

Population and depopulation: challenges regarding a demographic analysis in the Mexico State

Poblamiento y despoblamiento: retos para un análisis demográfico en el Estado de México

Juan Gabino González Becerril, Bernardino Jaciel Montoya Arce,
Bonifacio Doroteo Pérez Alcántara y Juan José Villavicencio

*Autonomous University of the Mexico State, Mexico
National Institute of Statistics and Geography-Toluca, Mexico*

Abstract

The objective of this text is to analyze the associations of the biological-social variables and categories around settlement and depopulation in the Mexico State in 2015-2020. It is interesting to highlight when two categories are close to each other and if they are often taken together. It is also worth looking for one or more continuous synthetic variables to summarize the categories. Finally, we seek to characterize groups of municipalities according to categories of settlement and depopulation. A group of municipalities may have a similar population or depopulation profile determined by their biological and social dimensions. That is, two municipalities are close to each other if they responded to the variables and associations in the same way. Based on a combination of information sources, rates, indices, cartographies and the multiple correspondence model are constructed, which synthesizes four groups of settlement and depopulation in the State of Mexico between 2015-2020.

Keywords: Population, depopulation, demographic system, fertility correspondence, mortality, migration, socioeconomic context.

Resumen

El objetivo de este texto es analizar las asociaciones de las variables y categorías biológico-sociales en torno al poblamiento y despoblamiento en el Estado de México en el periodo 2015-2020. Interesa destacar cuando dos categorías están próximas entre sí y si a menudo se toman juntas. También se destaca buscar una o varias variables sintéticas continuas para resumir las categorías. Por último, se busca caracterizar a grupos de municipios según categorías del poblamiento y despoblamiento. Un grupo de municipios puede tener un perfil similar de poblamiento o despoblamiento determinado por sus dimensiones biológico-sociales. Es decir, dos municipios están cerca el uno del otro si respondieron a las variables y asociaciones de la misma manera. Con base en una combinación de fuentes de información se construyen las tasas, índices, cartografías y el modelo de correspondencia múltiple, el cual sintetiza cuatro grupos de poblamiento y despoblamiento en el Estado de México entre 2015-2020.

Palabras clave: Poblamiento, despoblamiento, sistema demográfico, correspondencia fecundidad, mortalidad, migración, el contexto socioeconómico.

INTRODUCTION

The world as the Mexico State today faces great transformations at the social, economic, demographic and sanitary level. The Covid-19 pandemic included changes in the world's demographic equation, as well as that of the entity. In some cases they have been positive, other negatives, mark great challenges that must be addressed regarding the depth of the population/depopulation dichotomy. The challenge of the population equation includes its biological reproduction, volume, structure, dynamics, geographical distribution and its social dimension in the national and state territory (Ordorica, 2014; González, *et al.*, 2016)

At the same time, it is recognized that very little has been investigated about the processes of settlement and depopulation in their biological and social dimensions, which involve fertility, mortality, migration, the context of the Covid-19 pandemic, the setbacks socioeconomic, its impact on the development of municipalities or regions, as well as its main factors involved in the segmentation of the population derived from the pandemic.

In this text, settlement is understood as the process through which the settlement of a human group in a given space occurs. On the other hand, depopulation is the decrease in the population that lives in a place and occurs when population outflows due to excess mortality due to Covid-19 or the brake on emigration due to the pandemic, but that prior to it exceeded the inflows due to births or immigration. (Mojarro and Benítez, 2010: 188).

In this sense, the objective of this work is to investigate which determinants have greater weight in the settlement and depopulation in the Mexico State between 2015-2020, arguing that the variables of natural growth and some of the social dimension contribute to a greater extent to the settlement. Meanwhile, biological variables due to pandemic and socioeconomic affect more weight in depopulation. To demonstrate such a situation, the multiple correspondence model is used that graphically expresses the weight that each determinant has in relation to municipal settlement and depopulation.

The content of the study was taken from the book Population and Depopulation in the State of Mexico. Social processes, which briefly supports the topic of population change that is presented in this text. Also included is the multivariate correspondence analysis (MCA) methodology,¹ the analysis of results on settlement and depopulation and a brief discussion.

¹ Multiple correspondence analysis, available at <https://www.ibm.com/docs/es/spss-statistics/saas?topic=testing-multiple-correspondence-analysis> (12/05/2023).

POPULATION AND DEPOPULATION: BRIEF BACKGROUND

Demographic and economic sciences are some of the scientific disciplines that have referred to the segmentation of population and depopulation. For example, the argument of a renowned Mexican demographer, Gustavo Cabrera (2007: 240), who maintained that between the year 0 and 1,000 of the Christian era, Asia had been depopulated with 18 million people. From the bourgeois theory, the topic was also analyzed and it was considered that the behavior of the population is determined by social laws and as a biological demonstration of said behavior, Darwin's theory on the struggle for existence is used, but this aspect leaves out the rich multiplicity of historical development, as Engels and Marx maintained.²

For authors such as Pearl, Gini, Notestein, Landis, Carr-Saunders and Titmuss, cited by Smulevich (1971) there are multiple causes of poverty and depopulation: biological (birth and mortality), social (immigration and emigration) cues and economic (the well-being, the culture and the level of life) are those responsible for it. This argument coincides with Livi-Bacci (2007: 10), which does not speak openly of depopulation, meaning that a population tends to perpetuate itself and remain forever, but does not mean that it is eternal. The populations are formed and extinguished (depopulation); it is essentially formed by migrations associated with (in)adequate reproductive capabilities.

Settlement and depopulation have been present in the context of major crises such as wars, conquests, invasions, famines and epidemics that transform fecundity, mortality, age structures, their spatial distribution and their social context. In Pérez's terms (2022), "the pandemic caused a sudden stop to migrations, the withdrawal of the formation of new couples or new births, and, above all, excess mortality"; among other issues of the population today constitute obligatory segments to learn about possible alterations in residential guidelines in times of Covid-19.

For the French demographer Raymond Gessain (cited by Smulevich 1971: 111) the concern for understanding settlement and depopulation focuses on migration. For example, Raymond Gessain (cited by Smulevich 1971: 111) pointed out the immigration of Berbers to France as a factor that influenced depopulation.

We call foreigners to our land because we cannot find the means to have enough children ourselves (biological ingredient). This massive immigration is an extreme resource, but necessary because, unfortunately, there is

² See Marxism, available at <https://humanidades.com/marxismo/>

not the slightest doubt that no other current means can renew our demographic balance (Raymond Gessain, cited by Smulevich, 1971: 111)

But there are those who maintain that depopulation refers to the image of the “rural desert” (depopulation) and that it is the reverse of the “urban apocalypse” (population); that is, they refer to the depopulation of the countryside as another risk typical of the initial and intermediate stages of the urban transition. However, the concomitance of this demographic transition generates a situation in which the rural population continues to expand as a result of a more intense vegetative growth than that of urban areas (ECLAC, 2002).

The times of Covid-19, in 2020, were mainly reflected in a decrease in movements towards cities and an increase in departures from them, especially towards rural municipalities, many of which were returns. This means that the flows of people had a notable demographic impact on rural areas. However, despite the changes observed, most of the internal migrations were mainly between cities (highlighting the issue of daily mobility), as before the pandemic, and everything indicates that it was a temporary expression. due to the pandemic (González *et al.*, 2022).

To support the previous argument, some explain that depopulation is due to the combination of two factors. On the one hand, the significant increase in international emigration in the five-year period 2000-2005, which mainly affects the rural municipalities of the Traditional Migratory Region (TMR) and not the large cities, and on the other hand, a decrease, although in smaller proportion of the natural growth of the population (Canales, 2009: 37).

Another example is that as a consequence of the migration phenomenon to the United States, Zacatecas loses 80 people daily, 29 thousand per year and has absolute depopulation in 42 of its municipalities, that is, 72.41 percent of its territory (Moctezuma, 2013).

The Demography of Inequality approach maintains that in sociodemographic differentiation it is possible to identify depopulation and implies that the population is in a situation of vulnerability. Depopulation is a situation in which a risk structure is combined with response capacities and adaptive abilities on the part of the subjects. In this sense, the categories of settlement/depopulation present a differentiation of the determinants of fertility, mortality and migration, as well as age, sex, migration, ethnicity, etc. and account for the risks and adaptation of the subjects.

Settlement/depopulation implies gradients of vulnerability and changing possible scenarios at a macro level that can be affected by vulnera-

ble demographic groups, such as children, women, the elderly, indigenous people, migrants, heads of household, etc. (Canales, 2003). This must be understood based on recent economic events (past, present and future economic crises), social policy and the Covid-19 pandemic that affect population/depopulation.

Population and depopulation do not happen in the air, they occur in a given structural and historical context where social inequalities and polarization are expressed, whose effect on the demographic equation was much more expressive due to the pandemic. This is the context of the globalization and localization of the pandemic which promoted social differentiation or segmentation of the population (Canales, 2003).

In summary, the fact of settlement and depopulation occurs due to multifactorial effects, because they involve fertility, mortality, migration, the socioeconomic context, also the pandemic that has contact with the level of development, culture and environmental and social policy; which is why its regulation requires being objective of the population policies and laws in Mexico as well as in the entity.

THE DEMOGRAPHIC SYSTEM OF MEXICO STATE

The importance of the study of the demographic system of the State of Mexico under the approach of demographics of inequality lies in the fact that the entity is experiencing two simultaneous processes: settlement and depopulation. The configuration of the Mexican population is determined by the degree of unequal development of its municipalities and at the same time influenced by the proximity to Mexico City. However, in this exercise, to understand the segmentation of the entity in settlement/depopulation, it is based on the data that is available to be taken into account: the natural growth rate, the social growth rate and some that express the consequences. socioeconomic studies on settlement and depopulation.

This dichotomous construction or segmentation has depth when a causal explanation is sought (looking at it as a process) rather than in terms of static rates as has been done in recent years on this issue of human population in the country and in Latin America (Canales, 1999).

This study is justified because the State of Mexico is the most populated entity in the country with 16,943,627 inhabitants in 2020; In that same year, 366,210 births occurred (168,734 less than in 2019), even with the pandemic, it means that more than 300 thousand new individuals populated the State of Mexico due to their biological reproduction. In addition, 130,431 deaths were recorded (as they are departures it means depopula-

tion), but with 53,269 additional deaths compared to 2019, this is due to the effect of the so-called excess mortality due to Covid-19. This means, on the one hand, births contributed to the population of the 125 municipalities of the entity, which by the way registered a decrease in almost all of them in 2020 due to the pandemic.

In the case of mortality in all the municipalities of the State of Mexico, they were higher compared to 2019. In the reference year, 2020, the entity had 186,481 recent immigrants (they are the entry and means that they came to populate the entity) but it is a lower figure than in 2015 as it is 499,949 people, it should be said that those who arrived from other countries are excluded (this means that 313,468 stopped arriving in relation to 2015). The effects of Covid-19 are not exempt from this figure because some homes, municipalities, neighborhoods and localities were no longer counted, which affected the sub-enumeration. In the case of Mexican emigration to another federal entity in 2020, 1,146,497 people declared that they had the State of Mexico as their residence prior to the census exercise between 2015-2020, which meant 229,299 people, a figure lower than that of 2010, which was 332,627 emigrants. This information means that they changed their place of residence to some federal entity of the country and fall into the category of variable that affects state, municipal or local depopulation.

In this sense, it is possible to say that the recent evolution of the population of the Mexico State presents the following: in 1990 it had 9,815,950 people. By the year 2000, the population rose to 13,096,686, which implied an increase of almost three million inhabitants. In 2010, there were more than 15 million inhabitants (with 2.1 million additional inhabitants compared to 2000, a figure very close to the population of Guatemala, estimated for 2013 at 15,468,203). By 2020, 16,943,627 people, 756,019 additional people compared to 2015. In practically 30 years, the mexiquense entity had an absolute demographic growth of 7.1 million people (this is equivalent to the estimated population of Paraguay for 2020),³ although the average annual growth rates were lower (1.19, 1.9 and 0.9 percent, in 1990-2000, 2000- 2010 and 2015-2020) compared to previous decades or five-year periods. The rate is five times lower in the first decade of this century than in 1970, when it was estimated at seven percent. But much lower than that of 2015-2020. The decrease in the growth rate means depopulation, because children stopped being born thanks to the population

³ List of countries ordered by population, available at <https://www.populationpyramid.net/es/poblaci%C3%B3n-por-pa%C3%ADs/2020/> (Consulted on 12/10/2020).

policy implemented since 1974 (CIEPS, 2015), but with the addition of the Covid-19 pandemic and the consequent excess mortality.

On the other hand, projections from the National Population Council (CONAPO, 2010) indicate that in mid-2015 the Mexican entity would house 16,870,388; In 2020, 18,075,065, the census results were 16,943,627, which represented a difference of 1.1 million people,⁴ and by 2030, according to the aforementioned institution, it will have a population of 20,167,433 inhabitants. The magnitude of the population seen in a general way would indicate an unprecedented population, because in 2030 the Mexico State will have a population close to what the country had in 1940 (19.6 million people). Which would require a larger economic budget to respond to social demands, but the existence of depopulation is emphasized.

In addition to being the most populated entity in the country, it is a place of great inequalities in which some municipalities are experiencing the full demographic transition and others are beginning it, but the pandemic came to disrupt their demographic process or equation. It also has municipalities that are beginning the epidemiological transition and others that ended two decades ago, such as some that belong to the Metropolitan Zone of Mexico City.

In social terms, in the State of Mexico in 2020, they resided around 8.3 million people in poverty, a population equivalent to that of Mexico City according to Coneval, 2015. While in 2018 they were 7.1 million of people in that condition. More than ten million people with lower revenues to the poverty line.⁵

At the same time, it is an entity whose population in the context of the pandemic had educational lags, low average access to health services, access to social security, quality and spaces of housing, access to basic services in housing, access to quality nutritious food as well as many other delays resulting from the pandemic. It is a state that ranks fourth nationally in international migration and the receipt of remittances (González, 2012), with a significant number of municipalities with high rates of agricultural, secondary and tertiary specialization; Likewise, other municipalities that contain high percentages of uninhabited homes and countless unequal expressions of social development such as polarization due to marginaliza-

⁴ This difference in figures led to the Government of the State of Mexico promoting a constitutional controversy to the National Institute of Statistics and Geography. See in The State of Mexico goes against the INEGI figures, available at <https://www.elfinanciero.com.mx/opinion/enrique-quintana/2021/10/11/el-estado-de-mexico-va-contra--the-inegi-figures/> (12/10/2020).

⁵ CONEVAL, Poverty statistics in the State of Mexico, available at <https://www.co-neval.org.mx/coordinacion/entidades/estadodemexico/paginas/principal.aspx> (accessed 12/10/2022).

tion or social exclusion. For this reason, the State of Mexico is recognized as an entity of great economic, demographic and social contrasts (CIEPS, 2015).

Seen in this way, with the aggregate figures it is not possible to perceive the difference between settlement and depopulation. This is why it is necessary to disaggregate at the municipality level with its respective determinants, which can be verified in the correspondence model that will be presented in the following sections.

METHODOLOGY: MULTIPLE CORRESPONDENCE ANALYSIS (MCA)

Multiple Correspondence Analysis (MCA) is a statistical technique that is used to study the relationship between categorical variables that are displayed in a contingency table (Greenacre, 1993; Pérez, 2005; Gaxiola, 2008; CIEPS, 2015). This method helps explore the data and allows you to know the main links generated from said table. According to Greenacre (1993), the primary goal of multiple correspondence model (MCA) analysis is to transform a table of numerical information into a visualization such as the one expressed in Figure 2 and in maps 1 and 2, which for our research was of great usefulness. In the present work, the MCA serves to observe the depth in the characterization of the segmentation of the population/depopulation of the State of Mexico, as well as to observe links with the demographic and socioeconomic determinants.

In the application of MCA to settlement/depopulation, the following basic tools of this statistical technique were used: profiles, mass, distance, inertia and dimensions. But to achieve this, a table of variables and indicators had to be created in such a way that the biological-social factors of the population of the Mexico State could be synthesized.

The MCA can have as many dimensions as $n - 1$ categories have the variable with the highest category (Mancini, 2003). In this research, the variable with the greatest number of categories is the Social Growth Rate, which has five categories and the rest with four, so there can be up to four possible dimensions in this study. To proceed with running the model, the numerical variables had to be transformed into categorical or qualitative variables as shown in Table 1.

The previous diagram shows how the database was built with qualitative variables and then run it in Statistical Package for the Social Sciences 21, (SPSS 21) in stages, which help to better understand this statistical technique. The MCA allows the construction of a contingency table of two variables, in which a first relationship between them can be verified.

Table 1: From the correspondence coding process

Dimension	Depopulation/population (1, 2): 1 means depopulation and 2 population (dummypob)	
	Determinants of depopulation/population	
	Indicador a nivel municipal	Category coding
Biological		
	Municipal demographic transition (Natural Growth Rate) (tcnT)	-5 to 1 Advanced transition 1.01 to 2 Full transition 2.01 to 2.5 Moderate transition 2.6 to 9 Incipient transition
Social	Municipal social growth rate (tcs2015) 2015-2020	5 to 12 High attraction 1 to 4 Medium attraction a 0.9 Balance -0.1 to -1.9 Rejection -2 to -8 Strong rejection
	Index percentage of the municipal migratory intensity index (memig20p2)	0 to 0.054 Very low 0.054 to 0.162 Low 0.162 to 0.681 High 0.681 to 8 Very high
	Municipal economic activity index rate 2015-2020 (tasaiae520)	5.270 to 18= Specialized 2.085 to 5.270= Concentrated .516 to 2.085= Medium specialization 0 to .516= Not specialized or considered non-basic
	Index of Economic Specialization of the municipal Primary Sector (iesp2)	1.382 to 2.5 = Specialized 1.059 to 1.382= Concentrated .829 to 1.059= Medium specialized 0 to .829= Not specialized or considered non-basic
	Municipal Secondary Sector Economic Specialization Index (iess2)	0.0 to 0.9 Non-specialized or considered basic 1 Specialized or concentrated 1.01 to 14 Economic diversification
	Municipal Tertiary Sector Economic Specialization Index (iest2)	.975 to 1.60= Specialization .840 to .975 Concentrated .688 to .840= medium specialization 0 to .688= Non-basic or non-specialized
	Municipal Marginalization Index (imn20)	.917 to .96 Very high .86 to .892 High .892 to .917 Medium .66 to .86 Low
	Municipal social lag index (irs20)	-1.60 to -0.808= Very low -0.808 to -0.295 =Medium -0.295 to -0.068 Low -0.068 to 1.40 High
	Municipal uninhabited homes 2020 (vivdesh20)	1 to 9.2= Low 9.2 to 12 = Medium 12 to 16 = High 16 to 38= Very high

Source: own elaboration based on <https://igecem.edomex.gob.mx/sites/igecem.edomex.gob.mx>; https://data.amerigeoss.org/tr/dataset/indices-de-intensidad-migratoria-mexico-estados-unidos/resource/cab3af23-85a4-41db-a2f0-8a99c1b0c850?view_id=d87cc489-f83a-42c0-b6d6-079fb0afb5b5; INEGI, <https://www.inegi.org.mx/>, <https://www.gob.mx/conapo/documentos/indice-de-intensidad-migratoria-mexico-estados-unidos>, https://www.coneval.org.mx/Medicion/IRS/Paginas/Indice_Rezago_Social_2020.aspx

Based on this, frequency tables and the graphic representation of the contingency table can be constructed, cartography which is one of the attributes of this statistical technique, which more clearly displays the existing links between the study variables. This work considered ten variables, which are included in Table 1, showing the categories that are reflected in the graph of this statistical technique.

ANALYSIS OF RESULTS: POPULATION AND DEPOPULATION

Correspondence Analysis is a descriptive technique to represent contingency tables. The starting data for the correspondence analysis is a matrix. It has k categories. For example, a set of municipalities is classified into n possible rejection rates and k possible attraction rates. In general, the element X_{ij} of the matrix.

The methodology was developed by Benzecri (cited in Greenacre, 1993), in the early 60s of the 20th century at the University of Renner, France, (cited in Greenacre, 1993 and González *et al.*, 2016). In essence, it is a special type of principal components analysis but performed on a contingency table and using a weighted Euclidean distance called chi-square. This methodology is used to analyze data from population and housing surveys and censuses, since it allows us to look at similarities and closeness of the variables that have implications for settlement or depopulation. To do this, the quantitative variables were transformed into qualitative or nominal ones.

This model was taken as a reference because it is the one that best fits to evaluate the demographic determinants of settlement and depopulation, but, at the same time, it allows us to observe the weight of its socioeconomic determinants.

What is possible to evaluate based on this model is the proximity between municipalities in terms of similarity in their population or depopulation: two municipalities are similar if they have almost the same modalities in their demographic or socioeconomic determinants.

The model allows, on the other hand, to verify the proximity between different variable modalities in terms of association in depopulation/population: if they are close since they are globally present in the same municipalities and their population.

The model allows verifying the proximity between modalities of the same variable in terms of their similarity: they are exclusive by construction, if they are close it is because the municipalities that have them present almost the same behavior in the other determining variables.

Based on a basic exercise, it can be said that depopulation/population in the 125 municipalities of the State of Mexico is summarized in the following tables and figures.

Table 2. Summary of the 2015-2020 model

Dimension	Alfa of Cronbach	Explained variance		
		Total (Eigenvalues)	Inercia	% of variance
1	.837	4.299	.358	35.827
2	.735	3.066	.255	25.548
Total		7.365	.614	
Medium	.795 ^a	3.682	.307	30.687

a. The Average Cronbach's Alpha is based on the average eigenvalues.

Table 2, summary of the model, shows the dimensions of the equation that express the magnitude of the variance that on the one hand contributes 35.8 percent and the second 25.5 percent of the changes in population/depopulation. But what variables remained in dimension one and two? How much do the variables contribute? The variance indicates that 61.4 percent is explained by these two and the magnitudes have equal importance,⁶ which indicates that it is a good model to explain depopulation/population in 2020 for the State of Mexico.

Keeping in mind that dimension 1 represents depopulation and dimension 2 represents settlement, based on the discrimination table the following ideas can be noted.

The discriminant measure indicates that the variables that contribute the most to the population are the marginalization index (0.719), the municipal migratory intensity index (0.604), the municipal economic specialization index (0.829) and tertiary sector (0.753) and the percentage of uninhabited homes (0.142). In general terms, it can be said that the most important determinants of municipal depopulation are socioeconomic variables and this means that public policy must aim at this.

The discriminant measure represented in Table 3 indicates that the variables that differentially contribute to depopulation are a combination of demographic and socioeconomic variables; Likewise, the variables of the demographic system that supported the settlement of the municipalities of the State of Mexico were the Natural Growth Rate and the Social Growth

⁶ One is grouping the municipalities with depopulation and the two municipalities with population.

Rate. Change to be fundamental are the socioeconomic determinants such as the economic specialization index of the primary, secondary and tertiary sector as well as the migratory intensity index and the marginalization index (González *et al.*, 2016).

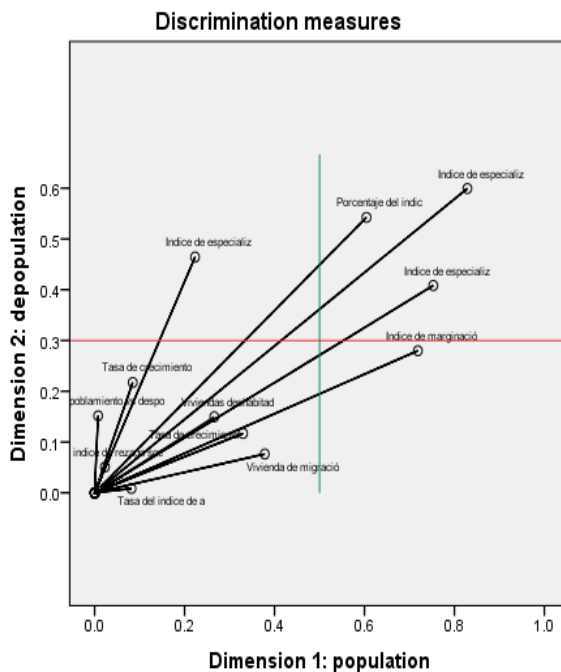
The above can be seen in Figure 1 in dimensions 1 and 2. On the second dimension, which determines depopulation, are the marginalization index, the migratory intensity index and the economic specialization index. On the right side, there is the first dimension, in which the variables that affect the population are the Economic Specialization Index of the primary, secondary and tertiary sector, as well as the migratory intensity index and the marginalization index and the uninhabited homes.

Table 3: Discrimination measures 2015-2020

	Dimension		Medium
	1	2	
Population vs depopulation	.008	.152	.080
Average annual growth rate of births 2015-2020	.085	.217	.151
Average annual growth rate of mortality 2015-2020	.330	.117	.223
Percentage of international migration intensity index	.604	.543	.573
International circular migration housing	.378	.076	.227
2015-2020 economic activity rate rate	.082	.008	.045
Municipal primary sector specialization index	.829	.599	.714
Economic Specialization Index of the secondary sector 2020	.223	.464	.344
Tertiary Sector Specialization Index 2020	.753	.408	.581
Municipal normalized marginalization index	.719	.280	.499
Municipal social backwardness index 20	.023	.051	.037
Municipal uninhabited homes 2020	.266	.150	.208
Total assets	4.299	3.066	3.682
% of variance	35.827	25.548	30.687

Source: own elaboration based on <https://igecem.edomex.gob.mx/sites/igecem.edomex.gob.mx/>; https://data.amerigeoss.org/tr/dataset/indices-de-intensidad-migratoria-mexico-estados-unidos/resource/cab3af23-85a4-41db-a2f0-8a99c1b0c850?view_id=d87cc489-f83a-42c0-b6d6-079fb0a-fb5b5; INEGI, <https://www.inegi.org.mx/>, <https://www.gob.mx/conapo/documentos/indice-de-in-tensidad-migratoria-mexico-estados-unidos>, https://www.coneval.org.mx/Medicion/IRS/Paginas/Indice_Rezago_Social_2020.aspx

Figure 1: Discrimination measures

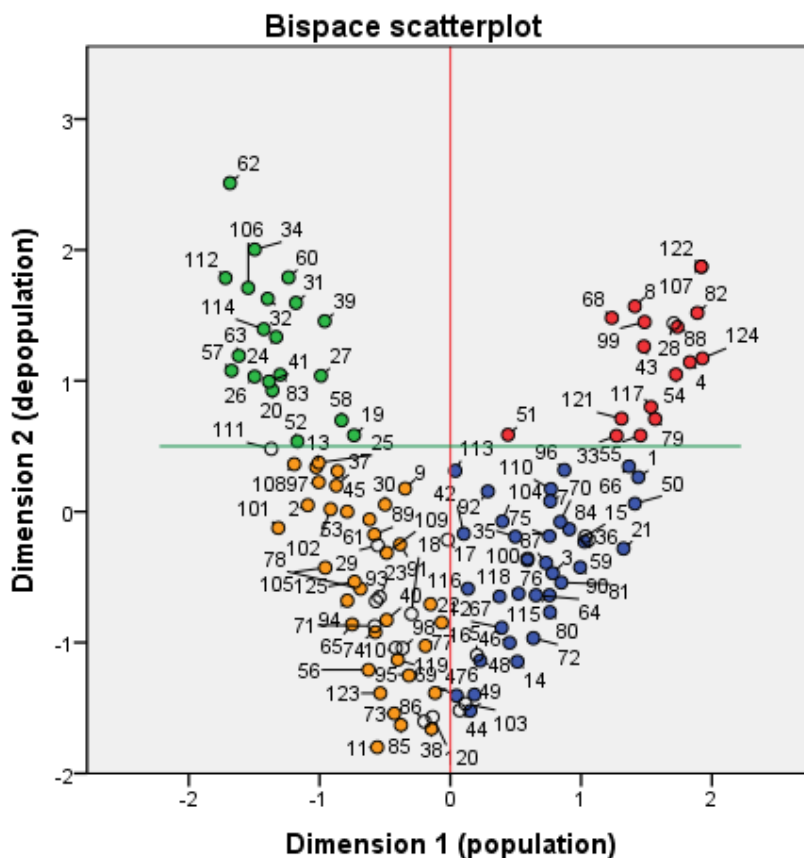


Main normalization by variable.

Source: own elaboration based on <https://igecem.edomex.gob.mx/sites/igecem.edomex.gob.mx>; https://data.amerigeoss.org/tr/dataset/indices-de-intensidad-migratoria-mexico-estados-unidos/re-source/cab3af23-85a4-41db-a2f0-8a99c1b0c850?view_id=d87cc489-f83a-42c0-b6d6-079fb0afb5b5; INEGI, <https://www.inegi.org.mx/>, <https://www.gob.mx/conapo/documentos/indice-de-intensidad-mi-gratoria-mexico-estados-unidos>, https://www.coneval.org.mx/Medicion/IRS/Paginas/Indice_Reza-go_Social_2020.aspx

Figure 2 shows the municipalities in a situation of depopulation differentiated in two ways. On the one hand, rural municipalities, for example, municipality number 122, which is Zacualpan and is located on the right side, dimension 2 and according to the marginalization indicators, agricultural specialization index, percentage of the Migratory Intensity Index indicates that it is a vulnerable municipality with a very high depopulation process. They are followed in order of importance by Sultepec (82), Amatepec (8), Tlatlaya (107), Tejupilco (84), Temascaltepec (88), Texcaltitlán (99), Oztolapan (68) and Ixtapan del Oro (43), among others.

Figure 2: Municipalities labeled according to case: depopulation-population



Main normalization by variable.

Source: own elaboration based on <https://igecem.edomex.gob.mx/sites/igecem.edomex.gob.mx>; https://data.amerigeoss.org/tr/dataset/indices-de-intensidad-migratoria-mexico-estados-unidos/re-souce/cab3af23-85a4-41db-a2f0-8a99c1b0c850?view_id=d87cc489-f83a-42c0-b6d6-079fb0afb5b5; INEGI, <https://www.inegi.org.mx/>, <https://www.gob.mx/conapo/documentos/indice-de-intensidad-mi-gratoria-mexico-estados-unidos>, https://www.coneval.org.mx/Medicion/IRS/Paginas/Indice_Reza-go_Social_2020.aspx

It should be noted that there were movements in the ranking of municipalities with rural depopulation between those found by González *et al.*, (2016) with data from 2000 and 2010. It was most likely due to the pandemic that affected the biological-social reproduction of these populations and The recurring eco-nomic crisis. On the other hand, the urban municipalities that create a group or segment of the municipal population

that are living the depopulation process which are: Nezahualcóyotl (62), Tlalnepantla (106), Naucalpan (60), Tultitlán (112), Cuautitlán (31), Cuautitlán Izcalli (32), Ecatepec (34), Coacalco (27), Valle de Chalco Solidaridad (114) among others.⁷ As you can see these municipalities are grouped towards dimension 2 (quadrant 2) which expresses urban depopulation. This segment of municipalities is very similar to the findings of González *et al.* (2016), but with the effect of the Covid-19 pandemic on the biological reproduction and its social dimension of the Mexican population in 2020.

Some rural municipalities mentioned belong to a group of 36 municipalities with high and very high rejection rates in the reception of population through internal migration in the entity between the period 2000 and 2010. Curiously, municipalities linked to international migration stand out, mainly There are more than 25 in the South of the Mexico State and others belonging to the indigenous zone located to the northwest of the entity (mainly Mazahuas and Otomíes). This area, in the south of the entity, is recognized as a place with a high migratory tradition (González, 2012) while those in the northeast share with the south a high social marginalization, extreme poverty and social backwardness (González, Soberón and López, 2014).

On the side of the municipalities belonging to the settlement segment, there is a differentiation where among the large number of municipalities of the entity –which together represent 87 percent– with a diversity of experiences in the settlement in the past, present, but, above all, everything, in the future. The municipalities that belong to the Metropolitan Zone of the Valley of Mexico stand out, especially the municipalities near the Felipe Ángeles International Airport (AIFA) such as Cuautitlán, whose population growth rate was 3.4 percent between 2015 and 2020, Tultitlán with a rate of -0.17 percent, Nextlalpan with 7.28 percent, Tecámac with 4.1 percent and Zumpango itself with 6.8 percent.

The municipalities adjacent to and close to the metropolitan areas of Toluca and Tianguistenco, which will grow as a result of the Toluca-Valley of Mexico Interurban Passenger Train. For example, Zinacantepec, whose population grew by an annual average of 1.48 percent between 2015-2020, Metepec did so by 1.22 percent, Lerma 2.95 percent, San Mateo Atenco 5.10 percent, Mexicalcingo 1.5 percent, among others.

⁷ The numbers do not correspond to the numbering of the municipalities according to the INEGI, 2010, it was sought to respect the alphabetical sequence, Figure 2.

The latter will change in their population size and infrastructure as soon as the Mexico-Toluca suburban train begins to operate. Due to the generation of new infrastructure and greater competitiveness of some economic sectors that will point towards the Mexican capital, Toluca and Tianguistenco will experience the phenomenon that districts such as Nezahualcóyotl and Ecatepec have already experienced: becoming a “dormitory city.”

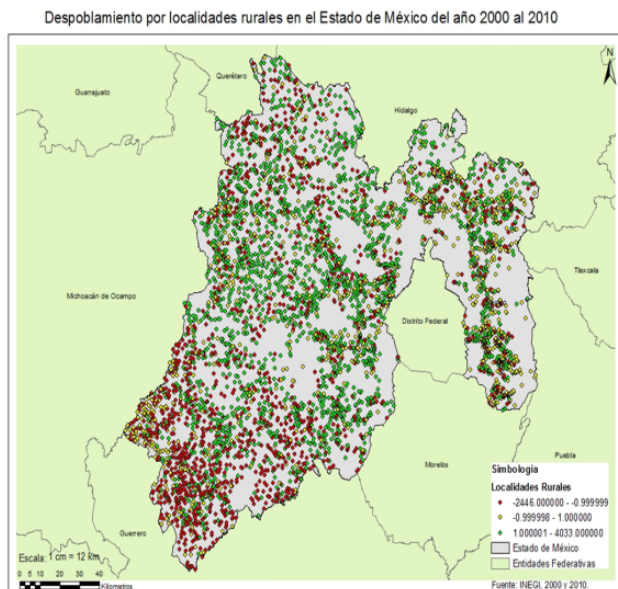
In the case of metropolitan municipalities such as Nezahualcóyotl, Tlalnepantla, Naucalpan, Coacalco and Ecatepec, it has been a concern to decrease their populations to such a degree of questioning the census results generated by the INEGI in 2020 by the government of the State of Mexico.

CONCLUSIONS

The different theoretical aspects about population and depopulation account for concern about this social phenomenon from the emergence of bourgeois theory to the present. As part of the production function, which supports the current capitalist system, it is necessary to review the causes of the population/depopulation dichotomy. As in other contexts in our country, depopulation has multiple determinants and consequences that will be different from those of the previous depopulates. The descriptive data and the statistical model of correspondence made evidenced that the associated variables of greater consistency around the settlement are those that refer to the demographic determinants: social growth and to a lesser extent its biological dimension. Regarding depopulation, the socioeconomic determinants are the most important at the municipal level. For this study we expected greater evidence due to the Covid-19 pandemic. But we believe that they will be in later years, as soon as the population information is updated we will be able to statistically represent the depopulation resulting from biological reproduction as an effect of the pandemic.

What we have been able to verify is that the localities in a situation of depopulation increased between 2000 and 2020. Here it could be a reflection of the Covid-19 pandemic. The demographic variables that determine the depopulation of the more than four thousand localities of the entity distributed in the 125 municipalities of the State of Mexico (Map 1 and Map 2) are, on the one hand, their biological dimension: mortality and fertility affected by Covid-19. 19 and on the other its social dimension; marginalization, social backwardness, poverty, economic specialization, international emigration of men and women who leave the entity to seek to improve their lives and that of their family. Without a doubt, internal emigration also influences, but this must be the subject of another investigation.

Map 1: Depopulation by rural localities in the State of Mexico 2000-2010



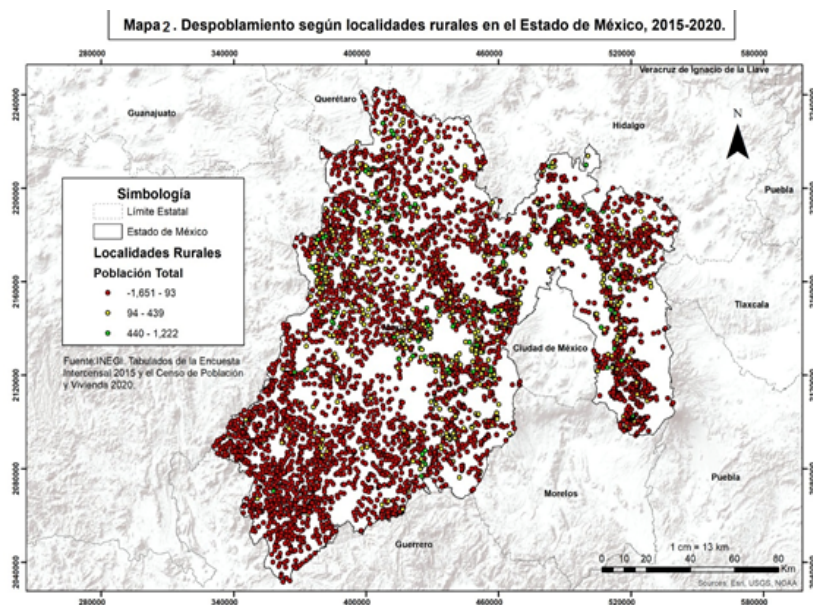
Source: own elaboration based on the ITER censuses of 2000, 2010, 2015 and 2020.

It seems to be incisive but we want to highlight the relationship between depopulation in the entity, explained by variables such as the specialization rates of the primary, secondary and tertiary sector, the first two sectors attract attention: it would seem that a fall in agricultural economic activity brings with it Depopulation of some rural municipalities and the secondary sector implies a reduction of the population, which allows to propose as a hypothesis that where there is an industry the population is not necessarily settled, but is in those places called bedrooms and in the entity an amount has been located important of municipalities that fulfill this function.

On the other hand, the service sector seems to have a positive relationship with population. However, it hides depopulation within, for example in the main historic municipal centers that have given rise to service activities and displaced the population to peripheral places, thereby creating the so-called peri-urban cities.

Furthermore, it is worth highlighting the relationship that socioeconomic indicators such as marginalization, poverty, migratory intensity and uninhabited housing have with the behavior of depopulation, since they are very important as conditions for population loss.

Map 2: Depopulation according to rural locations in the State of Mexico 2015-2020



Source: own elaboration based on the ITER censuses of 2000, 2010, 2015 and 2020.

Finally, it is considered that a settlement/depopulation analysis must include the greatest possible determinants, both economic and demographic, social and environmental. The virtue of the correspondence model allows us to include a series of variables that influence this demographic phenomenon, but, at the same time, it opens the possibility of reconsidering and rethinking the theoretical discussion about population/depopulation in times of pandemics or systemic crises resulting from Covid. -19 or later.

This leads us to think about large lines that must include population policies taking into account the following: For municipalities with depopulation, it is necessary to monitor and monitor the social growth variable. Because it concentrates the power of the entity's demographic transformation and influences the settlement. That is, public institutions must be attentive to the internal mobility of the population and its spatial distribution.

Along the same lines as population, it is proposed to monitor fertility indicators differentiated by municipality as a result of the pandemic, age groups and ethnicity. Because, for example, in the case of indigenous people who are experiencing a process of extinction, their reproduction will have to be encouraged. In the case of young people, we will have to monitor their contributions to fertility in municipal demographic growth

because according to recent arguments there is a segment that is not interested in having children. That is to say, their interests are in the social dimension rather than in biological reproduction.

For the issue of depopulation, it is required that social policy reach the most vulnerable population and influence poverty, marginalization, and urban and rural social backwardness. As well as in international migration and the municipalities with the greatest tradition located in the South of the State of Mexico. The same will have to implement circulation policies, not retention in the indigenous communities that are experiencing the depopulation process.

The State Development Plan of Mexico 2017-2023, proposed to influence marginalization and poverty but the current results have not responded to the millennium objectives (SDGs). Therefore, the new administration headed by its governor is suggested to work in a sustained manner to avoid the social exclusion of the population.

There are other indicators that are factors of depopulation, such as abandoned homes, which in this case is an indicator that institutions must monitor and propose policies about it and its residents.

Finally, the exercise is much broader that was sought to relate to the growth of the gross domestic product (economic activity index) and we find no relationship with the settlement/depopulation. This means that development goes on the one hand and population growth on the other. Therefore it is suggested that in municipal development plans articulate the population and development.

The economic specialization index and population/depopulation allows to verify that the more specialized the municipality in the agricultural activity, the greater the expulsion power of the population. This leads to proposing that the institutions responsible for agricultural policy manage to inhibit emigration with productive projects according to the vocation of the municipality or the region. This will allow cushioning the food crisis, hunger in the context of pandemic and postpandymia. What worries, is the specialization index of the tertiary sector and depopulation, since this happens mainly in urban centers. Each municipality has its own challenges and we will have to seek policies that reconcile the coexistence of the population and tertiary activity always seeking potential markets that inhibit the abandonment of its residents.

The demographic and socioeconomic determinants of the population/depopulation force to recognize the requirement of having a population law in the entity that addresses this problem as soon as possible.

BIBLIOGRAPHIC REFERENCES

Cabrera, Gustavo, 2007, *Obras demográficas selectas de Gustavo*, México, CEDUA. El Colegio de México, D.F.

Canales, Alejandro, 2009, “Despoblamiento, pobreza y remesas. Impactos sociales y demográficos de la migración internacional”, en Conapo, Foro Nacional *Las Políticas de Población en México. Debates y Propuestas para el Programa Nacional de Población 2008-2012*, D.F.

CEPAL, 2002, *Vulnerabilidad sociodemográfica: viejos y nuevos riesgos para comunidades, hogares y personas síntesis y conclusiones*, Vigésimo noveno período de sesiones, Brasilia, Brasil, 6 al 10 de mayo, Disponible en <http://www.eclac.cl/publicaciones/xml/0/9640/DGE2170-SES29-16.pdf>

CIEPS, 2015, *Propuesta de política pública para revertir el despoblamiento en los municipios del Estado de México*, documento elaborado por el CIEAP-UAEM, Toluca.

CONEVAL, 2015, *Medición de la pobreza en México y en las entidades federativas, 2014*, disponible en http://www.coneval.gob.mx/Medicion/Documents/Pobreza%202014_CONEVAL_web.pdf

CONEVAL, s/f, *Evolución de la pobreza por ingresos*, disponible en <http://www.coneval.gob.mx/Medicion/EDP/Paginas/Evolucion-de-las-dimensiones-de-la-pobreza-1990-2014-.aspx>

CONAPO, 2010a, *Índices de Intensidad Migratoria, 2010*. Consejo Nacional de Población, México.

CONAPO, 2010b, *Índices de Marginación, 2010*. Consejo Nacional de Población, México.

Gaxiola Robles Linares, Sergio Cuauhtémoc, 2008, *Precariedad laboral: hacia una caracterización de los trabajadores informales pobres en México, 1992 y 2006*, Facultad Latinoamericana de Ciencias Sociales, Sede México, Maestría en Población y Desarrollo, D.F.

González Becerril, Juan Gabino, 2012, “Antecedentes de la migración internacional del Estado de México”, en González Becerril, Juan Gabino y Montoya Arce, B. Jaciel, *Migración mexiquense a Estados Unidos: un análisis interdisciplinario* (comps.), CIEAP-UAEM, pp. 112-130, Toluca.

González Becerril, Juan Gabino, Soberón Mora, José Antonio, López Vega, Rafael, 2014, “La participación de la población indígena en la migración internacional: el caso del Estado de México”, en Juan Gabino González Becerril, Bernardino Jaciel Montoya Arce, Adán Barreto Villanueva, *Hitos demográficos del siglo XXI: migración internacional*, CIEAP-UAEM, pp. 313-334, Toluca.

González Leonardo, Miguel *et al.*, 2022, *Cambios de residencia en tiempos de Covid-19: un poco de oxígeno para el despoblamiento rural*, disponible en https://ced.cat/PD/PerspectivesDemografiques_026_ESP.pdf (Consultado el 12/10/2022).

Greenacre, Michael, 2008, *La práctica del análisis de correspondencia*, Fundación Banco Bilbao Vizcaya, www.fbbva.es

IGECM, 2012, *Boletín de Estadísticas Vitales 2012*, disponible en <http://igecm.edomex.gob.mx/descargas/estadistica/BOLETINDEEV/BOLETINEV2012.pdf>

INEGI, 2000, *Censo General de Población y Vivienda, 2000*. Instituto Nacional de Estadística y Geografía (INEGI), México.

INEGI, 2010, *Censo General de Población y Vivienda, 2010*. Instituto Nacional de Estadística y Geografía (INEGI), México.

Livi-Bacci, Massimo, 1994, “Notas sobre la transición demográfica en Europa y América Latina”, en *Transición demográfica en América Latina y el Caribe*, actas de *La IV Conferencia Latinoamericana de Población*, vol. 1, primera parte, México, ABEP/IUSSP/Prolap/SOMEDE.

Mancini, F., 2003, *Trabajo y certidumbre: condiciones y percepciones de la inseguridad laboral en México*. Tesis de Maestría en Población. FLACSO sede académica de México. V promoción 2001 – 2003.

Moctezuma, Miguel, 2013, “Retorno de migrantes a México. Su reformulación conceptual”, en *Papeles de Población*, vol.19 no.77, Toluca jul./sep., disponible en http://www.scielo.org.mx/scielo.php?pid=S1405-74252013000300009&script=sci_arttext

Mojarro, Octavio y Benítez, Germán, 2010, “El despoblamiento de los municipios rurales de México, 2000-2005”. en *La situación demográfica de México 2010*. <http://www.portal.conapo.gob.mx/publicaciones/sdm/sdm2010/12.pdf>

Ordorica Mellado, Manuel, 2014, “Momentos estelares en la dinámica demográfica del México de ayer, hoy y mañana”, en CONAPO, *La situación demográfica de México 2014*, pp. 13-23.

Pérez Díaz, Julio, 2022, *El impacto demográfico de la Covid-19*, disponible en http://www.enfermedadesemergentes.com/articulos/a805/Editorial_Dr-Perez_1-2022.pdf (Consultado el 12/10/2022).

Pérez, César, 2005, *Técnicas Estadísticas con SPSS 12*. Aplicaciones al análisis de datos, Prentice Hall, Madrid.

Smulviich, B., 1971, *Críticas de las teorías y la política burguesa de la población*, CELADE, Santiago de Chile.

AUTHOR’S RESUME CV

Juan Gabino González Becerril

Master in Population Studies from El Colegio de la Frontera Norte. He is a full-time professor-researcher at the Center for Research and Advanced Population Studies of the Autonomous University of the State of Mexico

(CIEAP / UAEM) and is director of the magazine Papeles de Población published by the same institution.

Email address: gonzalezg2012@hotmail.com

ORCID registration: <https://orcid.org/0000-0003-4274-4203>

Bernardino Jaciel Montoya Arce

Doctor in Sociology from the National Autonomous University of Mexico (UNAM). He belongs to the National System of Level I Researchers, has a PROMEP Desirable Profile. He is currently Coordinator of the Center for Research and Advanced Population Studies of the Autonomous University of the State of Mexico (CIEAP-UAEM). Among his recent publications are Indigenous Demography in the State of Mexico (co-author), 2013; Aging and factors associated with quality of life for elderly people in State of Mexico, 2017 (co-authored with Zuriel Soria-Romero) and “Indigenous education in the State of Mexico”, in Papeles de Población, 2013.

Email address: bjmontoyaa@uaemex.mx

Bonifacio Doroteo Pérez Alcántara

Bachelor in Geography, Master in Planning, Doctor in Education and Educational Sciences. He is a graduate of the Faculty of Geography of the Autonomous University of the State of Mexico, where he has worked since 1985 to date, being Career Coordinator, Administrative Deputy Director and Academic Deputy Director. He currently works as a Full-Time Research Professor and head of the Student Mobility Department. He specializes in Educational Research in the field of Geography and his publications revolve around this: 10 books, more than 20 scientific articles and just over 30 book chapters. Among the most recent publications, the book Educational Research in the Social and Natural Sciences (Ed. UAEM) and Geography Careers in Mexico, Past and Present (Ed. UAEM-Scientific Communication) stand out. The articles: Functional status in families of students with disabilities (Journal of Inclusive Education) and Theoretical Review of Powerful Geographic Knowledge (Didactic Journal of Geography).

Email address: bonipa62@gmail.com

Juan José Villavicencio Velázquez

Has a degree in Geography. Automated cartography specialist. Teacher in spatial and geoinformatics analysis by the Faculty of Geography of the UAEM. PROFESSIONAL ACTIVITY: Since 1993 it has been developed as a professional in the update and elaboration of cartography of the State of Mexico, and since 1999 he has been head of the Department of Cartog-

raphy and Territory in the State Coordination Mexico of INEGI, where he coordinates those activities. In this period he participated in historical theme projects developed by INEGI as: Documentary research and writing of the publication Territorial Division of the State of Mexico 1810-1995 Published in 1998 and compact Disco Capital Cities an urban historical vision (Toluca section) published in 1999. As a result of this participation, he has presented presentations and talks in different forums on the territorial evolution of the State of Mexico and the historical-urban evolution of the City of Toluca. Since 1992 he has worked as an undergraduate and graduate professor in Geography and Geomatics subjects at the Faculties of Geography, Urban and Territorial Planning and Economics of the UAEM. Publications: he is co-author of the textbook Geography, Environment and Society for high school level, edited by the UAEMéx, in 2006. Email address: juan.villavicencio@inegi.org.mx