



Urban expansion and the environmental effects of informal settlements on the outskirts of Xalapa city, Veracruz, Mexico

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ABSTRACT This paper analyzes the dynamics of population growth and urban expansion in the city of Xalapa, Mexico. It focuses on the establishment of informal settlements, which are one of the many threats to forest and farmland conservation (although these settlements are not the only source of the problem). Spatial analysis of growth data (using Geographical Information Systems (GIS) and statistical modelling) showed that by 2007, 90 per cent of the land area in the municipality of Xalapa had already been altered by human activity. Furthermore, informal settlements occupied around 54 per cent of the urban area. The cover of cloud forest, the region's original ecosystem that is of immense ecological importance and biological wealth, was calculated at only 7.6 per cent (9.3 square kilometres) and this is being threatened by the continued expansion of informal settlements. It appears that, at the time when these informal settlements are being established, a certain environmental logic operates, which in turn makes possible the social logic that sets off the occupation of spaces that are, in principle, not suitable for urbanization. The inadequate income of much of the population and their need for housing, as well as the absence of genuine long-term urban planning and, most importantly, the lack of legally available contiguous land for building, are encouraging the occupation of land not suitable for urban development, including sites at high risk of landslides and flooding. This is also causing natural resource and farmland degradation as well as the deterioration of living conditions within the urban boundary, problems that threaten the city's sustainability.

KEYWORDS ecological services / GIS / informal settlements / montane cloud forest / urbanization

I. INTRODUCTION

Informal (squatter) settlements⁽¹⁾ are a fact of life on the outskirts of many cities in the world, whether small, large or of medium size. Rapidly expanding Mexican cities are no exception.⁽²⁾ Settlements established without any formal town planning have no provision for urban services, let alone for any preservation of the surrounding ecology. Informal settlements can have a serious impact on the environment,⁽³⁾ yet urban and environmental policies in Mexico have been unable to prevent their

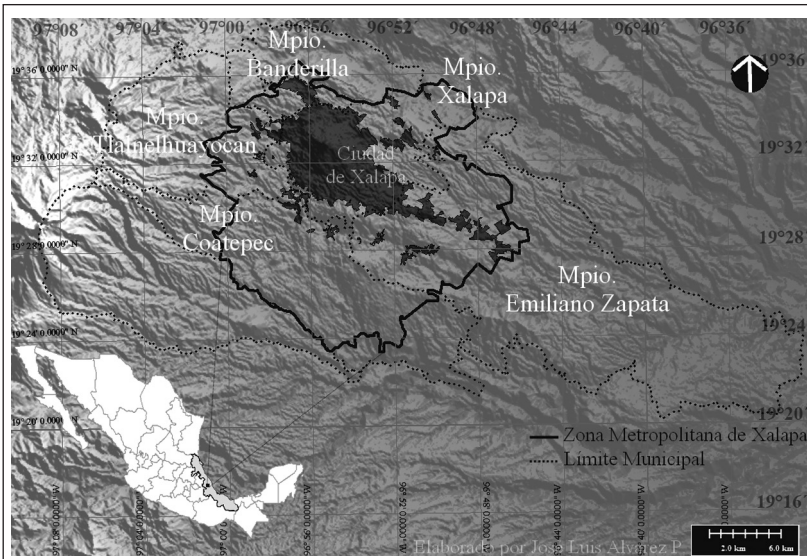


FIGURE 1

Location of the Metropolitan Zone of Xalapa (MZX), Veracruz, Mexico

SOURCE: Gobierno del Estado de Veracruz–Llave (2002), *Actualización del Programa de Ordenamiento Urbano de la Zona Conurbada de Xalapa, Banderilla, Coatepec, Emiliano Zapata y Tlalnelhuayocan, Xalapa de Enríquez, Veracruz*, Derechos Reservados de Estado de Veracruz–Llave Xalapa–Enríquez Veracruz, 674 pages, available at http://informacion.sedesmaver.gob.mx/transparencia/FraccionVII/Regionales/009_ActualProgOrdUrbXalBanEmZapTlal.pdf. (Satellite image from the Ikonos sensor with 4-band spectral resolution taken on 5 May 2007.)

spread,⁽⁴⁾ while paradoxically some of the authorities tend to ignore them or accept the situation, thus indirectly encouraging such practices.

The first part of this paper analyzes the features of the study area and the relevant legal framework. It goes on to describe how the environmental, economic and cultural components of urban development affect the city's growth and how that growth affects the ecosystem. The paper also analyzes the current pattern of informal growth and its impact on the outskirts of the city. It examines how this urbanization process has impacted the last remnants of montane cloud forest and agro-industrial crops of Xalapa and its surroundings. It also presents some findings and conclusions that could be of interest to other cities in Mexico or other countries facing similar situations.

II. THE STUDY AREA: XALAPA

Xalapa, located in the municipality of Xalapa in the centre of the state of Veracruz, covers an area of 122.33 square kilometres and has 457,614 inhabitants.⁽⁵⁾ Together with the municipalities of Banderilla,

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1. These are settlements where inhabitants are characterized as having the following: insecure residential status, meaning insecure tenure, inadequate access to safe water, inadequate access to sanitation and other basic infrastructure and services, poor structural quality of housing and overcrowding. See UN–Habitat (2003), *The Challenge of Slums: Global Report on Human Settlements*, UN–Habitat/Earthscan Publications Ltd., London and Sterling, VA, 301 pages. Also, settlements with the same characteristics regarding land, urban planning and

housing (depending on the context and public authority interpretations) can be considered either as formal or informal. See Durand-Lasserve, Alain (2006), "Treating people and communities as assets. Informal settlements and the Millennium Development Goals: global policy debates on property ownership and security of tenure", *Global Urban Development Vol 2*, No 1, March pages 1–15, available at <http://www.globalurban.org/GUDMag06Vol2Iss1/Durand-Lasserve%20PDF.pdf>.

2. García-Ortega, Roberto (2001), "Asentamientos irregulares en Monterrey, 1970–2000: divorcio entre planeación y gestión urbana", *Frontera Norte* No 13, July–December, pages 119–155; also Alegría-Olazábal, Tito and Gerardo Ordoñez-Barba (2005), "Legalizando la ciudad: asentamientos informales y procesos de regularización en Tijuana", *El Colegio de la Frontera Norte*, Tijuana, 176 pages; Huchzermeyer, Marie (2006), "The new instrument for upgrading informal settlements in South Africa: contributions and constraints", in Marie Huchzermeyer and Ely Karam (editors), *Informal Settlements: A Perpetual Challenge?*, UCT Press, Cape Town, South Africa, CORDAID, pages 41–61; Mollá, Manuel (2006), "El crecimiento de los asentamientos irregulares en áreas protegidas. La delegación Tlalpan", *Investigaciones Geográficas, Boletín Instituto de Geografía* No 60, UNAM, pages 83–109; and Fernández, Edésio (2008), "Consideraciones generales sobre las políticas públicas de regularización de asentamientos informales en América Latina", *Revista EURE* Vol XXXIV, No 102, August, pages 25–38.

3. Bazant, Jan (2001), *Periferias Urbanas. Expansión Urbana Incontrolada de Bajos Ingresos y su Impacto en el Medio Ambiente*, Trillas México DF, 268 pages; also Gerritsen, Peter, Alma Lomeli-Jiménez and Claudia Ortiz-Arrona (2005), "Urbanización y problemática socioambiental en la costa sur de Jalisco, México. Una aproximación", *Región y*

Tlalnelhuayocan and parts of Coatepec and Emiliano Zapata, it makes up the Metropolitan Zone of Xalapa (MZX)⁽⁶⁾ (Figure 1). Major business and service sector activities underlie its economic importance, and its considerable biological wealth derives from the surrounding cloud forest, an ecosystem of high biodiversity that is one of the most threatened in the country.⁽⁷⁾

The city is located in a region of great historical importance, as the Spanish conquistadores passed through Xalapa on their way to Mexico City. From 1521, Xalapa became the entry point for Spanish immigrants looking for a better climate and healthier conditions. The city centre, superimposed on the indigenous layout (dating from 1313), corresponds to the charter granted in the year 1572 and is still the hub of business activity. Xalapa has been mapped and studied since the earliest Spanish settlements, and the records hold a wealth of information useful for an analysis of the historical development of this urban space and its implications for the immediate natural surroundings. This information is relevant when looking for ways to reconcile orderly urban growth with environmental conservation.

Control of land use is extremely weak in medium-sized cities (i.e. with 100,000 to one million inhabitants) in the state of Veracruz.⁽⁸⁾ In Xalapa, the capital, expansion through informal settlement is proceeding apace and exacerbating urban problems, with no sign of any reduction in pressure on natural resources and neighbouring productive areas. Growth has been chaotic, with unplanned new settlements constantly springing up on the outskirts. There is minimal provision for green spaces within the urban boundary and the informal urbanization process makes the problem worse. The inhabitants of the settlements will eventually have to tackle this and fight for public green spaces.⁽⁹⁾

III. METHODOLOGY

The widening urban sprawl of Xalapa was analyzed in the context of both the municipality and the larger MZX. The population censuses of 1950, 1960, 1970, 1980, 2000 and 2005, together with historical data,⁽¹⁰⁾ were used to document the dynamics of population growth and its relationship with the expanding urban area of Xalapa. We were able to look at different stages of the urbanization process, compare them with the present urban landscape and identify the changes that took place at each stage in terms of growth, change or reduction in components such as housing blocks, highways, bodies of water and physical and cultural features, using the classifications corresponding to the year of the cartographic reconstruction in question. Analysis of spatio-temporal changes in vegetation cover and land use served as a baseline to map trends in deforestation, degradation and loss of biodiversity in the region.

The data were delimited by the vector and toponymic layers in digital format at a scale of 1:50,000, corresponding to the topographic charts marked as E14B26, E14B36, E14B27 and E14B37.⁽¹¹⁾ All the spatio-temporal information was entered in a Geographical Information System (GIS) on the ARC GIS 9.3 platform. Satellite images from the Ikonos sensor with 4-band spectral resolution (three in the visible and one in the infrared wavelengths) were used as a baseline. The spatial resolution of the scenes is two metres per pixel and the images were taken on 5 May 2007. These

were processed digitally using ER MAPPER 7.1 software to generate a map of current XMA vegetation and land use for 2007.

The vegetation of the municipality of Xalapa was cross-checked with studies by Zolá and by Castillo-Campos.⁽¹²⁾ Six field verification visits were made to delimit the vegetation, and in some cases soil types were used to do so.⁽¹³⁾

IV. URBAN EXPANSION AND INFORMAL SETTLEMENTS

The population of Xalapa began to rise sharply in the 1960s, increasing by more than 300 per cent by 1980 (from 63,509 to 204,594). Between 1950 and 1980, 100,000 people are reported to have migrated from rural areas to the city.⁽¹⁴⁾ Informal settlements were much in evidence during those decades. Xalapa has essentially grown outwards, mostly towards the north, as the deep ravines of Cofre de Perote to the west form a natural barrier to the process of urban expansion.

In the 1980s, Xalapa formed a conurbation with Banderilla to the northeast and Tlalnelhuayocan to the west, resulting in the establishment of the MZX. The surrounding forests dwindled rapidly due to urban pressure as well as conversion to dairy farming.⁽¹⁵⁾ In 1980, 40 per cent of the population of Xalapa was living on *ejido* land,⁽¹⁶⁾ which had been granted to peasant communities under agrarian reform⁽¹⁷⁾ and where low-income groups had established informal and frequently illegal settlements on the outskirts of the city.⁽¹⁸⁾

In the following two decades, 1980–2000, the population nearly doubled (from 204,594 to 390,590 inhabitants), with considerable further growth in the outlying settlements of makeshift dwellings inhabited by low-income groups. In the space of 55 years (1950–2005), the population grew from 59,309 to 413,136 inhabitants and the urban area from 8.3 to 57.3 square kilometres (2007), representing an increase of almost 700 per cent in both cases.⁽¹⁹⁾

If housing demand, supply and cost are examined in relation to income, the difficult situation facing the lowest-income groups becomes clear. Housing demand in the municipality of Xalapa is officially 7,430 units, while supply officially stands at 942 units,⁽²⁰⁾ with medium to high grade housing developments priced at 300,000–500,000 pesos, out of reach of the majority.

Analysis of income in the five MZX municipalities shows that inhabitants generally have very low incomes and there is a high level of job uncertainty. In Xalapa, 31.1 per cent of the population has an income of between two and five minimum wages,⁽²¹⁾ while in Tlalnelhuayocan, 42.5 per cent of the population has an income between one and two minimum wages⁽²²⁾ (Table 1). These are the groups – with limited income and limited access to housing supply – found in informal settlements. The outlook is poor and, with the constant arrival of further migrants, it is clear that current urban planning is in no position to meet this growing demand.

Documentation on squatter settlements in Xalapa is very hard to come by; the records are muddled, out of date and lacking in detail. The urban land registry does not provide complete or organized information either,⁽²³⁾ although some studies have been done. One estimate for the early 1990s calculated that 46 per cent of the people living on the outskirts

Sociedad Vol XVII, No 33, May–August, pages 107–132; Vinoth-Kumar, J Antony, S K Athan and R J Bhandari (2007), “Spatio-temporal analysis for monitoring urban growth – a case study of Indore City”, *Journal of Indian Society of Remote Sensing* Vol 35, No 1, pages 11–22; and Hahs, Amy, Mark McDonnell, Michael McCarthy, Peter Vesk, Richard Corlett, Briony Norton, Steven Clements, Richard Duncan, Ken Thompson, Mark Schwartz and Nicholas Williams (2009), “A global synthesis of plant extinction rates in urban areas”, *Ecology Letters* Vol 12, No 11, August, pages 1165–1173.

4. Scheingart, Martha and Clara Salazar (2003), “Expansión urbana, protección ambiental y actores sociales en la Ciudad de México”, *Estudios Demográficos y Urbanos* Vol 18, No 3, pages 433–460.

5. Although its official area measures 118.45 square kilometres, the figure of 122.33 square kilometres is given because Banderilla was obliged to cede 388 hectares to Xalapa following a dispute over territory that arose from the physical encroachment of the expanding city of Xalapa on the municipality. Mapping office analysis data from INEGI (2000a), *Planos por Localidad Urbana. XII Censo General de Población y Vivienda del 2000*, Aguascalientes, México; also INEGI (2010), *Censo de Población y Vivienda 2010. Estados Unidos Mexicanos Resultados Preliminares*, Veracruz de Ignacio de la Llave, 251 pages, see www.censo2010.org.mx/doc/cpv10p_pres.pdf.

6. Gobierno del Estado de Veracruz–Llave (1989), “Decreto de conurbación de los municipios de Xalapa, Banderilla, Coatepec, San Andrés Tlalnelhuayocan, Rafael Lucio, Emiliano Zapata, Teocelo y Xico”, declarado por el Poder Ejecutivo del Estado *Gaceta Oficial, Órgano del Gobierno del Estado de Veracruz–Llave* Vol 140, No 12, Xalapa, 28-1-89; also Gobierno del Estado de Veracruz–Llave Xalapa–Enriquez, Veracruz (2004), *Actualización del*

TABLE 1
Income in minimum wages (MW) of the population in Veracruz and Metropolitan Zone of Xalapa

Wages	Less than 1 MW		1–2 MW		2–5 MW	
	Population	%	Population	%	Population	%
State of Veracruz	555,942	23.65	758,399	32.27	451,686	19.21
Banderilla	1,171	19.19	2,337	38.31	1,624	26.62
Coatepec	7,663	24.96	11,374	37.06	6,038	19.67
Emiliano Zapata	3,842	22.03	7,217	41.39	3,018	17.31
Xalapa	23,968	14.94	48,484	30.23	49,861	31.09
Tlalnahuayocan	1,182	30.62	1,642	42.53	510	13.21

SOURCE: INEGI (2008), *Sistema Municipal de Bases de Datos (SIMBAD) 2008, Resultados 1990 a 2005, Censo de Población y Vivienda*, available at http://www.inegi.gob.mx/lib/olap/general_ver4/MDXQueryDatos.asp.

Programa de Ordenamiento Urbano de la Zona Conurbada de Xalapa-Banderilla-Coatepec-Emiliano Zapata-Tlalnahuayocan, Derechos Reservados Gobierno del Estado de Veracruz-Llave Xalapa-Enríquez, Veracruz, 674 pages, available at http://informacion.sedesmaver.gob.mx/transparencia/FraccionVII/Regionales/009_ActualProgOrdUrbXalBanEmZapTlal.pdf.

7. Rzedowski, Jerzy (1978), *La Vegetación de México*, Ed. LIMUSA, México DF, 478 pages.

8. Falcón-García, Jerónimo Rafael (2006), "Por una ciudad amigable: la propuesta de los gobiernos de las ciudades medias de Veracruz, México", Memoria en el marco del VIII Congreso Iberoamericano de Municipalistas, celebrado en Guayaquil (Ecuador) 12 al 16 de noviembre de 2006, 23 pages, available at <http://www.voxlocalis.net/revistas/num23/doc/CIUDADES%20AMIGABLES.pdf>.

9. Hernández-Bonilla, Mauricio (2005), "Mejoramiento del espacio público en las colonias populares de México. Caso de estudio de Xalapa-Veracruz", *Revista INVI* Vol 20, No 53, May, pages 181–199.

10. From INEGI, *Censos General de Población y Vivienda y Censos de Población y Vivienda 1950, 1960, 1970*,

of Xalapa (around 300,000) worked in construction or the informal service sector (for instance as cleaners, in domestic service, as drivers or street vendors).⁽²⁴⁾ Because their income was low, they were likely to be housed in informal settlements. In 2000, around 40 per cent of the area of Xalapa was occupied by informal settlements, most of them in hazardous areas.⁽²⁵⁾ Figure 2 and Table 2 show the informal settlements established in the municipality of Xalapa in the 1990s and formalized in 2000, although not all of them are on the map. There is an estimated 10 year delay in updating the data.

The *ejido* system of land stewardship has played a particularly important role in shaping rural processes in Veracruz, as this is the state with the largest number of *ejidos* and agrarian communities, numbering nearly 3,000.⁽²⁶⁾ It has also been a significant factor in the process of urban expansion because *ejido* land was located mainly around cities, and for several decades the *ejidos* supplied land for illegal urbanization. When initially granted to peasant communities, *ejido* land was clearly defined as non-commercial.⁽²⁷⁾ However, the shortage of accessible urban land for the most disadvantaged groups led to the occupation of *ejido* land⁽²⁸⁾ on the outskirts of a number of cities in Mexico. The result was an illegal market in which *ejido* land was taken over for urban development.

Prior to 1992, the law restricted the commercialization of land as a way of protecting social ownership. When Article 27 of the Mexican Constitution was reformed in 1992, the private ownership and sale of *ejido* and communal land was permitted. It was hoped that illegal sales for urbanization purposes could be controlled by bringing this land into legal urban development in an orderly manner. But the capacity of municipal governments to organize and plan urban development was limited,⁽²⁹⁾ and it proved impossible to consolidate the organization of the market in socially owned land. On the contrary, it led to more land speculation, given the increase in the value of agrarian land likely to be urbanized and the uncertainty concerning land tenure.⁽³⁰⁾ This increased the dynamic process of changes in land use. New settlements sprang up, including informal settlements on less desirable land for low-income groups who

TABLE 2
Irregular settlements in the municipality of Xalapa, Veracruz established in the 1990s

District	Location	Number of lots	Inhabitants INEGI (2000)	Total number of dwellings	Inhabitants with health services	Migrants
Ampliación Renacimiento						
Convergencia	Northwest	65				
Diamante	Northwest		306	71	71	16
Dolores Hidalgo	Northwest	315	698	153	128	35
El Porvenir – Cerro Colorado	Northwest	161	448	98	89	19
Esmeralda	Northwest					
Encino Ampl. UNE–PRI	Northwest	52	1,031	232	211	64
Flores de Casa Blanca	Northeast	164				
Insurgentes	Northwest					
Las Flores	Northwest					
Loma Bonita	Northeast	76				
Los Arenales	Southeast					
Luis Donald Colosio	Northwest	62	674	163	112	62
Manantiales	Northwest		1,551	352	442	119
Miradores de San Roque	Northwest	132	44	14	4	4
Nuevo Renacimiento	Northwest					
Renacimiento	Northwest		681	157	122	28
San Judas Tadeo	Northeast	99				
Solidaridad	Northeast					
9 de Abril	Northwest					
Encinos – <i>Ejido</i> Sumidero	Northeast					
Ampliación Nacimiento	Northwest					
Las Jacarandas	Northeast					
Rotaria	Northeast					
Lomas de Sumidero	Northeast					
Bosques del Sumidero	Northeast					

SOURCE: Urban Development Department of Xalapa, Veracruz and INEGI (2000), *Planos por Localidad Urbana. XII Censo General de Población y Vivienda del 2000, Aguascalientes, México. Principales Resultados por Localidad*, Aguascalientes, México (The estimates are for inhabited private housing.) See also SCINCE por Colonias, Veracruz-Llave (2003), *XII Censo General de Población y Vivienda 2000, Desglose Geográfico: Localidad, Disco Compacto, Entidad Federativa Veracruz, Primera Edición, Decenal*. (SCINCE is a system for consulting census information. This is the most recent information because the 2005 INEGI count did not cover this level; so settlements where no information appears are those set up after 2000. In the year 2000, there were around 377 settlements.) And see INEGI (2008), *Sistema Municipal de Bases de Datos (SIMBAD) 2008, Resultados 1990 a 2005, Censo de Población y Vivienda*, available at http://www.inegi.gob.mx/lib/olap/general_ver4/MDXQueryDatos.asp.

had no other ways of obtaining housing.⁽³¹⁾ Since 2000, as a result of unfavourable market conditions, limited job opportunities and the lack of support for small-scale productive activities in the countryside, there has

1980, 1990, 2000 and 2005, Aguascalientes, México (population censuses 1950, 1960, 1970, 1980, 1990, 2000

and 2005); also INEGI (2000b), "Ciudad de Xalapa–Enriquez", *Ciudades Capitales: Una Visión Histórico Urbana* Vol 4, Aguascalientes, México, compact disc.

11. DGG–INEGI (2000), *Cartas Topográficas y Datos Vectoriales*, Escala 1:50,000, Claves E14B26, E14B36, E14B27 y E14B37, Aguascalientes, AGS, México.

12. Zolá, Manuel G (1984), *La Vegetación de Xalapa*, Veracruz, INIREB, Xalapa, Veracruz, 155 pages; also Castillo-Campos, Gonzalo (1991), *Vegetación y Flora del Municipio de Xalapa*, Veracruz. *Programa del Hombre y la Biosfera (MAB, UNESCO)*, Instituto de Ecología AC, H Ayuntamiento de Xalapa, Veracruz, 148 pages.

13. Rossignol, Jean-Pierre, Daniel Geissert, Adolfo Campos and Jean Kilian (1987), *Mapa de Unidades Morfoedafológicas del Área Xalapa-Coatepec*, Escala 1:75,000, INIREB-ORSTOM-CIRAD, Xalapa, Veracruz; also Rossignol, Jean-Pierre and Daniel Geissert (1987), *Mapa de los Recursos en Tierras del Área Xalapa-Coatepec*, Escala 1:75,000, INIREB-ORSTOM-CIRAD, Xalapa, Veracruz.

14. Zentella Gómez, Juan Carlos (2005), "Relaciones intermunicipales y gobernabilidad urbana en zonas metropolitanas en México. El caso de la Zona Metropolitana de Xalapa", *Estudios Demográficos y Urbanos* Vol 20, No 2, May–August, pages 229–267.

15. Capitanachi, Clío, Elsa Utrera and Carmen Smith (2003), *Sistema de Áreas Verdes Urbanas: Estrategia para el Ordenamiento del Crecimiento Urbano en Ciudades Medias. Caso de Estudio: Xalapa, Veracruz*, UV–INECOL, Sistema de Investigación del Golfo de México (CONACYT) Xalapa, Veracruz, México, Informe Técnico Final, Proyecto Clave: 00-04-001-V, 260 pages.

16. An *ejido* is a population group (parties) of men and women who have been granted collective rights to mainly

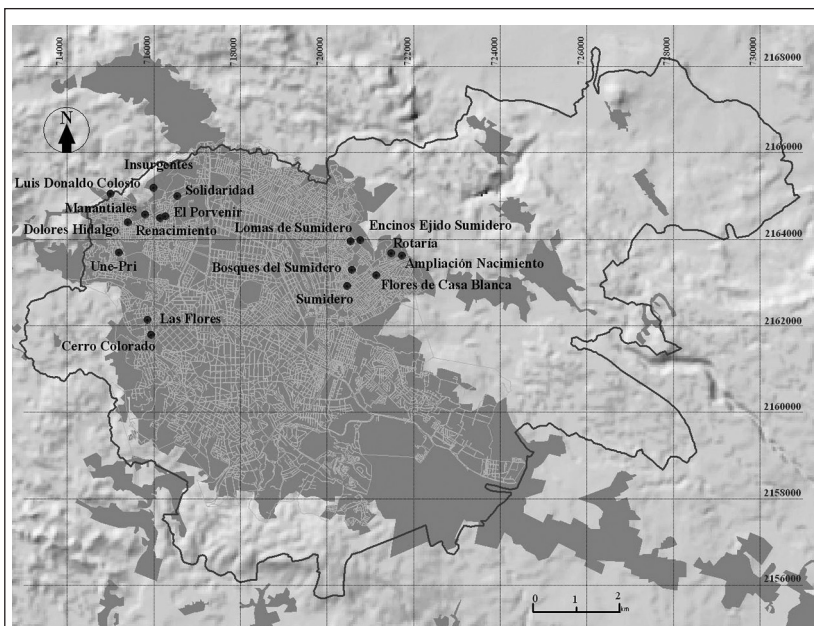


FIGURE 2
Informal settlements set up in the municipality of Xalapa, Veracruz (delineated) in the 1990s and formalized in 2000

SOURCE: SCINCE por Colonias, Veracruz–Llave, *XII Censo General de Población y Vivienda 2000* (2003), Desglose Geográfico: Localidad, Disco Compacto, Entidad Federativa Veracruz, Primera Edición, Decenal. (Satellite image from the Ikonos sensor with 4-band spectral resolution taken on 5 May 2007.)

been a wave of migration toward the urban centres⁽³²⁾ and, consequently, more building on unregistered *ejido* land.

Not all *ejido* land is similar in terms of its development potential. There are areas that are more valuable for cultivation and also more valuable for development purposes; and there are other areas that are steep or forested, which are less suitable for either cultivation or development – although they may have great ecological significance. Land that is less suitable for development is more likely to be developed informally by those with a low income.

Figure 3 illustrates the urban expansion of Xalapa into *ejido* lands and Table 3 shows the loss of this land between 2000 and 2007.⁽³³⁾ These data show a decrease of 7.75 square kilometres (19 per cent) from the original 40.02 square kilometres of *ejido* land in the municipality of Xalapa. According to our findings, this urban expansion comprises mainly informal settlements, resulting in a total urbanized area of 57.3 square kilometres in 2007. The 7.75 square kilometres represents 13.5 per cent of the total urbanized area for 2007, and when this is added to the 40 per cent of the urban area occupied mainly by informal settlements that was reported for 2000,⁽³⁴⁾ it means that approximately 54 per cent of the city's area is estimated to be occupied by informal settlements.⁽³⁵⁾ (In the

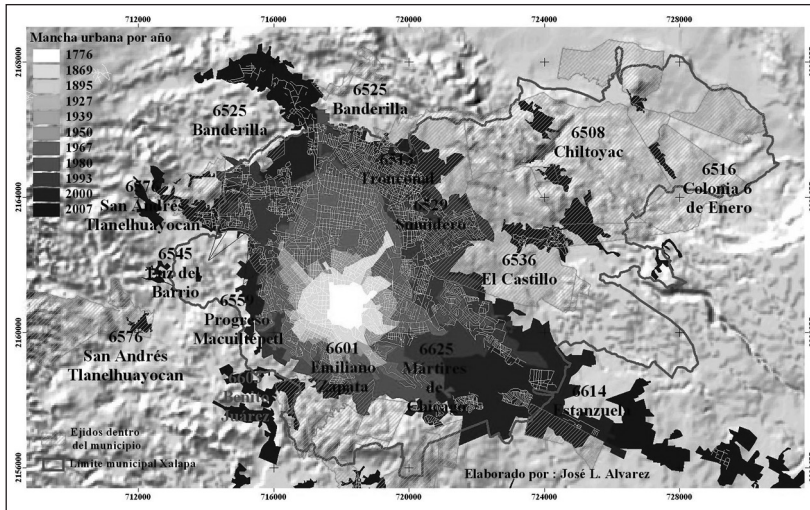


FIGURE 3

Urban expansion, particularly onto ejido land, on the outskirts of Xalapa, Veracruz in 2007

SOURCE: INEGI (2007), *Carta de Núcleos Agrarios. Avance al 31 de Diciembre 2006*, Carta Topográfica, Escala 1:250,000, Aguascalientes, México, update in 2000. (Satellite image from the Ikonos sensor with 4-band spectral resolution taken on 5 May 2007.)

country at large, approximately 50 per cent of the current urban area is made up of informal settlements.)⁽³⁶⁾

The most seriously affected *ejidos* have been Luz del Barrio and Progreso Macuiltépetl (sic. Macuiltépetl), where the entire area has become urbanized. To the northeast, the greatest change occurred in the El Castillo *ejido* (2.66 square kilometres lost),⁽³⁷⁾ which stands out as an example of the urbanization process affecting the *ejidos* around Xalapa (Photo 1). The establishment of some informal settlements led to legal uncertainty over land tenure, both for the *ejidatarios* and for the owners of the buildings. One alternative for government was to formalize land tenure through expropriation,⁽³⁸⁾ in order to incorporate the *ejido* system within the process of urban development and stem the chaotic growth of Xalapa.

Settlements on *ejido* land around Xalapa cannot be formalized in the short term because the occupants have not acquired full ownership of the land, which makes the process of proving tenure more difficult. The complexity and slowness of the process of converting *ejido* land to private ownership makes this process even more difficult. Given the high value of the best-placed *ejidos* in relation to the urban fringe, particularly where the land is flat or gently sloping, many farmers divide up and sell their land for urban use without going through official channels. In the area around Xalapa, housing developments on *ejido* land are also common because some property development companies buy up land without planning permission at low cost and then build on a large scale, making large profits; and with the possible complicity of some authorities, who know that the most disadvantaged people have no way of purchasing a

agrarian production on a tract of land. Members hold the land in usufruct. *Ejido* land is a tract of land with a legal title that grants the rights of use by parties who are members of an *ejido*. See INEGI (2006), *Núcleos Agrarios Tabulados Básicos por Municipio: Programa de Certificación de Derechos Ejidales y Titulación de Solares*, PROCEDE, Veracruz Ignacio de la Llave, Glosario, Abril del 1992 al 31 de Diciembre de 2004, pages 145 and 147, available at http://mapserver.inegi.org.mx/geografia/espanol/cartcat/tabulados/PDF/tbe_ver.pdf; also Procuraduría Agraria (1995), *Glosario de Términos Jurídicos*, Procuraduría Agraria, México, page 17; and Secretaría de la Reforma Agraria (1992), *Ley Agraria*, SRA, México, page 363.

17. Marchal, Jean-Yves and Rafael Palma (1985), *Análisis Gráfico de un Espacio Regional: Veracruz*, INIREB-ORSTOM, Xalapa, Veracruz, 220 pages.

18. Villanueva-Olmedo, Minerva (2008), "Urbanización y nuevos territorios urbanos en una ciudad capital: Xalapa, Veracruz", *BOLETIN Electrónico, CIESAS Golfo* Year 2, No 7, available at <http://www.ciesas-golfo.edu.mx/boletin/1-7/contenido/editorial.html>.

19. See reference 10, INEGI population censuses, together with historical data.

20. BANCOMER (2008), "Estudio del mercado de vivienda en: VERACRUZ", available at http://www.hipnal.com.mx/not_ver.html.

21. To give an idea of how much money this is, one litre of milk in Mexico in 2010 would represent about 17 per cent of a labourer's minimum daily wage (57.46 pesos).

22. The minimum daily wage in Veracruz for 2010 was 57.46 pesos, equivalent to less than US\$ 5 per day.

23. Gobierno del Estado de Veracruz-Llave, Secretaría de Finanzas y Planeación del Estado de Veracruz, Dirección de Catastro (1998), *Plano General de la Ciudad de Xalapa, Veracruz*, Escala aproximada 1:7,500 Xalapa, Veracruz, México, Claves

Catastrales y Colonias; also H Ayuntamiento de Xalapa, Veracruz, Unidad de Catastro y Patrimonio (2009), *Relación de Colonias y Fraccionamientos y Unidades Habitacionales de la Ciudad de Xalapa, Veracruz, Anexo Gráfico*, Municipio de Xalapa; and Abbot, John (2001), "Use of spatial data to support the integration of informal settlements into the formal city", *International Journal of Applied Earth Observation and Geoinformation* Vol 3, No 3, May, pages 267–277.

24. Vela-Martínez, Rafael (2004), "Congestionamiento urbano en Xalapa: falta de planeación urbana en una ciudad media. Cuarta y última parte", *Enfoque Veracruz*, 11 pages, available at http://www.enfoqueveracruz.com/analisis/des_regional/problematika/congestionamiento%20urbano%20en%20xalapa4.htm.

25. See reference 15.

26. INEGI–ORSTOM (1988), *Atlas Ejidal del Estado de Veracruz, Encuesta Nacional Agropecuaria Ejidal 1988*, Aguascalientes, 26 pages.

27. *Ejido* land was clearly defined as non-commercial; all kinds of land transactions used to be prohibited, not only purchase and sale but also rental agreements and sharecropping, where a piece of land is ceded temporarily in exchange for a share in the profits earned from working it. The agrarian property was inalienable, imprescriptible, non-attachable and non-transferable.

28. Some *ejidos* received all their land as communal property, whereas others obtained a mixture of individual and communal tenure; see Muñoz-Piña, Carlos (2003), "Reformas de segunda generación en materia ambiental y agraria para los bosques en México", *Gaceta de Economía* Número Especial Año 9, pages 181–198.

29. Olivera, Guillermo (2005), "La reforma al Artículo 27 constitucional y la incorporación de las tierras ejidales al mercado legal de suelo urbano en México", *Scripta Nova. Revista*

TABLE 3
Loss of *ejido* land area due to urban growth on the outskirts of Xalapa, Veracruz between 2000 and 2007

<i>Ejido</i>	Area according to the national agrarian records (km ²)	Urban area (km ²)	Area lost (%)
	2000	2007	
Banderilla (Banderilla)	1.066	0.297	27.86
Emiliano Zapata (Emiliano Zapata)	2.913	1.061	36.42
San Andrés Tlalnahuayocan (Tlalnahuayocan)	10.073	1.067	10.59
Benito Juárez (Xalapa)	0.635	0.388	61.10
Chiltoyac (Xalapa)	14.997	1.238	8.25
Colonia 6 de Enero (Xalapa)	5.104	0.24	4.70
El Castillo (Xalapa)	12.11	2.657	21.94
La Concepción (Xalapa)	0.312	0.16	51.28
Luz del Barrio (Xalapa)	0.576	0.576	100.00
Mártires de Chicago (Xalapa)	1.268	0.037	2.92
Progreso Macuilitépetl (Xalapa)	0.385	0.382	99.22
Sumidero (Xalapa)	1.487	0.711	47.81
Tronconal (Xalapa)	3.149	1.369	43.47
Total for the municipality of Xalapa	40.023	7.758	19.00
Total for all surrounding municipalities	54.075	10.183	20.00

SOURCE: INEGI (2007), *Carta de Núcleos Agrarios. Avance al 31 de Diciembre 2006*, Carta Topográfica, Escala 1:250,000, Aguascalientes, México, updated in 2000.

house in these housing developments.⁽³⁹⁾ In the *ejidos* located near the urban areas, the price of land is high; the demand to participate in the market for urban land is the main incentive to acquire title,⁽⁴⁰⁾ and owners of the land, the *ejidatarios*, also sell land to urban developers.

Furthermore, there is a strong incentive to continue the process of converting *ejido* land, through state mortgage credit offered by agencies such as Infonavit⁽⁴¹⁾ as part of the policies to boost purchases of new housing. Speculation in *ejido* land is one of the most important factors in the establishment of informal settlements, yet no estimate has been made of the impact on the supply of land under *ejido* and communal ownership for urban uses.⁽⁴²⁾

V. LAND USE AND ITS IMPLICATIONS FOR BIODIVERSITY AND FOR THE SAFETY OF INFORMAL SETTLERS

A map of vegetation and land use in the MZX was prepared for 2007 to obtain more recent data (Figure 4). The results show that in the municipality of Xalapa, 90 per cent of land has been altered due to



PHOTO 1

View of an informal settlement in the El Castillo *ejido*, to the northeast of the city of Xalapa, Veracruz in what was a shade coffee plantation

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human activity, with the remnants of natural vegetation, cloud forest and fallow land covering just 7.6 per cent of the area (9.3 square kilometres) to the northwest and south of Xalapa. The best-preserved areas are to the northwest on the borders with Tlalnelhuayocan and Banderilla.⁽⁴³⁾ Montane cloud forest, which occupies less than 1 per cent of the national territory, is the habitat of around 2,500 species of vascular plants, almost 30 per cent of which are endemic to Mexico, accounting for around 10 per cent of the country's floristic richness and with the highest degree of biodiversity per unit area.⁽⁴⁴⁾

Despite the small area of montane cloud forest in the municipality of Xalapa, it has some of the greatest concentrations of flora, a total of 1,300 species.⁽⁴⁵⁾ Montane cloud forest and many of its components have survived as a result of shade coffee cultivation, which has encouraged the maintenance of tree cover⁽⁴⁶⁾ and occupies 14.1 per cent (17.3 square kilometres) of the land area of Xalapa municipality. For example, to the northeast, shade coffee plantations are mainly monocrops, with trees of the genus *Inga* (*Inga jinicuil* (jinicuil) and *Inga paterno* (chalahuite)),⁽⁴⁷⁾ described as "shade monocrop";⁽⁴⁸⁾ but even so they preserve a good proportion of the biodiversity of the surrounding forests.⁽⁴⁹⁾ Studies of various groups such as birds, mammals, arthropods and orchids have shown that a large proportion of the species of the original forest can co-exist with these coffee agro-ecosystems (Figure 5).⁽⁵⁰⁾

Coffee production is frequently not economically viable.⁽⁵¹⁾ Coffee plantations are constantly exposed to conversion to sugarcane as a result

Electrónica de Geografía y Ciencias Sociales Vol IX, No 194 (33), University of Barcelona, 1 August 2005, available at <http://www.ub.edu/geocrit/sn/sn-194-33.htm>.

30. Palacio-Muñoz, Víctor H, José Luis Montesillo-Cedillo and Eugenio E Santacruz de León (2007), "El mercado de tierras en México, teoría y método de análisis", *Revista Académica de Economía* No 77, 10/04/2007, Número Internacional Normalizado de Publicaciones Seriadas, 27 pages, available at <http://www.eumed.net/cursecon/ecolat/mx/2007/mcl.htm>.

31. Palacio-Muñoz, Víctor H (2002), "Las tierras agrícolas de alta productividad frente al mercado de tierras urbano", *Laberinto (Filosofía, Política y Economía)* No 10, pages 43–52, October, available at http://dialnet.unirioja.es/servlet/listaarticulos?tipo_búsqueda=EJEMPLAR&revista_búsqueda=1842&clave_búsqueda=57914; also Smolka, Martim (2003), "Informalidad, pobreza urbana y precios de la tierra", *Perspectivas Urbanas, Land Lines 1* Vol 15, No 1, Lincoln Institute of Land Policy, 6 pages, available at [http://www.lincolninstitute.edu/pubs/dl/825_Informalidad 01-03.doc](http://www.lincolninstitute.edu/pubs/dl/825_Informalidad%2001-03.doc).

32. Gravel, Nathalie (2007), "Mexican smallholders adrift: the urgent need for a new social contract in rural Mexico", *Journal of Latin American Geography* Vol 6, No 2, pages 77–98.

33. INEGI (2007), *Carta de Núcleos Agrarios. Avance al 31 de Diciembre 2006*, Carta Topográfica, Escala 1:250,000, Aguascalientes, México, update in 2000.

34. See reference 15.

35. A description reflecting what commonly happens in this case is given in Ortiz, Leonardo (2006), "Definición de asentamiento irregular", *Correo: El Diario del Estado de Guanajuato*, 7 December, available at <http://www.correo-gto.com.mx/notas.asp?id=7493>: [These settlements] "...are the ones where clandestine land sales take place, with an individual landowner or

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intermediary offering plots of land that are not equipped with basic services." The *ejidatarios* divide their land into lots for non-agricultural use without changing its land use class from *parcelar* agricultural to urban.

36. González-Patiño, Rosendo (2007), "Asentamientos humanos irregulares. Ponencia presentada en el Congreso Nacional de la Federación de Colegios de Ingenieros Civiles", 24 April, available at http://www.inforural.com.mx/centro.php?id_rubrique=118&id_article=5771#.

37. This *ejido* was established by decree on 7 July 1924.

38. The land was expropriated in favour of CORETT, the Commission for the Formalization of Land Tenure (La Comisión para la Regularización de la Tenencia de la Tierra), *Diario Oficial* (2009), "Secretaría de la Reforma Agraria decreto por el que se expropia por causa de utilidad pública una superficie de 9-60-15 hectáreas de agostadero de uso común, de terrenos del *ejido* El Castillo, Municipio de Xalapa, Veracruz", *Diario Oficial* (2009), "Secretaría de la Reforma Agraria decreto por el que se expropia por causa de utilidad pública una superficie de 9-60-15 hectáreas de uso común, de terrenos del *ejido* El Castillo, Municipio de Xalapa, Veracruz", *Diario Oficial* (2009), available at <http://ordenjuridicodemo.segob.gob.mx/Federal/PE/APF/APC/SRA/Decretos/2009/04122009%281%29.pdf>.

39. García-Espinosa, Salvador in Carlos F Márquez (2008), "Especulación de promotoras de vivienda, lastre del crecimiento de mancha urbana", *La Jornada Michoacán*, Sección Municipios, 3 August 2008, available at <http://www.lajornadamichoacan.com.mx/2008/08/03/index.php?seccion=municipios&article=008n1mun>.

40. Galeana, Fernando (2004), "Who wants credit? Explaining the demand for land titling in Mexico", *SURI*, Spring, pages 16-21.

41. Instituto Nacional de

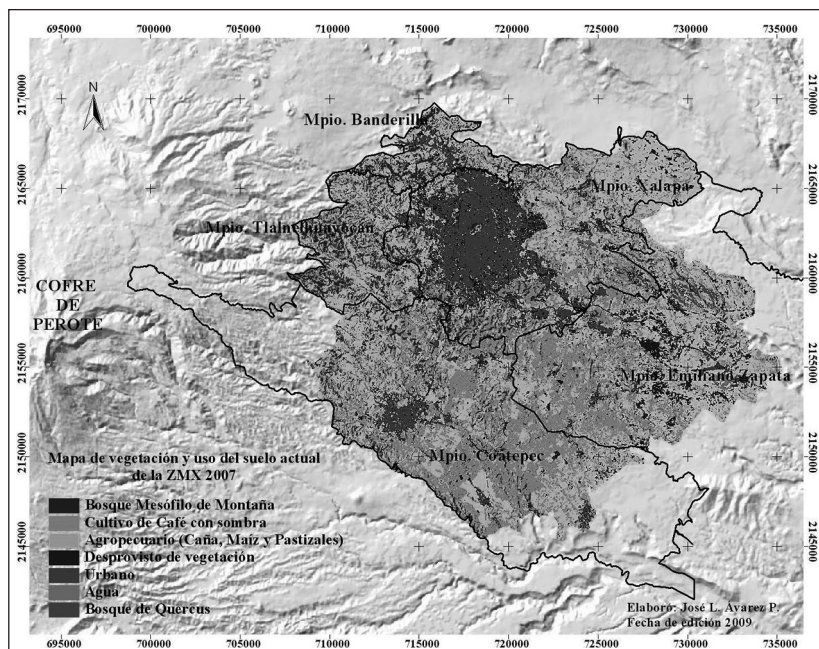


FIGURE 4
Vegetation and land use in the Metropolitan Zone of Xalapa, Veracruz, 2007

SOURCE: DGG-INEGI (2000), *Cartas Topográficas y Datos Vectoriales*, Escala 1:50,000, Claves E14B26, E14B36, E14B27 y E14B37, Aguascalientes, AGS, México. (Satellite image from the Ikonos sensor with 4-band spectral resolution taken on 5 May 2007.)

of the broad fluctuations in coffee prices. In Coatepec, an area of coffee plantations measuring 1,325 square kilometres shrank by 84 per cent between 1990 and 2003, while sugarcane plantations quintupled.⁽⁵²⁾ Nevertheless, it is likely that both coffee and sugarcane plantations will be affected by urban development in view of the high prices fetched by such land on the outskirts of the city.

The threat to biodiversity posed by current land use patterns is accompanied by the threat to the people occupying ecologically valuable land. Generally speaking, the topography around Xalapa is rough with uneven relief and small, deep ravines, although there are also ridges, streams and rivers. The pre-consolidated clay soils of volcanic origin are highly unstable and liable to water erosion; they can crack as a result of either rain or drought, as evidenced by the breaking away of slopes exposed to the full force of the weather. Hurricanes and tropical storms intensify the rainy season and cold fronts extend it. These features make it very expensive to provide services and infrastructure. According to available data, urbanization on unsuitable land is two to three times more costly, and building costs can increase by up to 50 per cent.⁽⁵³⁾ As a result, squatters live in housing inappropriate for the conditions, and

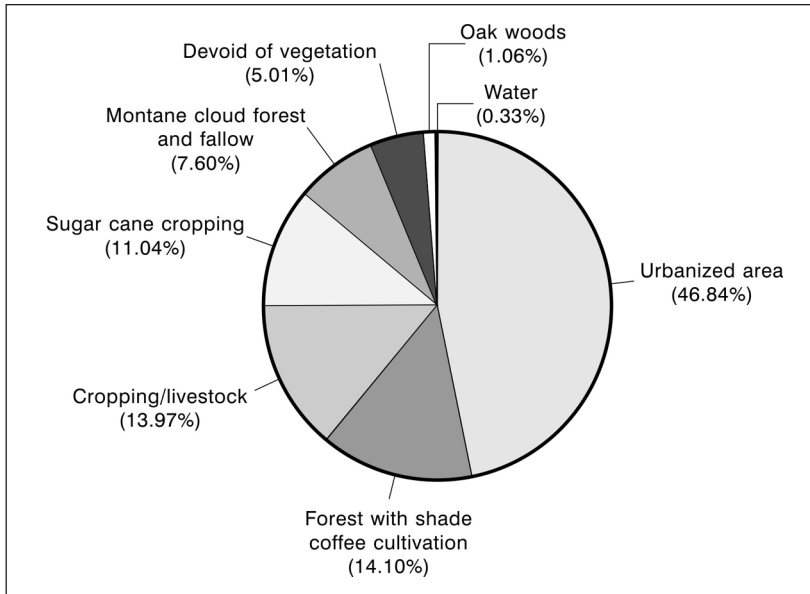


FIGURE 5
Percentage vegetation cover and land use in the municipality of Xalapa (2007)

SOURCE: Elaborated from satellite image from the Ikonos sensor with 4-band spectral resolution taken on 5 May 2007.

are constantly exposed to environmental hazards such as landslides on the higher ground and flooding in the low-lying areas.⁽⁵⁴⁾ Slopes of between 14 and 27 per cent of inclination are most at risk of landslides, while slopes up to 13 per cent are liable to flooding. In the informal settlements, the dirt tracks disappear or turn into temporary rivers following heavy rainfall, leaving people practically cut off and with no vehicles or other services being able to reach them. As noted already, informal settlements in Xalapa have been established on land that is not suited to development – for instance, land in inaccessible places or that is at high risk from landslides. At the same time, paradoxically, this is often land that has high ecological value.

The Regional Development Ministry⁽⁵⁵⁾ has attempted through various plans⁽⁵⁶⁾ to steer urban growth to the east and southeast of the city of Xalapa, where its research shows that there are better conditions for building, fewer hazards for the inhabitants and less impact on natural resources, mainly in the municipality of Emiliano Zapata. According to the Xalapa Municipal Development Plan,⁽⁵⁷⁾ the land there is more suitable for urban development, and the environmental impact would be less severe, because it is gently sloping and has little agricultural potential. Nevertheless, population growth has made adequate planning and control of land use much harder, exceeding the capacity of all government plans.⁽⁵⁸⁾

Although it cannot be known for certain in what direction informal urbanization in Xalapa is heading, the trend in recent years suggests that it is most likely to continue toward the north and northeast, as well as toward the northwest where the best preserved remnants of montane

Vivienda para los Trabajadores (National Workers Housing Institute). Margins in the institutional housing market are determined by the amount of credit granted by Infonavit or credit institutions. Developers establish how much house building, advertising and financing their business will cost and then make adjustments to safeguard their profit margins. They look for the cheapest land and, of course, the lowest prices are found on the outskirts, on farmland or undeveloped *ejido* land. This explains why all the developments are found on the outskirts, although in the long run the city will have to cover the costs of providing services.

42. Duhau, Emilio (2004), "Políticas habitacionales e integración en México. Del estado promotor a la promoción inmobiliaria", *Mundo Urbano* No 23, July–August–September, 11 pages, available at http://www.mundourbano.unq.edu.ar/index.php?option=com_content&view=article&id=53&catid=98.

43. Williams-Linera, Guadalupe, Robert Manson and Eduardo Isunza-Vera (2002), "La fragmentación del bosque mesófilo de montaña y patrones de uso del suelo en la región oeste de Xalapa, Veracruz, México", *Madera y Bosques* Vol 8, No 1, Spring, pages 73–89.

44. See reference 7; also Rzedowski, Jerzy (1996), "Análisis preliminar de la flora vascular de los bosques mesófilos de montaña de México", *Acta Botánica Mexicana* No 35, pages 25–44; Williams-Linera, Guadalupe (2007), *El Bosque de Niebla del Centro de Veracruz: Ecología, Historia y Destinos en Tiempos de Fragmentación y Cambio Climático*, CONABIO–Instituto de Ecología AC, Xalapa, Veracruz, México, 208 pages.

45. See reference 12, Castillo-Campos (1991).

46. See reference 44, Williams-Linera (2007).

47. Ortiz-Ceballos, Gustavo (2004), *El Agroecosistema Café: Crisis de Mercado y Sustentabilidad*, Tesis de

Doctorado en Ciencias, Programa de Agroecosistemas Tropicales, Colegio de Posgraduados, Campus Veracruz, México, 125 pages.

48. Moguel, Patricia and Víctor Toledo (1999), "Biodiversity conservation in traditional coffee systems of Mexico: a review", *Conservation Biology* Vol 13, No 1, February, pages 1–12.

49. Perfecto, Ivette, Robert Rice, Russel Greenburg and Martha E Van der Voort (1996), "Shade coffee: a disappearing refuge for biodiversity", *Bioscience* Vol 46, No 8, September, pages 598–608; also see reference 48.

50. Manson, Robert, Vicente Hernández-Ortiz, Sonia Gallina and Klaus Mehlreter (editors) (2008), *Agroecosistemas Cafetaleros de Veracruz: Biodiversidad, Manejo y Conservación*, Instituto de Ecología AC (INECOL) e Instituto Nacional de Ecología (INESEMARNAT), México, 348 pages.

51. Pineda-López, María del Rosario, Gustavo Ortiz-Ceballos and Lázaro Rafael Sánchez-Velásquez (2005), "Los cafetales y su papel en la captura de carbono: un servicio ambiental aún no valorado en Veracruz", *Madera y Bosques* Vol 11, No 2, pages 3–14.

52. Muñoz-Villers, Lyssette and Jorge López-Blanco (2007), "Land use/cover changes using Landsat TM/ETM images in a tropical and biodiverse mountainous area of central-eastern Mexico", *International Journal of Remote Sensing* Vol 29, No 1, October, pages 71–93.

53. Topelson de Grinberg, Sara (2007), "Ciudades mexicanas", Ponencia Foro Internacional Sobre Políticas Públicas, 5 pages, available at http://www.miaulavirtual.com.mx/administracionpoliticaspublicas/desarrollo_social/ForoInternDesSocMex/ForoIntDesSocMexPDFs/03_Ciudades/02_Ciudades_Sara%20Topelson_SEDESOL.pdf.

54. The inhabitants of 52 settlements on the outskirts of Xalapa suffer flooding or landslides every year because they live in high risk areas.

55. SEDERE (1999), "Programa parcial de desarrollo urbano del sector oriente de la zona



PHOTO 2
Beginnings of the establishment of a squatter settlement in the Benito Juárez ejido, to the south of the city of Xalapa, Veracruz

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cloud forest are found. In addition, to the south of Xalapa, in the montane cloud forest of the Benito Juárez *ejido*, an informal settlement is fast expanding, with one makeshift dwelling appearing every week (Photo 2, monitored for 6 months). Although the squatters start building with non-permanent, recycled materials, the oldest dwellings already have a more solid structure. This suggests that the problem is not building but rather the lack of availability of suitable building land. It is important to preserve this residual vegetation not only because of its intrinsic biological value but also because of the role of tree cover in regulating the local climate and urban microclimate. This is a valuable ecological service, increasingly so in these times of global warming and when human well-being will depend on the preservation of vegetation.

Thus, in Xalapa, informal settlements are often found in areas of great value in terms of ecology, natural beauty and aquifer replenishment. The development of such land makes it difficult to create or maintain public green spaces within the boundary, resulting in a fragmented urban landscape unable to benefit from the ecological services those spaces can deliver. The Millennium Ecosystem Assessment notes that ecosystems represent natural capital which, if appropriately managed, can generate services essential to the well-being and healthy development of human societies. Human intervention has harnessed the benefits of ecological services and improved the quality of life for many people. However, it has also weakened the ability of ecosystems to deliver these services, considerably reducing the prospects for sustainable development and

human quality of life as well as causing serious problems of ecological imbalance and social inequality.

According to environmental criteria, physical features (topography) have a critical role in the type of urbanization that occurs, because the more inaccessible the place, the less likely it is to experience formal urbanization.⁽⁵⁹⁾ For example, a forest located in a steeply sloping area will not be of interest to developers but it will be open to informal urbanization due to the land's low or non-existent market value. When agricultural or grazing land is located in flat areas, provision of services is simple and it can easily be urbanized; the land thereby acquires a commercial value and comes onto the formal property market. Informal settlements have to use land with less commercial value; consequently, low-income groups pay an apparently low price but expose themselves to the risk of losing their few assets and, occasionally, even their lives.

In the absence of a sufficient supply of land with services for housing, nature conservation areas are highly vulnerable to informal urbanization which, in the circumstances, is morally almost impossible to stop.⁽⁶⁰⁾ This is a vicious cycle that only increases the number of informal settlements. In addition, when there is a disaster, emergency steps have to be taken to relocate the people settled in those places. The question therefore arises as to whether informal settlements can be relocated before the occurrence of a disaster, re-stating the dilemma involved in trying to assess clearly the relative costs of prevention or cure, a recurrent theme in Mexican government policy.

Informal settlements in Mexico that began as a problem paradoxically appear to have become a solution, concealing the shortage of housing for the most disadvantaged groups. By meeting housing demand, the informal settlements have protected the Mexican government from social unrest, even though it proved incapable of meeting this social need. Because of this, as of 1973 the government took steps, although controversial,⁽⁶¹⁾ to formalize tenure in settlements where people had possession but not ownership.⁽⁶²⁾ The efficacy of urban development planning has been restricted by the lack of monitoring and evaluation of urban land use plans and programmes, as well as the weak links between urban planning and management activities⁽⁶³⁾ and the difficulty of putting a planning system into operation in advance of rapid, informal urbanization.⁽⁶⁴⁾

VI. CONCLUSIONS

The land in the municipality of Xalapa has undergone various transformations, from forest to farming to urban, or directly from forest to urban use. This paper shows how the environmental logic and social logic that dictate the establishment of informal settlements cannot be dissociated: the process is determined socially by the inhabitants' low income, and environmentally by physical features (topography). These factors need to be taken into account when planning cities.

The demand for urban land will continue to increase, primarily due to pressure both from people migrating to the city because they have no economic alternatives in their place of origin and from resident demand for new households. In environmental terms, this places more strain on forests and agriculturally productive areas in the rural fringes of metropolitan areas. In Xalapa, the low level of pristine vegetation cover

conurbada de Xalapa, México", available at http://www.dgouverver.gob.mx/M_programas.htm.

56. Gobierno del Estado de Veracruz–Llave (2002), *Actualización del Programa de Ordenamiento Urbano de la Zona Conurbada de Xalapa, Banderilla, Coatepec, Emiliano Zapata y Tlanelhuayocan, Xalapa de Enriquez, Veracruz, Derechos Reservados de Estado de Veracruz–Llave Xalapa–Enriquez Veracruz*, 674 pages, available at http://informacion.sedesmaver.gob.mx/transparencia/FraccionVII/Regionales/009_ActualProgOrdUrbXalBanEmZapTlal.pdf.

57. Xalapa Municipal Development Plan (2005–2007a), *Xalapa de Enriquez, Veracruz, Diagnóstico Xalapa y sus Regiones*, available at <http://www.xalapa.gob.mx/plan/diagnostico.pdf>; also Xalapa Municipal Development Plan (2005–2007 b), *Mapa de Acciones de Desarrollo Estratégicos 2030 del Plan de Desarrollo Estratégico Xalapa 2030*, available at <http://www.xalapa.gob.mx/plan/objetivos.pdf>.

58. Ramírez-Garibay, Jesús Manuel (2010), "Asentamientos irregulares en propiedad social. Revisión de alternativas para su prevención y solución", *ANÁLISIS, Estudios Agrarios, Procuraduría Agraria*, pages 19–60, available at http://www.pa.gob.mx/publica/rev_36/Jes%C3%BA%20Manuel%20Ram%C3%ADrez%20Garibay.pdf.

59. Although this is outside the scope of this work, it should be pointed out that middle- and high-income groups do settle in inaccessible places covered in forest because of their considerable aesthetic value; however, in such cases they leave "big" green spaces.

60. See reference 2, Mollá (2006).

61. See reference 2, Fernández (2008).

62. CORETT (Comisión para la Regularización de la Tenencia de la Tierra) (2006), "Programa de regularización de lotes y programa de suelo libre", available at <http://>

sedesol2006.sedesol.gob.mx/manualmicrorregiones/11_Sedesol_CORETT.pdf; also SEDESOL (2008), "PASPRAH, Apoyo para los avocados", Ecos del Desarrollo Urbano de la Subsecretaría de Desarrollo Urbano y Ordenación del Territorio Nacional Dirección General de Desarrollo Urbano y Suelo 31 Octubre de 2008, Columna 32, pages 1–5, available at <http://www.sedesol2009.sedesol.gob.mx/archivos/802074/file/ECOS32%20PASRAH.pdf>.

63. See reference 2, García-Ortega (2001).

64. Dredge, Dianne (1995), "Sustainable rapid urban expansion, the case of Xalapa, Mexico", *Habitat International* Vol 19, No 3, January, pages 317–329.

65. See reference 20.

66. Garcés-Fierros, César (2009), "Suelo urbano para la población pobre de México. La situación demográfica de México", in Consejo Nacional de Población (compilador), *La Situación Demográfica de México 2009*, México DF, Primera Edición, September 2009, pages 87–102, available at <http://www.conapo.gob.mx/publicaciones/sdm/sdm2009/06.pdf>.

67. Ávila-García, Patricia (1998), "Nuevas tendencias de urbanización y problemática urbana en una ciudad media: el caso de Morelia", in Víctor Gabriel Muro (editor), *Ciudades Provincianas de México. Historia, Modernización y Cambio Cultural*, Colegio Michoacano, Zamora Michoacán, pages 282–295.

(less than 10 per cent) that is virtually confined to *ejido* land, together with the urban sprawl advancing towards this land, shows the need to take immediate action and enforce policies to protect and conserve these areas in a way that benefits the inhabitants of the municipality.

Urban planning does not take full account of the need to provide serviced plots or housing for low-income groups. However, the most serious problem appears to be the shortage of land suitable for building, as this shortage is causing the degradation of natural resources and the deterioration of living standards within the urban boundary, above all because land for future urban growth is in the hands of property developers focusing on middle- and high-income groups.⁽⁶⁵⁾ This means that the current supply and demand situation exacerbates the problem of access to urban land for low-income households.⁽⁶⁶⁾ As a result of speculation on the outskirts of the city, land purchase by the authorities is an expensive measure, and expropriation has a high political cost.

Urban planning should safeguard the collective interest and its prime objective is to preserve the quality of life, which includes protecting the environment. Nevertheless, the leading role in the urban planning process of local government, with community participation, should be a legal requirement that is actually enforced.⁽⁶⁷⁾ If it is not, informal settlements of populations with high social vulnerability will continue to grow. Even though the land is purchased at a low commercial price, the personal cost is potentially high as the residents are in danger of losing their property and even their lives.

Sustainable urban development means that there must be some territorial reserves, including conservation areas and land for low-income groups, together with land use planning, the availability of infrastructure, and housing planned in harmony with the surrounding area. It is also a central aspect of environmental management to plan for the preservation of urban green spaces that deliver ecological services such as temperature regulation, improved air quality, water infiltration and recreation.

Insufficient account has been taken of the dynamics of land use in the region, its effects on the natural surroundings and its complex relationship with social, economic and political issues when looking at ways to conserve the natural resources needed for satisfactory living conditions within the urban boundary. Planning should be underpinned by data on rates of growth, settlement patterns and expansion, if infrastructure and services (which must include environmental services) are to be delivered. The need for this information should not be ignored, because it can help to guide policies on infrastructure and public services.

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