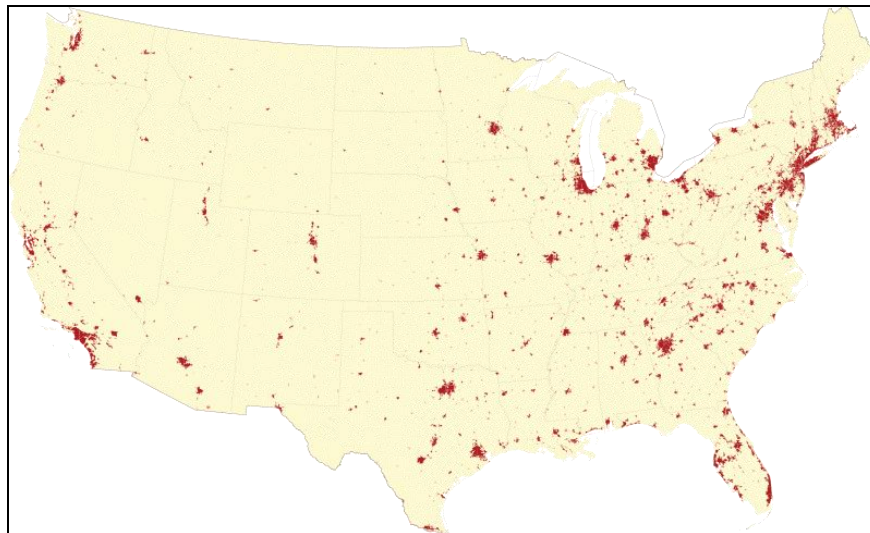
**Graphic num. 2: Top ten metropolitan areas SMA in consumption of land (1970-1990)**



*Source: Bureau of Census USA*

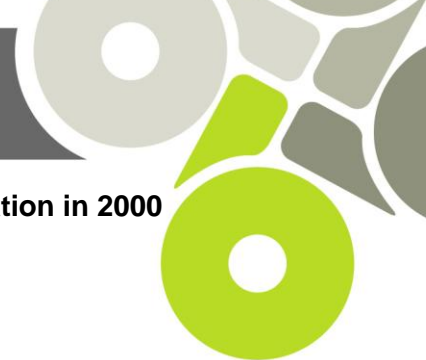
Figure number 1 shows us the urbanized areas in the continental U.S.A., where one can see a bigger concentration in the West side, especially in the northwest coast.

**Figure num. 1: Map of the U.S.A. with Sprawl in 2000**



*Source: Transferred from en.wikipedia; transferred to Commons by User:Sfan00\_IMG using CommonsHelper.*

The study has been focused on the sprawl analysis of the 12 urbanized areas which in 2000 had populations in excess of 3 million inhabitants, according to the information from the U.S. Census Bureau.



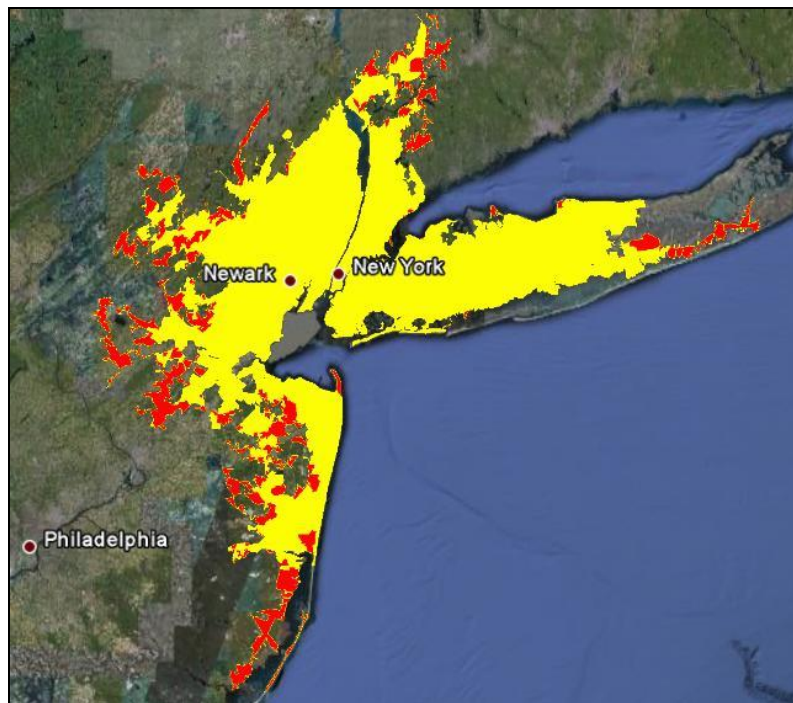
**Table num. 1: Urbanized areas with more than 3 million population in 2000**

Urbanized Areas	Pop. 2000
New York-Newark, NY-NJ-CT	17,799,861
Los Angeles-Long Beach-Santa Ana, CA	12,492,983
Chicago, IL-IN	8,307,904
Philadelphia, PA-NJ-DE-MD	5,149,079
Miami, FL	4,919,036
Dallas-Fort Worth-Arlington, TX	4,145,659
Boston, MA-NH-RI	4,032,484
Washington, DC-VA-MD	3,933,920
Detroit, MI	3,903,377
Houston, TX	3,822,509
San Francisco-Oakland, CA	3,782,562
Atlanta, GA	3,499,840

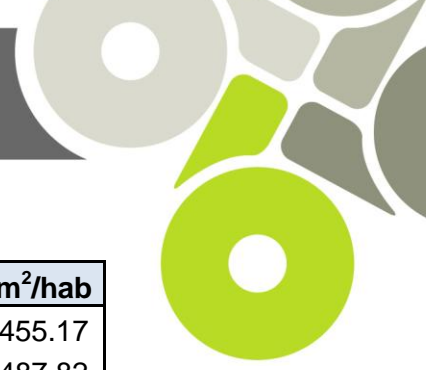
*Source: Elaborated from information of the U.S. Census Bureau*

The aforementioned urbanized areas (UA) are analyzed by comparing the land consumption in 1990 and 2000. The yellow tone of Figures 2-13 indicates the urbanized areas in 1990 with the red tone indicating the urbanized land in 2000. For each of the areas land consumption is expressed as a measure of area per 1,000 inhabitants.

**Figure num. 2: Urban growth of the UA of New York-Newark, NY-NJ-CT**



*Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001.*

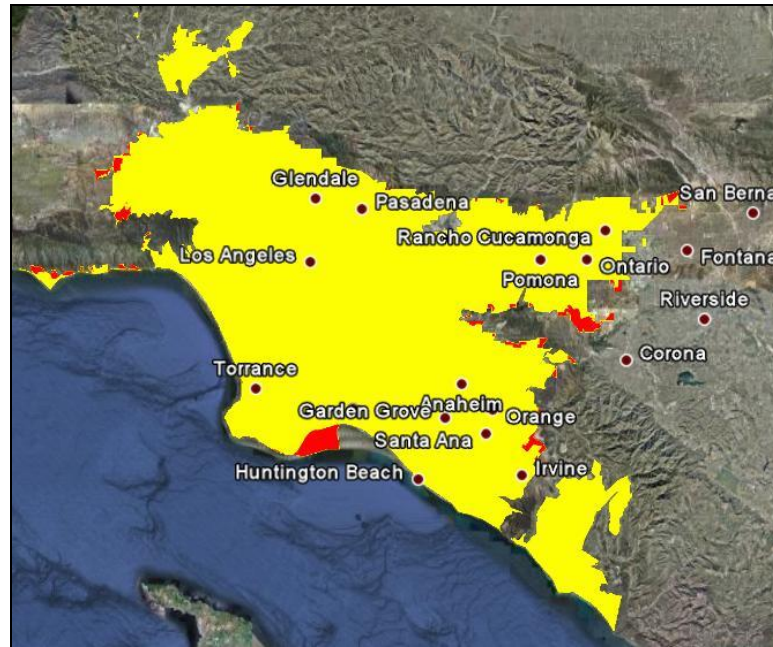


The values for New York-Newark, NY-NJ-CT urbanized area are these:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	16,044,493	7,302.98	2,196.98	45.52	455.17
2000	17,799,861	8,683.20	2,049.92	48.78	487.82

The urbanized area of New York--Newark, NY-NJ-CT has a land consumption of 487.82 m<sup>2</sup> per 1,000 inhabitants in 2000.

**Figure num. 3: Urban growth of the UA of Los Angeles-Long Beach-Santa Ana, CA**



Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001.

For its part, the values for Los Angeles-Long Beach-Santa Ana, CA urbanized area are:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	11,402,955	4708,79	2.421,63	41,29	412,94
2000	12,492,983*	5.204,05	2.400,63	41,66	416,56

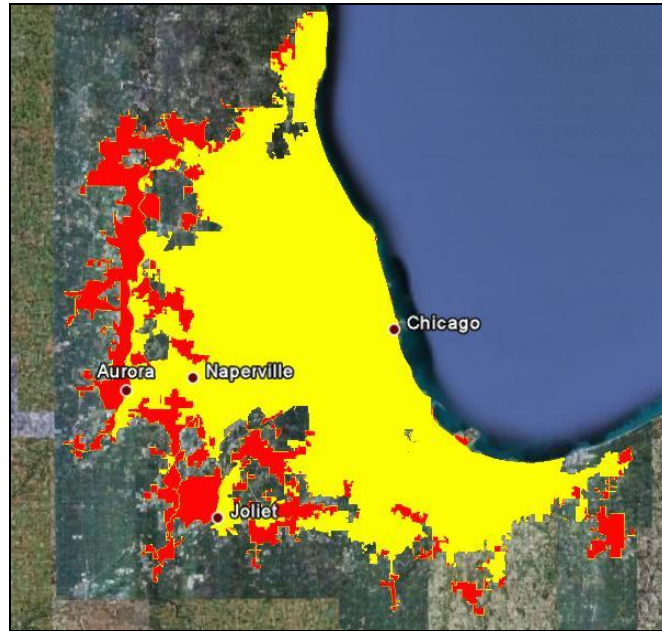
The urbanized area of Los Angeles-Long Beach-Santa Ana, CA has a land consumption of 416.56 m<sup>2</sup> per 1,000 inhabitants in 2000.

UA	Pop. 2000	Km2
Los Angeles--Long Beach--Santa Ana, CA	11,789,487	4,708.79
Mission Viejo, CA	533,015	354.53
Santa Clarita, CA	170,481	140.72
<b>TOTAL Los Angeles in 2,000</b>	<b>12,492,983</b>	<b>5,204.05</b>





**Figure num. 4: Urban growth of the UA of Chicago, IL-IN**



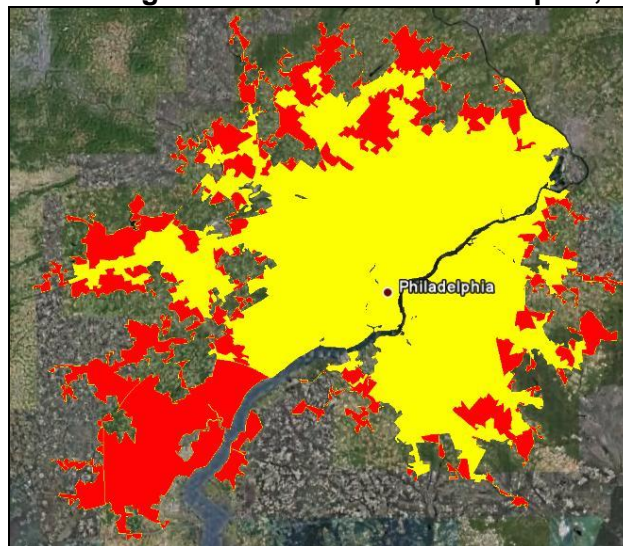
Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001.

In the case of Chicago, IL-IN urbanized area the values are shown in the following table:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	6,792,211	4,180.08	1,624.90	61.54	615.42
2000	8,307,904	5,498.10	1,511.05	66.18	661.79

The urbanized area of Chicago, IL-IN has a land consumption of 661.79 m<sup>2</sup> per 1,000 inhabitants in 2000.

**Figure num. 5: Urban growth of the UA of Philadelphia, PA-NJ-DE-MD**





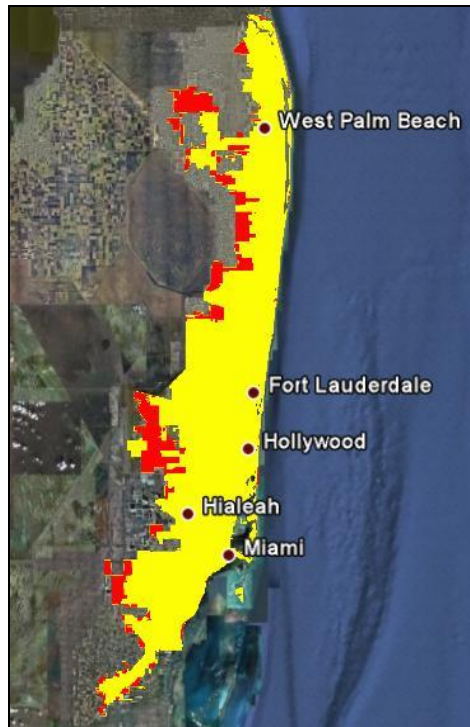
Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001

According to the information from the U.S. Census Bureau these are the values for Philadelphia, PA-NJ-DE-MD urbanized area:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	4.222.000	2.890,57	1.460,61	68,46	684,64
2000	5.149.079	4.660,70	1.104,79	90,52	905,15

The urbanized area of Philadelphia, PA-NJ-DE-MD has a land consumption of 416.56 m<sup>2</sup> per 1,000 inhabitants in 2000.

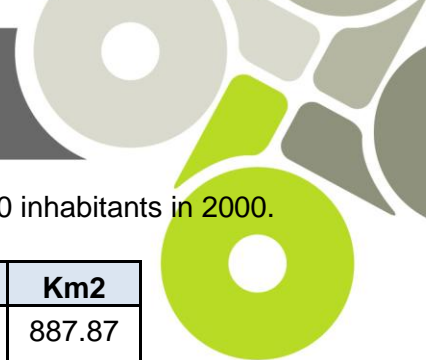
**Figure num. 6: Urban growth of the UA of Miami, FL**



Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001

For Miami, FL urbanized area the values are:

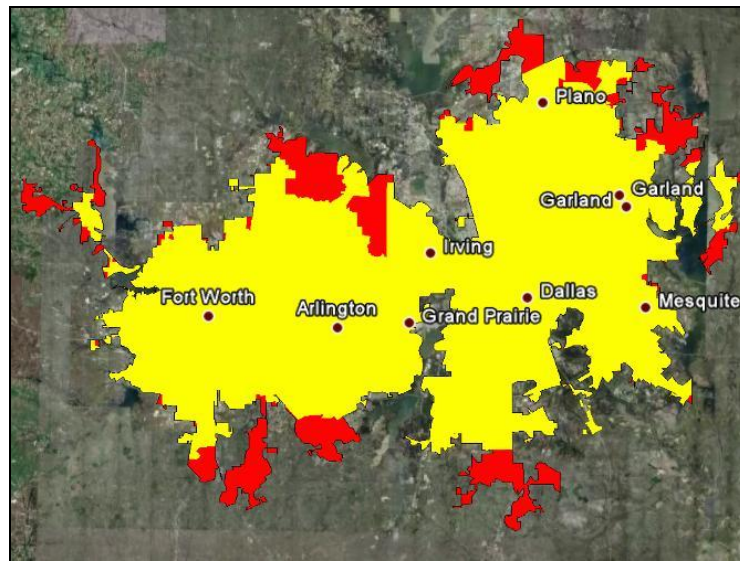
Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	3,152,798*	1,748.46	1,803.19	55.46	554.57
2000	4,919,036	2,890.67	1,701.67	58.76	587.65



The urbanized area of Miami, FL has a land consumption of 587.65 m<sup>2</sup> per 1,000 inhabitants in 2000.

UA	Pop. 1990	Km2
Miami--Hialeah	1,914,689	887.87
Fort Lauderdale--Pompano Beach--Hollywood, FL	1,238,109	860.59
<b>TOTAL Miami, FL</b>	<b>3,152,798</b>	<b>1,748.46</b>

**Figure num. 7: Urban growth of the UA of Dallas-Fort Worth-Arlington, TX**



*Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001*

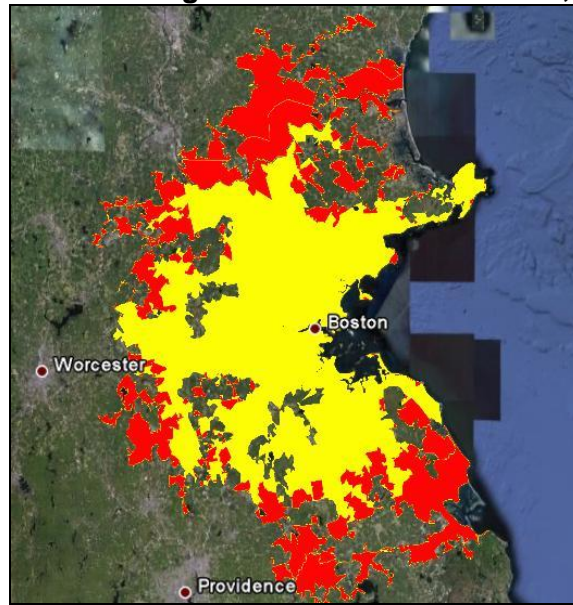
For Dallas, TX urbanized area:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	3,198,199	3,156.11	1,013.34	98.68	986.84
2000	4,145,659	3,644.50	1,137.51	87.91	879.11

The urbanized area of Dallas-Fort Worth-Arlington, TX has a land consumption of 879.11 m<sup>2</sup> per 1,000 inhabitants in 2000.



**Figure num. 8: Urban growth of the UA of Boston, MA-NH-RI**



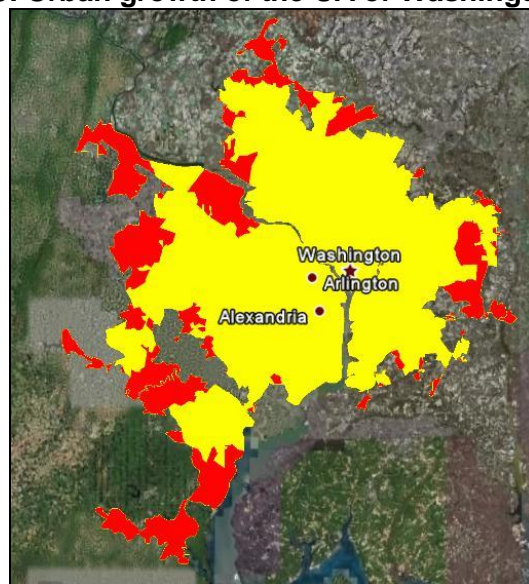
Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001

Regarding the Boston, MA--NH—RI urbanized area, the information are:

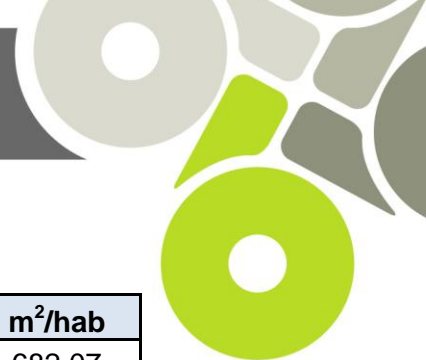
Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	2,774,717	2,378.78	1,166.45	85.73	857.31
2000	4,032,484	4,496.67	896.77	111.51	1,115.11

The urbanized area of Boston, MA-NH-RI has a land consumption of 1,115.12 m<sup>2</sup> per 1,000 inhabitants in 2000.

**Figure num. 9: Urban growth of the UA of Washington, DC-VA-MD**



Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001

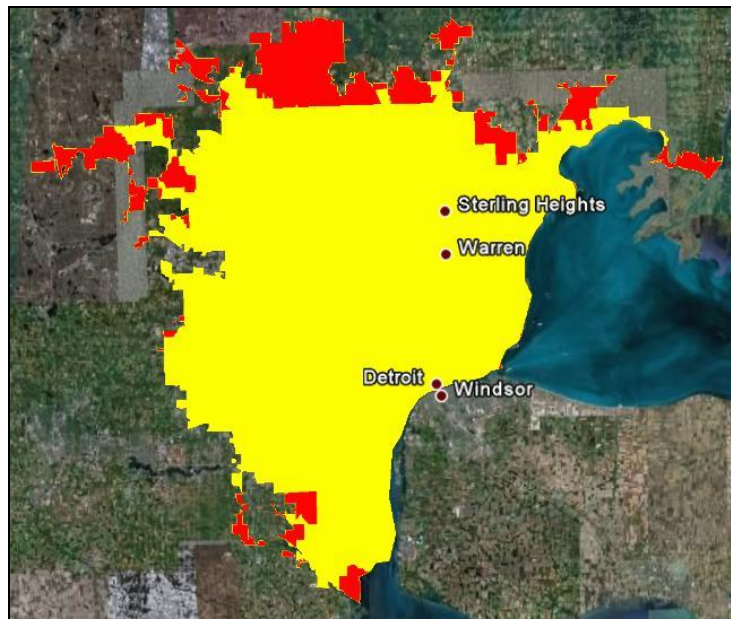


Moreover, the values for Washington, DC--VA--MD urbanized area are:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	3,363,047	2,293.84	1,466.12	68.21	682.07
2000	3,933,920	2,996.01	1,313.05	76.16	761.58

The urbanized area of Washington, DC-VA-MD has a land consumption of 761.58 m<sup>2</sup> per 1,000 inhabitants in 2000.

**Figure num. 10: Urban growth of the UA of Detroit. MI**



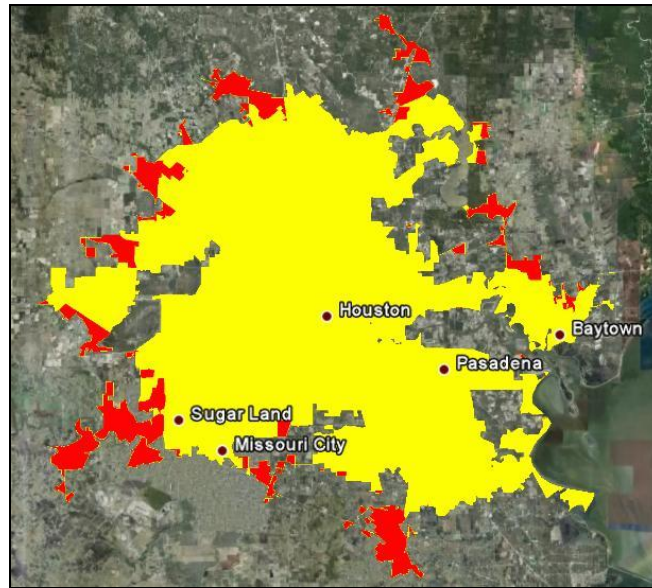
*Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001*

For Detroit, MI urbanized area the values are:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	3,697,424	2,897.50	1,276.07	78.37	783.74
2000	3,903,377	3,267.14	1,194.74	83.70	837.00

The urbanized area of Detroit, MI has a land consumption of 837.00 m<sup>2</sup> per 1,000 inhabitants in 2000.

**Figure num. 11: Urban growth of the UA of Houston. TX**



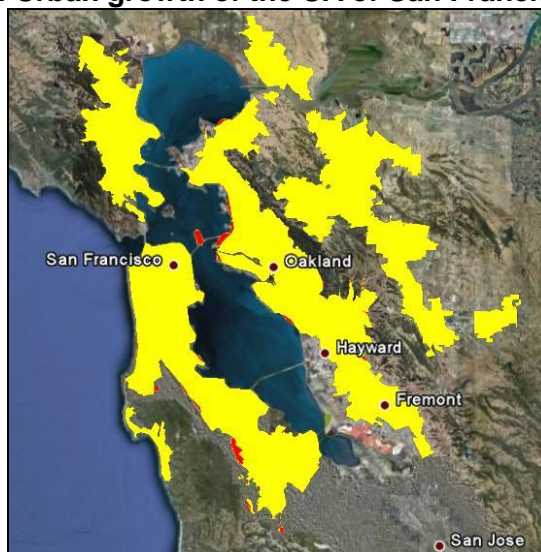
Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001

According to the information from the U.S. Census Bureau these are the values for Houston, TX urbanized area:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	2,902,449	2,948.55	984.36	101.59	1,015.88
2000	3,822,509	3,354.72	1,139.44	87.76	877.62

The urbanized area of Houston, TX has a land consumption of 877.62 m<sup>2</sup> per 1,000 inhabitants in 2000.

**Figure num. 12: Urban growth of the UA of San Francisco-Oakland. CA**



Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001



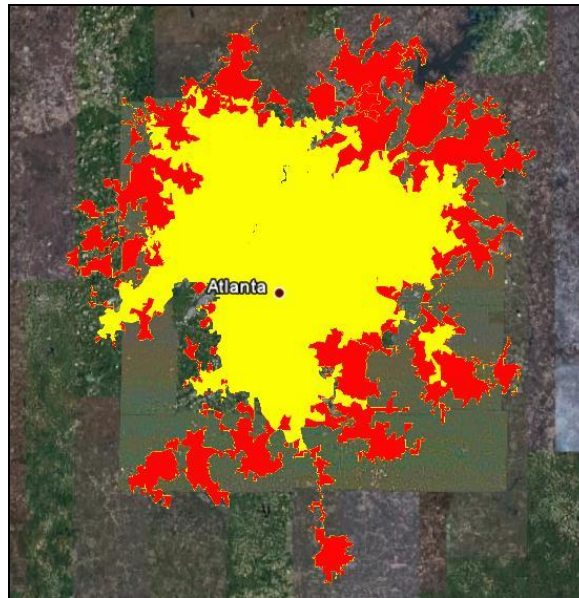
According to the information from the U.S. Census Bureau these are the values for San Francisco--Oakland, CA urbanized area:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	3,629,864	1,896.97	1,913.51	52.26	522.60
2000	3,782,652*	1,735.45	2,179.59	45.88	458.80

The urbanized area of San Francisco--Oakland, CA has a land consumption of 458.80 m<sup>2</sup> per 1,000 inhabitants in 2000.

UA	Pop.2000	Km2
San Francisco--Oakland, CA	2.995.769	1107,75
Concord, CA	552.624	457,02
Livermore, CA	75.202	54,06
Half Moon Bay, CA	No data	28,68
Vallejo, CA	158.967	87,94
<b>Total San Francisco--Oakland en el 2000</b>	<b>3.782.562</b>	<b>1.735,45</b>

**Figure num. 13: Urban growth of the UA of Atlanta. GA**



*Source: Elaborated from information of the U.S. Census Bureau, Geography Division, Cartographic Products Management Branch, 2001*

Finally the values for Atlanta, GA urbanized area, are:

Year	Population	Km <sup>2</sup>	Dens km <sup>2</sup>	Ha/1,000hab	m <sup>2</sup> /hab
1990	2,157,344	2,925.55	737.41	135.61	1,356.09
2000	3,499,840	5,083.06	688.53	145.24	1,452.37

The urbanized area of Atlanta, GA has a land consumption of 1,452.38 m<sup>2</sup> per 1,000 inhabitants in 2000.



#### 4. - The Urban Sprawl in Spain

In Spain there has been an intense increase in the land occupation in the recent decades, due to the highly dynamic process produced by the artificial land uses.

Based on data provided by the CORINE Land Cover project we can say that the artificial land use has increased in Spain between the years 1990 and 2000, 168,460 ha. This represents a 25.14% of the artificial land at the beginning of this decade.

Comparing with other European countries (see table number 2), Spain is the most dynamic country in urban expansion, ahead of Germany (158,843 ha), France (122,880 ha) and Italy (82,633 ha). In relative terms, is the third country with the most pronounced urban growth in the studied decade, after Portugal (38.64%) and Ireland (30.67%).

**Table num. 2: Artificial land use process in Europe (1991-2000)**

	Urbanized land 1990	Urbanized land 2.000	Variation 1990-2000	Increment Urbanized land	Population Density 1990	Population Density 2000	Variation Density 90-00	Inc. Pob. / Inc SU
AUSTRIA	340.169	350.581	10.412	3,06%	22,90	23,21	0,31	33,39
BELGIUM	607.568	624.433	16.865	2,78%	16,40	16,38	-0,02	15,73
BULGARIA	542.247	545.315	3.068	0,57%	16,12	14,57	-1,55	-259,85
CZECH Rep.	475.904	480.882	4.978	1,05%	21,66	21,23	-0,43	-19,46
GERMANY	2.738.368	2.897.211	158.843	5,80%	29,18	28,44	-0,74	15,63
DENMARK	298.682	311.548	12.866	4,31%	17,25	17,19	-0,07	15,64
ESTONIA	89.562	91.537	1.975	2,21%	17,32	14,88	-2,43	-95,37
SPAIN	669.993	838.453	168.460	25,14%	58,13	48,59	-9,53	10,67
FRANCE	2.538.988	2.661.868	122.880	4,84%	22,47	22,35	-0,12	19,93
GIBRALTAR	294	313	19	6,46%	91,63	88,33	-3,30	37,32
GREECE	254.733	289.934	35.201	13,82%	40,22	37,98	-2,24	21,78
CROATIA	162.433	166.841	4.408	2,71%	28,00	26,96	-1,04	-11,38
HUNGARY	521.543	529.419	7.876	1,51%	19,84	19,25	-0,59	-19,96
IRELAND	104.435	136.468	32.033	30,67%	33,72	28,30	-5,42	10,62
ITALY	1.348.146	1.430.779	82.633	6,13%	42,14	40,44	-1,70	12,65
LITHUANIA	213.320	213.978	658	0,31%	17,35	16,28	-1,07	-331,38
LUXEMBOURG	20.840	22.610	1.770	8,49%	18,54	19,51	0,97	30,94
LATVIA	85.208	85.325	117	0,14%	31,04	27,68	-3,36	-2422,93
NETHERLANDS	370.704	453.827	83.123	22,42%	40,60	35,29	-5,32	11,57
POLAND	1.026.665	1.041.477	14.812	1,44%	37,25	36,86	-0,40	9,42
PORTUGAL	172.916	239.739	66.823	38,64%	57,72	42,90	-14,82	4,55
ROMANIA	1.488.613	1.495.941	7.328	0,49%	15,57	14,73	-0,84	-155,40
SLOVENIA	54.184	54.446	262	0,48%	35,71	36,50	0,79	199,75
SLOVAKIA	276.169	276.522	353	0,13%	19,12	19,48	0,37	306,21
SAN MARINO	625	698	73	11,68%	39,14	39,41	0,27	41,73
Un. KINGDOM	1.783.646	1.817.051	33.405	1,87%	32,17	32,53	0,36	51,92

By provinces and autonomous regions, the land consumption has been different. In absolute terms, first of all is the growth in Madrid (29,789 Ha) and Valencia (29,308 ha), well ahead of Andalucia (19,652 Ha), Castilla-Leon (16,635 Ha), Catalonia (13,250 Ha), Castilla-La Mancha (12,834 Ha), Murcia (10,143 ha) and other regions. Meanwhile, by provinces, besides Madrid, Alicante has grown (15,697 Ha), Murcia, Valencia (9,699 ha) and the Balearic Islands (8,140 ha).

In relative terms, the geography of urban growth has affected mainly the region of Murcia (52.63%), Navarre (50.96%), Madrid (49.09%), Valencia (47, 65%) and Balearic Islands (42.75%), compared to



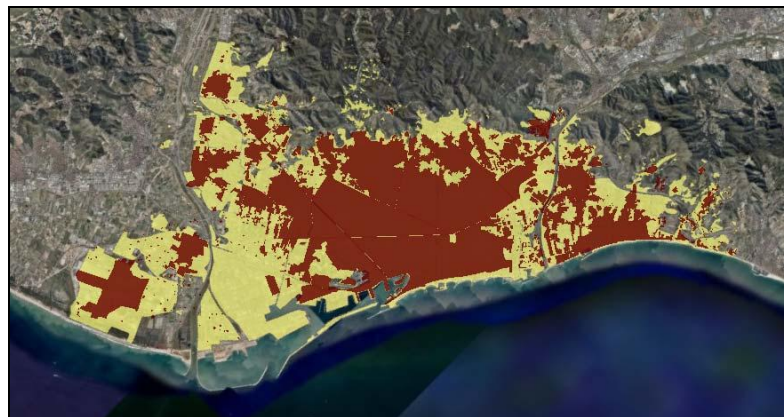


Canary Islands (8.43), Catalonia (10.84%) and Galicia (12.66%), which have experienced a content smart growth.

The expansion of urbanization has occurred, if we leave aside the exceptions of Navarre and Madrid, on the Mediterranean coast (with the exception of Catalonia and Andalucia). So out as the provinces with the highest relative growth Alicante (59.90%), Castellon (59.83%), and two districts near Murcia which have grown higher. In the rest of Spain with the cases of Navarre and Madrid already mentioned, there is to highlight the relative growth in some provinces of the two Castillas, like Soria (60.17%), Leon (44.56%), Salamanca (42.22%), Guadalajara (41.60%) and Valladolid (40.68%). It is also noteworthy Ourense, with a relative growth of 42.51%, well above the other provinces of Galicia. The Provinces with less dynamic urban growth in the decade 1990-2000 have been Teruel (5.35%), Palmas (6.29%), Girona (6.84%), Almeria (7.41%), Pontevedra (7.90%), Coruña (8.88%), Guipuzcoa (9.71%) and Barcelona (10.38%).

In particular, Centre of Land Policy and Valuations of the UPC has studied urban growth produced by a group of Spanish urban areas between 1956 and 2006, specifically the urban areas of Barcelona, Madrid, Cordoba, Murcia and the coast of Alicante. In these five areas the population has doubled in the period studied, but more important is that the land consumed by urbanization has grown much more pronounced: a 258%. A total of 673 km<sup>2</sup> urbanized, of which 320 have been developed in the Madrid area, 126 in the coast of Alicante, 98 in the coast of Murcia, 72 at the Barcelona metropolitan area and 57 km<sup>2</sup> in the municipality of Cordoba. The consumption of land per 1,000 inhabitants has increased in these five urban "landscapes" from 6.31 ha in 1956 to 9.19 in 1990 and 11.04 in 2006. This has represented a consumption of 12.48 Ha. per 1,000 new residents of land, if we consider only the increase of land use in relation to the balance of population, between 1956 and 1990, and just 6.31ha. up until 1956. This ratio of land consumption increased between 1990 and 2006, reaching 35.37 Ha. per 1,000 new inhabitants.

**Figure num. 14: Barcelona urban growth evolution (1956-2006)**



Source:CPSV

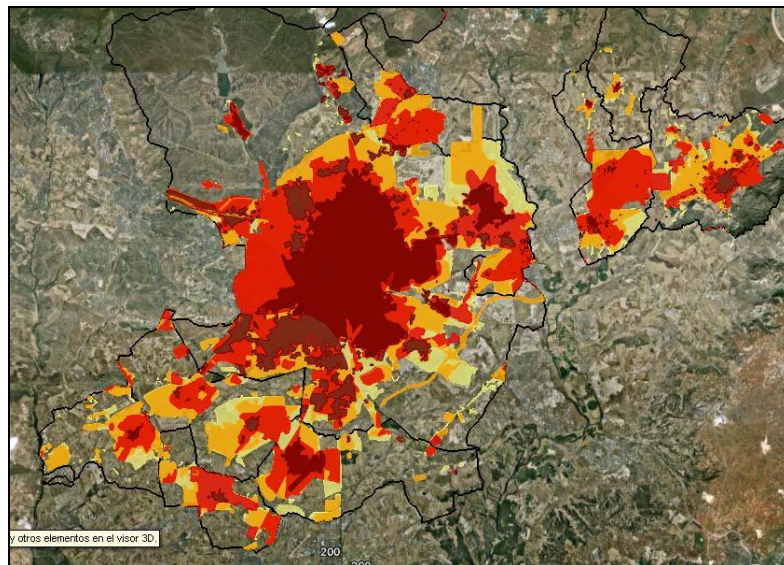
I.e. in the last 15 years there has been a relative increase in land consumption (per person per year), three times higher than in the first 35 years studied. The sprawl is, therefore, a pathological condition in contemporary Spain.

For urban areas, the greater exponent of the model which might be called compact city, is the metropolitan area of Barcelona, whose per capita consumption of land has been maintained throughout the past 50 years into moderate level. This has gone from a consumption of 4.84 ha. per 1,000 inhabitants to 6.11 in 2006. More moderate than the increases experienced by the agglomeration of



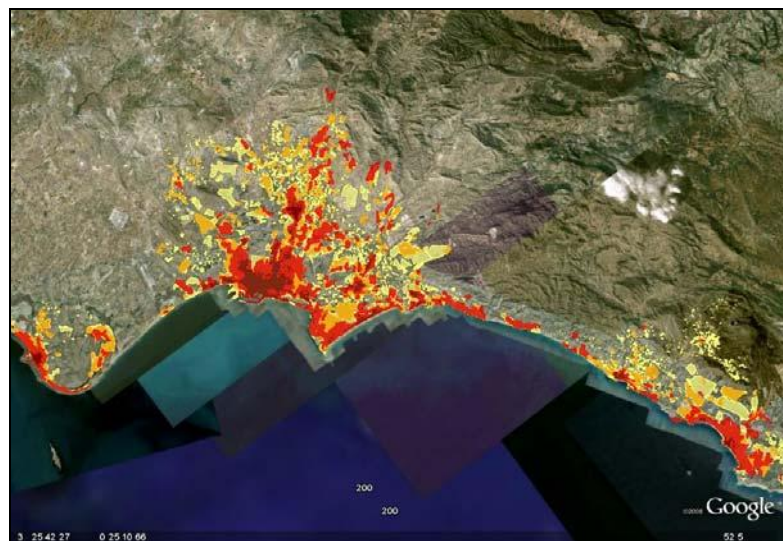
Madrid (10.15 in 2006 versus 7.27 in 1956).

**Figure num. 15: Madrid urban growth evolution (1956-1990-2000-2006)**

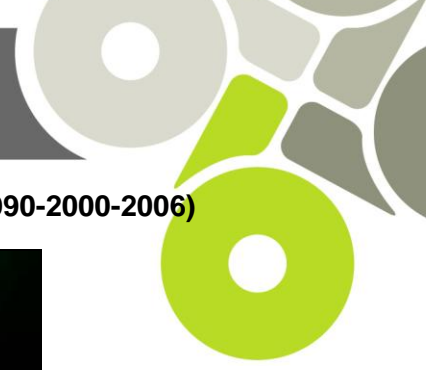


Source: CPSV

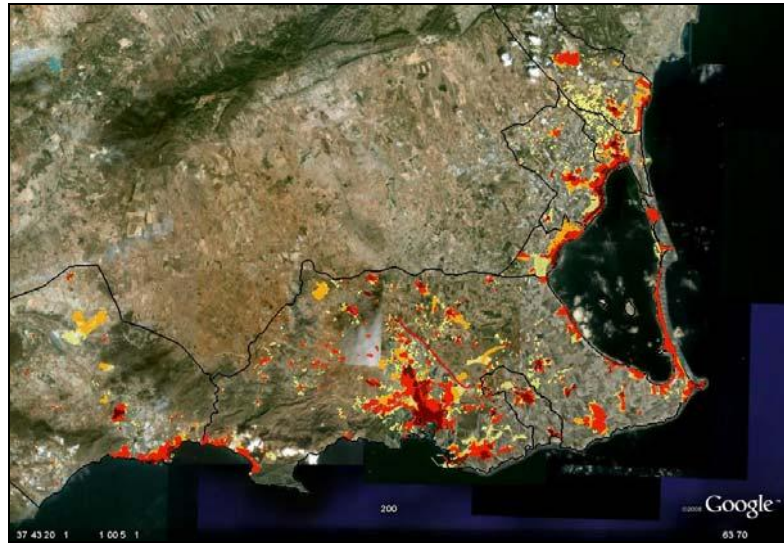
**Figure num. 16: Coast of Alicante urban growth evolution (1956-1990-2000-2006)**



Source: CPSV

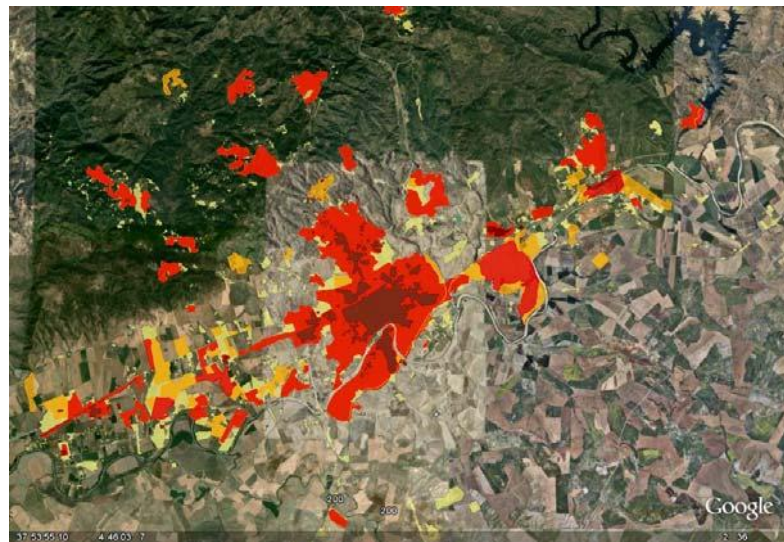


**Figure num. 17: Coast of Murcia urban growth evolution (1956-1990-2000-2006)**



Source: CPSV

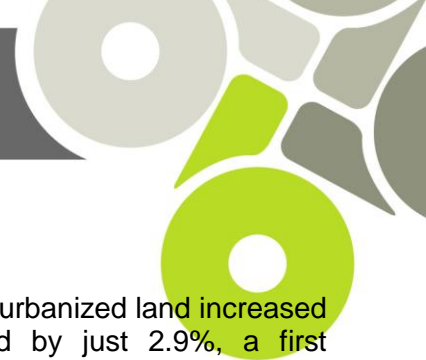
**Figure num. 18: Cordoba urban growth evolution (1956-1990-2000-2006)**



Source: CPSV

In the opposite direction to Barcelona, there is the large sprawl of Cordoba (20.31 versus 4.92), Costa de Alicante (21.61 versus 9.30) and, above all, Murcia (34.16 vs. 9, 16). The urban sprawl spreads primarily by the Mediterranean coast, but is not exclusive monopoly of it, as evidenced by the high sprawl in an intermediate city as Cordoba.

The analysis of the urbanization process occurred in Spain between 1956 and 2006 suggests, therefore, the coexistence of two opposing models of urbanization. On one hand, the maintenance of the compact city, as shown in the example of Barcelona, where the emphasis is on the revitalization of the built up area rather than mass consumption of new land for urbanization. On the other hand, the model of the city dispersed the paradigmatic examples of the Mediterranean coast, where low density and extensive land use are linked to a speculative real estate development.



Consider two models more precisely:

- In the metropolitan area of Barcelona (RMB), an example of compact city, the urbanized land increased between 1990 and 2000, 5875 ha., (9.9%). As the population increased by just 2.9%, a first approximation would suggest that sprawl has also polluted the most compact in this decade. But if you look at the growth of households, who are the truly applicants for urbanized land, the above conclusion is not so obvious: the main housing units increased by 246,847 between 90 and 00, 18.1% more than the increase in urbanized land. In turn, the workplaces, also applicants of urban space, grew by 16.8%, also more than the artificial land. Therefore, in the period 1990-2000, land-use per household fell from 201.5 m<sup>2</sup> to 188.6 m<sup>2</sup>. The sprawl was lower in the decade studied in Barcelona.
- Choosing the Alicante province as an example of a dispersed city, the urbanized land grew by 18,198 ha. in this decade, a 64.7% of the existing in 1990. The population increased by 13.1%, household 30.9% and 52.8% of jobs. And the consumption of land per applicant household- employment rose from 360.2 m<sup>2</sup> in 1990 to 418.7 m<sup>2</sup> in 2000. As shown, the growth of jobs and homes did not offset the increase in urbanized land, so we can say there was a real process of sprawl in the studied decade. Alicante consumes more than double urban land per household in Barcelona.

Both models, therefore, have distinct behaviors. While in the first model the processes are occurring in order to maintain the compactness as one of the guiding elements of urban policy, in the second, the established goal of maximum development towards an unsustainable urbanization, in which consumption of natural resources as land and energy appears as distinctive features. This dual trend towards maintaining the compactness and to the dispersion of urbanization, characterizes the urbanization process in Spain now.

## 5. - The Urban Sprawl in Mexico.

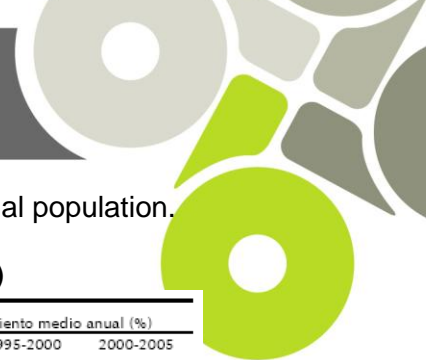
In the case of Mexico, as in Spain, is in the second half of last century that cities experienced higher growth, so from 12 metropolitan areas in 1960 (Unikel, 1978) to a total of 56 in 2005, which account for 56% of the national population, 78.6% of the national urban population and 75% of gross domestic product (SEDESOL, CONAPO and INEGI, 2008).

**Table num. 3: Metropolitan Areas Indicators in Mexico (1960-2005)**

Indicator	1960	1980	1990	2000	2005
Metropolitan areas	12	26	37	55	
Delegations and metropolitan Municipalities	64	131	155	309	345
Federative entities	14	20	26	29	29
Total population (million)	9.0	26.1	31.5	51.5	57.9
Percentage of national population	25.6	39.1	38.8	52.8	56.0
Percentage of urban population	66.3	71.1	67.5	77.3	78.6

*Source: Delimitation of the metropolitan areas in Mexico 2005. SEDESOL, CONAPO and INEGI, 2008.*

Our analysis is focused in the urban sprawl in the nine metropolitan areas over one million inhabitants in 2000: Valle de Mexico, Guadalajara, Monterrey, Puebla-Tlaxcala, Toluca, Tijuana, Leon, Juarez and La



Laguna. These nine metropolitan areas concentrated a 35.4% of the total national population.

**Table num. 4: Population Growth in MA (1990-2005)**

Rango	Zonas metropolitanas	Población				Tasa de crecimiento medio anual (%)		
		1990	1995	2000	2005	1990-1995	1995-2000	2000-2005
Total nacional		81 249 645	91 158 290	97 483 412	103 263 388	2.1	1.6	1.0
Total zonas metropolitanas	56	42 554 959	49 119 422	53 293 293	57 878 905	2.6	1.9	1.5
1 000 000 o más hab.	9	27 489 970	31 414 813	34 009 175	36 601 562	2.4	1.9	1.3
500 000 a 999 999 hab.	18	9 110 635	10 888 247	12 022 172	13 456 460	3.2	2.3	2.0
Menos de 500 000 hab.	29	5 954 354	6 816 362	7 261 946	7 820 883	2.4	1.5	1.3
Resto del país		38 694 686	42 038 868	44 190 119	45 384 483	1.5	1.2	0.5

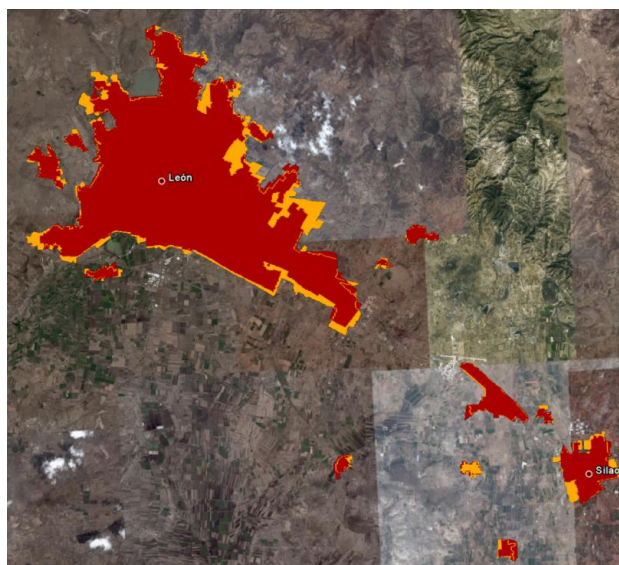
Source: *Delimitation of the metropolitan areas in Mexico 2005. SEDESOL, CONAPO and INEGI, 2008.*

In absolute growth in the five years from 2000 to 2005, the greatest increase in consumption of urban land has been the metropolitan area of Puebla-Tlaxcala (17,448.61 ha.), followed by the metropolitan area Valle de Mexico (10,997 ha.).

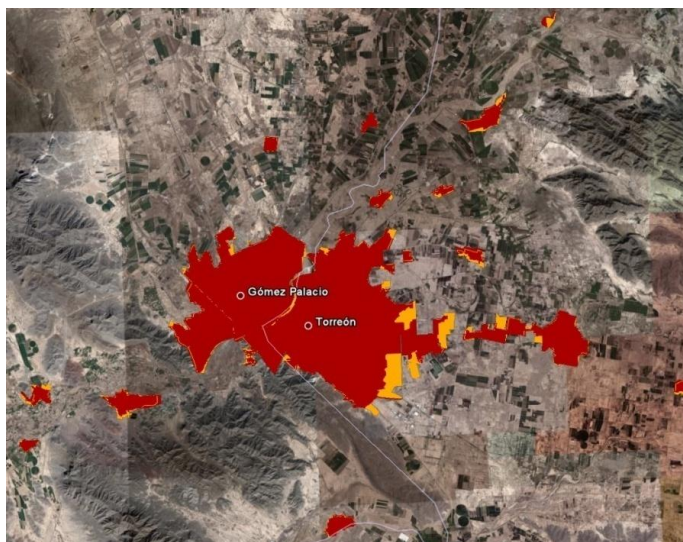
It is relevant, that especially in the case of Puebla-Tlaxcala, and the Metropolitan Area of Mexico City, in addition to the sprawl, these areas have had a "metropolitanización". That means, metropolitan area Puebla-Tlaxcala has joined 15 municipalities in the studied time and ZM Valle de Mexico has added to its surface 24 municipalities of Estado de Mexico.

Monterrey has filed a consumption of land of 7,611.62 ha in the same time and Guadalajara 4,830.89 ha. It also highlighted the growth in the Tijuana area (3,887.66 ha). The cities with less consumption of land of the nine MA's were Toluca (2633.25), La Laguna (2988.37 has.), Leon (3075.78) and Juarez (3134.55).

**Figures num. 19&20: Leon and De la Laguna urban growth (2000-2005).**



Source: *Elaborated from INEGI and CONAPO data bases.*

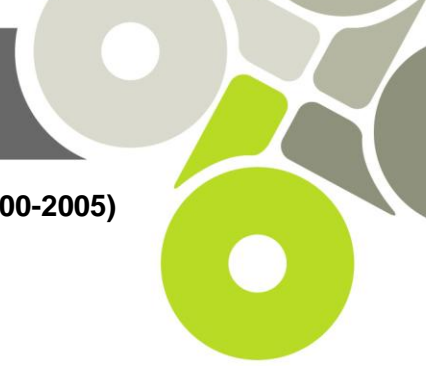


Source: Elaborated from INEGI and CONAPO data bases.

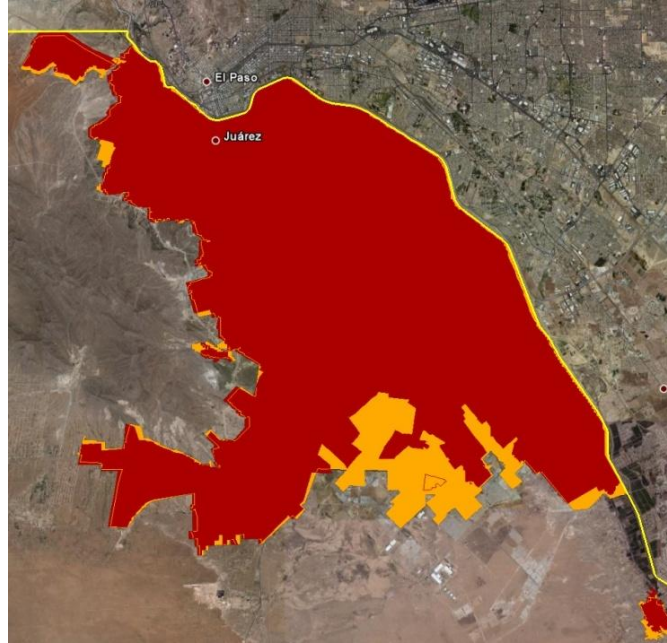
**Table num. 5: Population & Land Consumption in MA (2000-2005)**

Metropolitan Area	POB_00	POB_05	DIF. POB	SUE_URB_00	SUE_URB_05	DIF. SU	Increase
ZM De la Laguna	1,007,291	1,110,890	103,599	21,226.99	24,215.36	2,988.37	14.08%
ZM Guadalajara	3,699,136	4,095,853	396,717	50,067.80	54,898.69	4,830.89	9.65%
ZM Juarez	1,218,817	1,313,338	94,521	27,334.53	30,469.08	3,134.55	11.47%
ZM Leon	1,269,179	1,425,210	156,031	16,113.27	19,189.05	3,075.78	19.09%
ZM Monterrey	3,299,302	3,738,077	438,775	63,654.65	71,266.27	7,611.62	11.96%
ZM Puebla-Tlaxcala	1,885,321	2,470,206	584,885	49,834.05	67,282.66	17,448.61	35.01%
ZM Tijuana	1,274,240	1,575,026	300,786	26,879.79	30,767.44	3,887.66	14.46%
ZM Toluca	1,451,801	1,633,052	181,251	33,989.83	36,623.07	2,633.25	7.75%
ZM Valle de Mexico	18,396,677	19,239,910	843,233	211,616.51	222,613.51	10,997.00	5.20%

In relative terms, the results vary. The metropolitan area with higher urban growth is again, Puebla-Tlaxcala (35.01%), followed by Leon (19.09%), Tijuana (14.46%) and La Laguna (14.08%). In a second group of high growth were the metropolitan areas of Monterrey (11.96%), Juarez (11.47%) and Guadalajara (9.65%). Finally the regions that have lower urbanization are Toluca (7.75%) and the metropolitan area Valle de Mexico (5.20%).



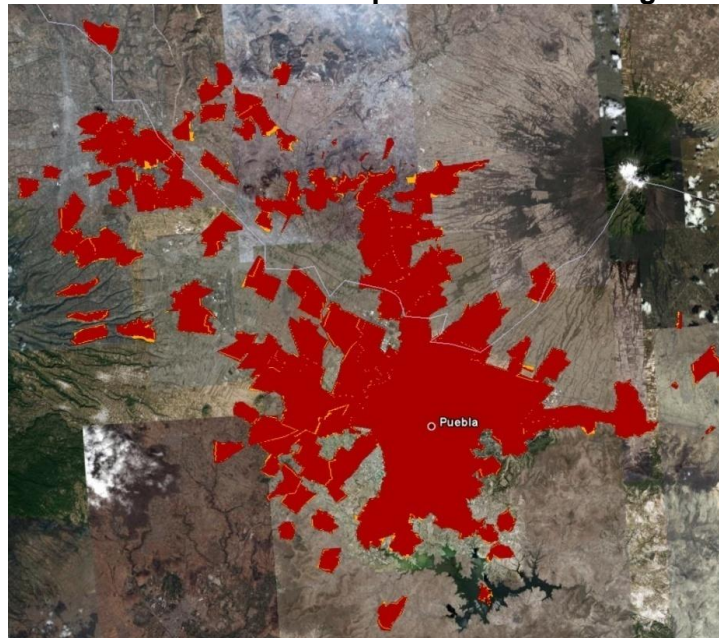
**Figure num. 21: Juarez Metropolitan Area urban growth (2000-2005)**



*Source: Elaborated from INEGI and CONAPO data bases.*

This is explained by the different stages of transformation during the “life” of the cities and their municipalities. On one side we have cities with high global population growth, resulting in high demands for land for housing and new urban centers for trade and services. Such is the case of metropolitan areas of Juarez. On the other side Puebla-Tlaxcala, where the highest growth occurred in the periphery, like in Juarez (14.6%) and San Andres Cholula (6.5%), but the urban growth of this metropolitan area is due too and over all, to the incorporation of 15 municipalities that were not part of the metropolis in 2000. That does explain the high consumption of land in this short period of time.

**Figure num. 22: Puebla-Tlaxcala Metropolitan Area urban growth (2000-2005)**



*Source: Elaborated from INEGI and CONAPO data bases.*

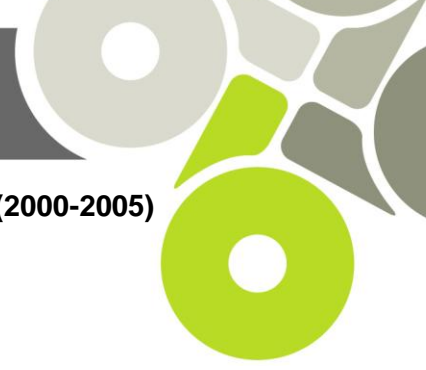
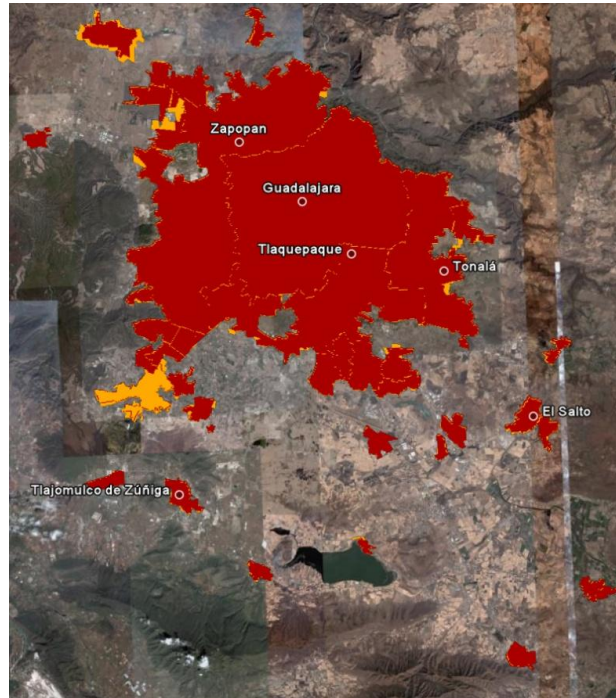
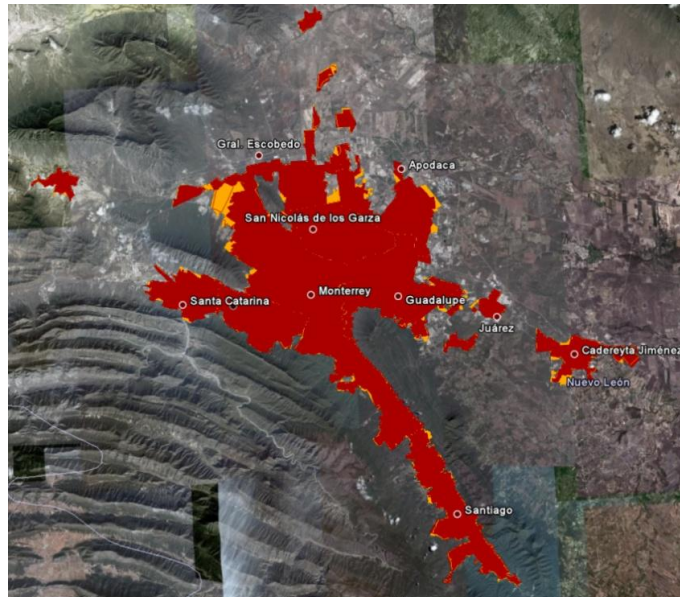


Figure num. 23: Guadalajara Metropolitan Area urban growth (2000-2005)



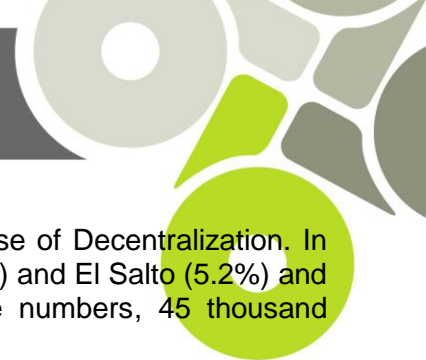
Source: Elaborated from INEGI and CONAPO data bases.

Figure num. 24: Monterrey Metropolitan Area urban growth (2000-2005)



Source: Elaborated from INEGI and CONAPO data bases.





Also, the three largest metropolis of the country are in Absolute Relative Phase of Decentralization. In the case of Guadalajara, with high growth rates in Tlajomulco de Zuñiga (10.8%) and El Salto (5.2%) and negative growth rates in the central city of Guadalajara, losing in absolute numbers, 45 thousand inhabitants.

The case of the ZM Monterrey with high population growth in Garcia (10.7%), Apodaca (7.1%) and Salinas Victoria (6.9%) and loss of population in the San Nicolas de Garza (20 thousand inhabitants).

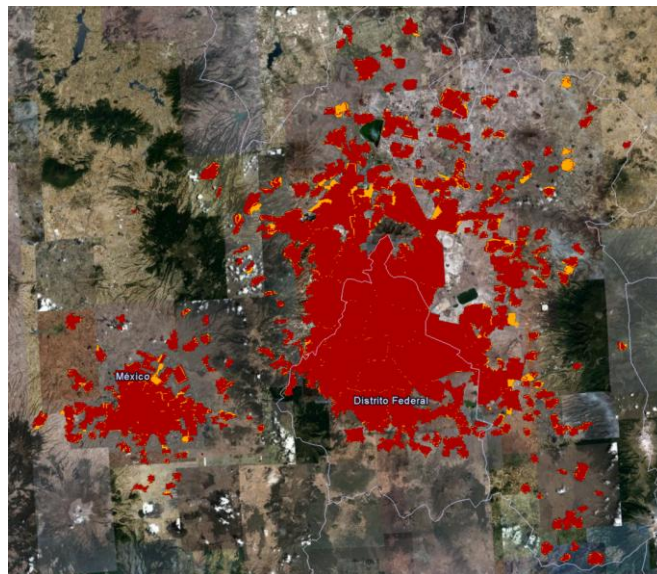
Finally, the case of the Metropolitan Zone Valle de Mexico, won population in Chicoloapan (14.8%), Tecamac (8.2%), Huehuetoca (8.1%), Cuautitlán (6.8%), Ixtapaluca (6.7%) and Tezoyuca (5.4 %). The central municipalities and delegations, in absolute terms, have the greatest losses, in which Nezahualcóyotl highlights (with a loss of 85 thousand inhabitants), Gustavo A. Madero (42 mil), Tlalnepantla (38 mil), Naucalpan (37 thousand), Iztacalco (16 thousand), Azcapotzalco (16 thousand) Venustiano Carranza (15 thousand) and Coyoacán (12 thousand).

This phenomenon of urbanization has resulted in at least three metropolitan areas which concentrated over one quarter of the total inhabitants of Mexico.

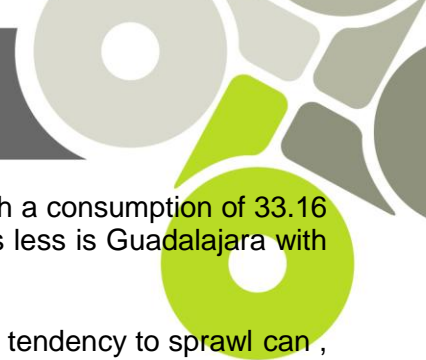
As already mentioned, the urban sprawl has increase in the last decades of the last century, and Mexico was no exception. It is also important to mention, the momentum of the housing finance sector in the beginning of this century. In this sense, the INFONAVIT (main source for financing housing) granted in the period 2000 to 2007 136% more than in the previous 27 years of existence of the Institute. This resulted in 2'593,321 housing credits.

However, the growth of this sector has been directed to developments of single-family homes, and low and medium density of vertical and horizontal buildings, and always auto-oriented developments.

**Figure num. 25: Toluca and Valle de Mexico (DF) Metropolitans Areas (2000-2005)**



*Source: Elaborated from INEGI and CONAPO data bases.*



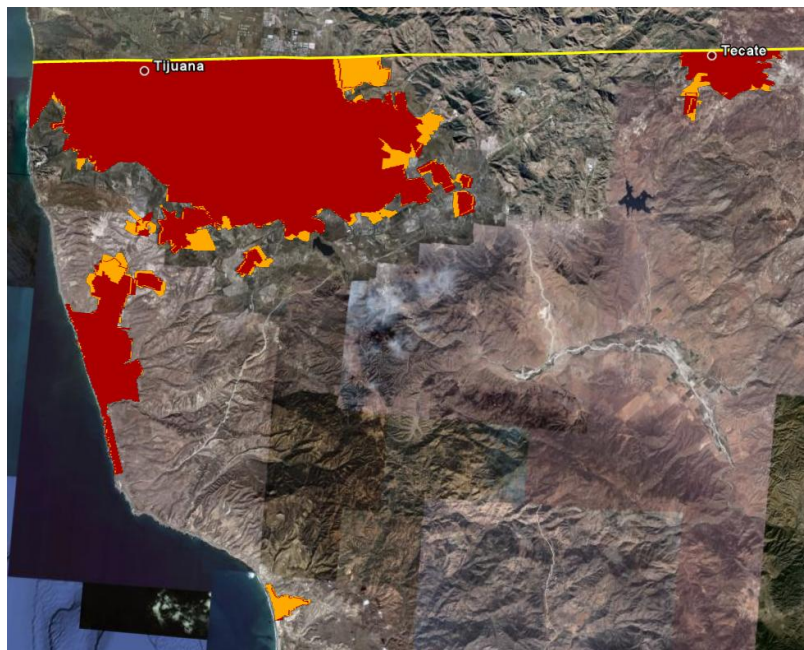
The metropolitan area who sprawls more in the period 2000-2005 is Juarez, with a consumption of 33.16 hectares for every thousand inhabitants. And the opposite, the MA who sprawls less is Guadalajara with 12.17 hectares per thousand inhabitants and Tijuana with 12.92.

If we analyze the average of urban densities of the nine metropolitan areas, the tendency to sprawl can , again, be observed. All the MA's have declined in density in this five years, with the exception of Tijuana, whose density has increased slightly from 83.9 inhabitants/ha in 2000 to 85.8 inhabitants/ha in 2005.

**Table num. 6: Urban Density in MA (2000-2005)**

Metropolitan Area	DMU_00	DMU_05
ZM De la Laguna	87.8	83.3
ZM Guadalajara	137.6	133.2
ZM Juarez	91.1	76.9
ZM Leon	142.2	128.9
ZM Monterrey	120.1	116.6
ZM Puebla-Tlaxcala	93.9	82.5
ZM Tijuana	83.9	85.8
ZM Toluca	67.1	66.8
ZM Valle de Mexico	170.7	166

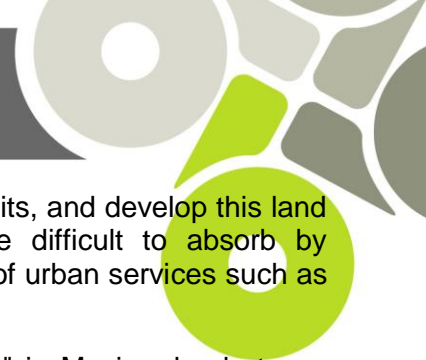
**Figure num. 26: Tijuana Urban Growth (2000-2005)**



Source: Elaborated from INEGI and CONAPO data bases.

The sprawl in Mexico is present in all metropolitan areas studied, as a result not only of the high mobility obtained with the generalized use of the car, but also by socio-economic issues.

Among them, there is the preference of developers to locate new housing of low and medium density in the suburbs of the city. This is due mainly to the costs of land. It seems more profitable to buy land at low



cost, which is classified as land for future grow or land even outside the city limits, and develop this land bringing high demands of roads, transportation and services, that will be difficult to absorb by governments, thus, delaying the consolidation of the city and the development of urban services such as recreation, education, sports or health.

This city model, also generated by the influence of the "American way of life" in Mexico, leads to an unsustainable city, as the dispersion generates environmental, social and economic impacts. Example of this, the high energy and land consumption, the decrease in leisure-time, that redounds in a lower quality of life, and a high demand for urban services and infrastructure.

Another big problem generated by the diffuse city is the public transport, as it requires a large investment to reach all areas of the city, so people must solve their problem of mobility with the use of private cars.

Also, the dispersed city leads in many cases to lack of identity and insecurity, which results in the fragmentation of the city. Such is the case of the "gated communities" in all Mexican metropolitan areas, which are built for people with middle and high income and promotes the privatization of public space, in search of safety and quality of public space (neighborhood park and playground basically), excluding the rest of the citizens and without "looking out" and building a city that makes no city.

However, the urban policy in Mexico in the last years is about making cities with sustainable development and to increment the urban densities.



## 5. Spain and Mexico, two opposite models?

Spain and Mexico (New Spain in the colonial language) took the 8th and 9th place in the ranking of world economies. There are traits, therefore, that make them similar, but also elements that differentiate them. The per capita income, as the geography and history of both countries make them different.

But talking about the urban sprawl is not very different. Contrary to the hypothesis of income level, Mexico seems to sprawl more. However the trend seems to be to increase greatly in Spain rather than in Mexico.

Spain, until now characterized by a compact urbanization, has denoted worrisome trends toward sprawl in recent decades. Between the 90's and 2000 was the European country with the highest consumption of land.

At detail, we can find that there are two contradictory phenomena: the Barcelona and Bilbao "model", in which we find the regeneration of the existing urban land and a non-extensive growth, compared to the Mediterranean coast "model", characterized by the high dispersion of urbanization.

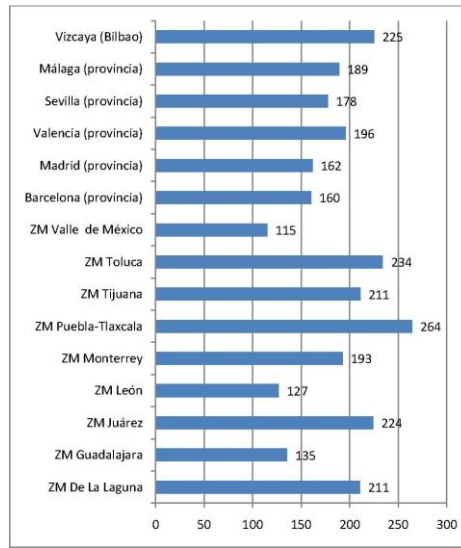
Diagnosis of Mexico in the years 2000 to 2005 suggests a process of fewer sprawls than in Spain. On the density of population (or per capita consumption of land), the Mexican AM seem denser than Spanish Metropolitan Provinces. Especially in the metropolitan areas of Valle de Mexico, Leon and Guadalajara (see graphic number 3).

**Table num. 7: Population and Urban Land in Mexico and Spain (2000)**

Metropolitan Area		Pob_00	Sue_Urb_00
<b>México</b>	ZM De La Laguna	1007291	21226.99
	ZM Guadalajara	3699136	50067.80
	ZM Juárez	1218817	27334.53
	ZM León	1269179	16113.27
	ZM Monterrey	3299302	63654.65
	ZM Puebla-Ixcala	1885321	49834.05
	TZM Tijuana	1274240	26879.79
	ZM Toluca	1451801	33989.83
	ZM Valle de Mexico	<b>18396677</b>	<b>211616.51</b>
<b>Spain</b>	Barcelona (province)	4804606	76952.13
	Madrid (province)	<b>5372433</b>	<b>86860.43</b>
	Valencia (province)	2227170	43574.87
	Sevilla (province)	1747441	31022.83
	Málaga (province)	1302240	24633.04
	Vizcaya (Bilbao)	857565	19313.34

Source: Self prepared.

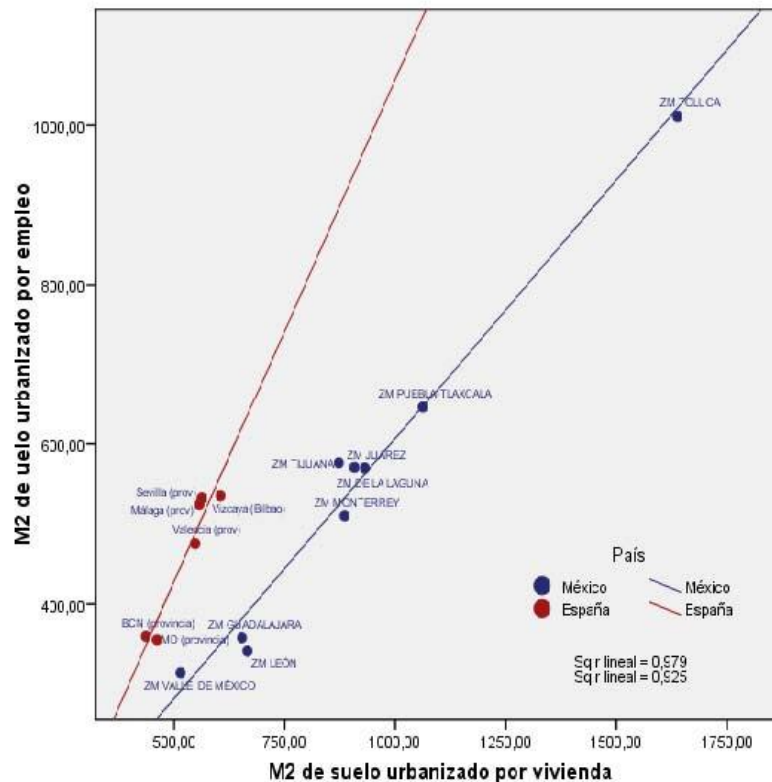
Graphic num. 4: Land Consumption (square meters per inhabitant) in Spain and Mexico (2000)



Source: Self prepared.

On another hand, if we look to the "real plaintiffs": the consumption of land for housing and employment (lesser extent) suggests that there is more sprawl in Mexico. As we can see in graphic number 5, in Mexico there is a greater sprawl of housing and jobs than in Spain.

Graphic num. 5: Urban Land per home and employment in Spain and Mexico (2000)



Source: Self prepared.



Finally, we can say that it is necessary to assess the convenience of designing a compact, denser and sustainable city in order to create cities that make city and, thus, improve the quality of life.

Even though there is too much to study and analyze about the urban sprawl process in both countries, we can say that the regeneration, land recycling, compact and integrated developments, may be the way forward.

## Bibliography

DEMATTEIS, Giuseppe. *Suburbanización y periurbanización. Ciudades anglosajonas y ciudades latinas*. Dentro de *La ciudad dispersa*. Suburbanización y nuevas periferias. Barcelona: Centro de Cultura Contemporánea de Barcelona, 1998.

EWING, R., PENDALL, R. & CHEN, D. *Measuring Sprawl and Its Impact*, Smart Growth America, 2002.  
 MONCLÚS, Javier. *Estrategias urbanísticas y crecimiento suburbano en las ciudades españolas: el caso de Barcelona*. Dentro de *La ciudad dispersa*. Suburbanización y nuevas periferias. Barcelona: Centro de Cultura Contemporánea de Barcelona, 1998.

SALINGAROS, Nikos. *La ciudad compacta sustituye a la dispersión*. Dentro de *La ciudad de baja densidad. Lógicas, gestión y contención*. Por Francesco Indovina. Diputació de Barcelona, España: 2007.

COUCH y Karecha. *Controlling urban sprawl: some experiences from Liverpool*. Published in *Cities*, [Volumen 23, No. 5](#), 353-363. Inglaterra, Octubre 2006.

GALSTER, George, Royce Hanson y Michael R. Ratcliffe. *Wrestling sprawl to the ground: Defining and measuring an elusive concept*. *Housing Policy Debate*, Volumen 12, Number 4. Fannie Mae Foundation, USA, 2001.

INDOVINA, Francesco. *Algunas consideraciones sobre la ciudad difusa*. Dentro de *Doc. Anál. Geogr.* Número 33. Venecia Italia, 1998.

MARMOLEJO, Carlos y Mariana Stallbohm. *Paisajes en transición, la reconfiguración espacial del uso del suelo en la RMB: ¿Hacia un cambio de paradigma urbanístico?*. Barcelona, España, 2008.

SCHNEIDER, Annemarie y Curtis Woodcock, *Compact, Dispersed, Fragmented, Extensive? A Comparison of Urban Growth in Twenty-five Global Cities using Remotely Sensed Data, Pattern Metrics and Census Information*. Published in *Urban Studies*, Vol. 45, No. 3, 659, Inglaterra, march 2008.

SEDESOL, CONAPO e INEGI, *Delimitación de las zonas metropolitanas de México 2005*; INEGI, Edición 2008.

TSAI, Yu Hsin. *Quantifying Urban Form: Compactness versus 'Sprawl'*. Published in *Urban Studies*. Vol. 42, No. 1, 141-161, England, January 2005.