Boletín de la Asociación de Geógrafos Españoles N.º 63 - 2013, págs. 429-434
I.S.S.N.: 0212-9426

GENERAL ECOLOGICAL PLANNING OF MEXICAN TERRITORY: METHODOLOGICAL APPROACH AND MAIN EXPERIENCES

José Ramón Hernández-Santana[1],
Manuel Bollo-Manent[2]
Ana Patricia Méndez-Linares[1]
[1] Instituto de Geografía, Universidad Nacional Autónoma de México
santana@igg.unam.mx, patyml@igg.unam.mx
[2] Centro de Investigaciones en Geografía Ambiental, Universidad Nacional Autónoma de México
manent@gmail.com

The key objective of the Mexican general environmental land use management program[1] (*programa de ordenamiento ecológico general del territorio*, POEGT) is to minimize environmental conflicts resulting from sectorial land use, by means of appropriate and balanced spatial planning of Federal Public Administration (*Administración Pública Federal*, APF) activities. In Mexico, environmental planning is a policy instrument designed to describe, diagnose and propose ways of using land and its natural resources, using a rational and diversified use perspective with the consent of the population (SEMARNAP, 2000). In the case of Mexico, this need to reach a dynamic balance between availability of natural resources, the expectations of the population, the development of the interests of the country's different social and economic sectors, and the self-recovery or restorative capacity of the biophysical environment, is legally and administratively supported by the regulations set out in the General Law of Ecological Balance and Environmental Protection (*Ley General del Equilibrio Ecológico y la Protección al Ambiente*, LGEEPA) (SEMARNAT, 1988, 2003), which establishes the Secretary of Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*, SEMARNAT) as the body authorized to devise the POEGT, with the participatory consent of the population. This program is obligatory throughout the country.

The aforementioned law stipulates that the process of environmental land management comprises different stages: 1) description of land system; 2) integrated diagnosis of land system; 3) forecast (public participatory debate); 4) proposition of general environmental

1 The name of this program translates literally as the 'general ecological territorial management program', but in conceptual terms it is closer to the notion of an environmental land use management program, hence the latter is the term used in this document.

land use management model (*Modelo de Ordenamiento Ecológico General del Territorio*, MOEGT); and 5) implementation. Thus, the general objective of this paper is to present the main results of the following: description and diagnosis of the land system in Mexico; environmental evaluation under different temporal and tendential scenarios, within phase III (prospective or forecast); and with reference to stage IV, the formulation of the occupation model of the different sectorial development plans and programs (protection of flora and fauna, forests, agriculture, mining, industry, tourism, and social development), the proposed MOEGT, with reference to the strategies, guidelines and environmental actions for each of the sectorial land use propositions.

The POEGT was financed by SEMARNAT and the National Institute of Ecology (*Instituto Nacional de Ecología*, INE), and carried out by a team of 36 researchers and technicians from the Institute of Geography, the Centre for Environmental Geography Research, and the Regional Center for Multidisciplinary Studies of the National Autonomous University of Mexico (*Universidad Nacional Autónoma de México*, UNAM), together with specialists and consultants from the Autonomous University of Queretaro (*Universidad Autónoma de Queretaro*) focusing on the evaluation of public policies (Ongay & Zorrilla, 2008a) and on the environmental requirements of the sectorial aptitude of each sector of the Federal Government (Ongay & Zorrilla, 2008b).

Situated in the southern part of North America, Mexico has an area of approximately 1,964,375 km^2 (INEGI, 2008), with a rich geodiversity and 12% of global biological diversity (CONABIO, 2008). Its total population is approximately 112,322,757 (INEGI, 2010) and its GDP ranks 14th in the world (IMF, 2009). In order to carry out research within the POEGT, biophysical environmental units were adopted as the unit of territorial analysis (López-Blanco, 2007, 2008). A total of 145 biophysical environmental units were used for the analysis. In 1988 was published the Environmental Land use Management Manual, and in that same year, the LGEEPA was brought into force (Diario Oficial de la Federación, 1988).

In Mexico during the Presidential term 1989-1994, the first National Program for Environmental Protection was published, in which the POEGT was defined and a first attempt made at its execution. It remained a core element of the national development strategy during 1995-2000. However at this time, the effort was limited by weak sectorial participation, nonexistent coordination with the environmental sector, and a lack of synthesized cartographic information in digital format for automatic processing.

In 2003, LGEEPA regulations on environmental management were published. However at this time it was not possible to reach an intersectorial agreement in favor of national environmental management. Finally, in 2006, conditions provided the methodological, judicial and sectorial maturity necessary to carry out the general environmental land use management program. The basic results of this process, the first of its kind in the country, are outlined in this paper.

There are a range of examples of research and application of environmental land use management in Mexico at a regional and municipal level, but there is no national level vision of land use planning. To date, 64 environmental land management regulations have been issued for regions and municipalities, and some for marine regions, many of which are currently in the implementation phase (http://www.semarnat.gob.mx/temas/ordenamientoecologico/Paginas/ODecretados.aspx). The Mexican POEGT was decreed in the *Diario Oficial de la Federación* on Octobrer 7, 2012.

The Mexican general environmental land use management process began with the description and diagnosis of the national biophysical environment, based on existing scientific knowledge of this and the current status of its resources, without the generation of new primary information. Thus, the following methodological sequence was established:

(1) Identification of cartographic and statistical inputs for the integrated description and diagnosis of national territory; (2) Integration of a cartographic data base, at a scale of 1:2 000 000, with the thematic variables needed for the environmental description; (3) Formulation of products of description and diagnosis (stages I and II); (a) Identification of the regions of the country most vulnerable to certain dangerous natural processes and phenomena (volcanism, earthquakes, hurricanes, landslides and changes in the hydrothermal system); (b) Recognition of the country's natural conditions, states, processes and phenomena, especially those with historical degradation implications, such as a decrease in water quality and quantity, soil degradation, deterioration of vegetation and desertification; (c) Establishment of a national environmental (biophysical) regionalization (145 UABs), to support territorial analysis; (d) Proposition of regions with immediate need for environmental protection, conservation, and restoration; (e) Determination of sectorial aptitude of the land, according to environmental attributes and the criteria of each sector of the APF; and (f) Identification of areas of intersectorial conflict and synergy in regional workshops, with the participation of representatives of the different sectors at state and national level; (4) Production of the contextual situation for 2008, of temporal trends (years 2012, 2023, 2033) and the strategic situation (of territorial implementation of environmental policies), based on the integrated analysis of the current environmental conditions of each of the 145 UABs, and the level of intersectorial conflict and/or synergy, as part of stage III (forecast) of the POEGT.

To evaluate current environmental condition, geoecological environmental evaluation theory (Mateo *et al*, 1994) was applied, using 18 indicators of biophysical degradation, anthropic modification, socioeconomic situation and availability of surface and subterranean hydrological resources. For the projections of degradation or recuperation of the current environmental state for the years 2012, 2023 and 2033, regional workshops were held in the cities of Guadalajara, Mexico City, and Tuxtla Gutiérrez, in which the different sectors participated. This work was strengthened during 2009 and 2010 with the workshops that were held in the cities of Hermosillo, Monterrey, Guadalajara, Mexico City, Oaxaca and Mérida, cities representing the main regions of the country (Northeastern, Northwestern, Eastern, Central, Southern, and Southeastern respectively); (5) Analysis of federal public policy, consideration of environmental attributes of each sector to determine sectorial aptitude for each of the 145 UABs, and consultation on areas of sectorial interest in the country. At this time, both the UABs most appropriate for each sectorial activity, together with those UABs with occupational interests for the APF sectors, were identified; (6) Identification and classification of levels of priority attention (very high, high, medium, low and very low) for each of the UABs, based on the present environmental conditions and level of intersectorial conflicts in each of them. Through this, it was revealed which of the UABs had the highest degree of environmental damage, and which were the most conflictive due to intersectorial competition, something which undoubtedly will increase environmental damage, in some cases irreversibly; (7) Establishing environmental regionalization, through the component parts of the environmental policy proposed for each UAB, and the respective level of priority atten-

tion, and sectorial aptitude. On basis of these three technical-judicial elements, expressed in the LGEEPA, 80 types of ecological-productive region were documented which in turn indicated the optimal conditions for sectorial use, and the urgent need for federal budget support for their recuperation; (8) Analysis of the degree of compatibility between sectorial aptitude and sectorial interest use per UAB, with visits to identify those sectorial use interests that are incompatible with the environmental potential of each unit. This stage allowed these interests to be distinguished, and for compatible sectorial interests to be encouraged; and (9) Formulation of MOEGT proposal (Stage IV), based on results of the description and diagnosis (Stages I and II), and the integration of forecast scenarios (Stage III). The final valuations for each UAB of current environmental conditions; tendential projections to 2012, 2023 and 2033; the proposed environmental policy; the classification of sectorial conflicts; the level of priority attention; the predominant sectorial aptitudes and interests; the degree of compatibility among them; as well as the sectorial activity proposal, are all displayed in tables inserted in the paper. As well as proposing the sectorial occupation model, 10 general environmental guidelines were drawn up in three groups (aimed at environmentally sustainable land use, the improvement of the social system and urban infrastructure, and the strengthening of management and institutional coordination). The guidelines present 44 environmental strategies and 273 implementation actions, most of which are in keeping with the National Development Plan 2006-2012.

SIG Arc Gis, v. 93 was used for processing the information to integrate the variables necessary for the description, integrated diagnosis, forecast and sectorial occupation proposal.

The analysis of environmental biophysical degradation processes in Mexico reported 31.5% desertification due to anthropogenic influence (Hernández Cerda, 2008a), 50.2% of soil exhibiting some kind of degradation (López García, 2008b), and 47.9% of vegetation cover presenting different types of degradation (Sánchez Colón *et al*., 2008a, 2008b).

The environmental core of the POEGT determined the contextual and tendential analysis, through the geoecological evaluation of current environmental conditions, according to the methodology of Mateo *et al*. (1994, 2001), and on the basis of the loss of natural potentials, soil loss and degradation, the extent and distribution of desertification processes, and the manifestation of a range of different social and economic indicators. In this sense, the environmental conditions of the UABs was classified according to the following condition categories: stable, stable to medium-stable, medium-stable, medium stable to instable, unstable, unstable to critical, critical, critical to very critical, and very critical.

In addition to the 18 variables, the tendential scenarios of environmental conditions to 2023 and 2033 included some considerations concerning climate change, such as temperature rises, soil moisture, increased annual rainfall and coastal flooding due to rising sea levels and increased surface runoff in the watersheds of the Gulf of Mexico (INE, 2006). The evaluation and weighting of all the variables included expert opinion gained from the regional and sectorial consultation and validation workshops, especially in terms of soil and vegetation degradation trends, desertification, population growth, social marginalization, and the degree of intersectorial conflict and/or synergy.

In the 2023 scenario, those UABs with an environmental condition in the stable, stable to medium-stable, medium-stable categories accounted for 23.81% of the national total, and are located mainly in the Northern region. This is 11.63% lower than in the 2008 scenario.

At the other end of the scale, the categories of unstable to critical, critical, critical to very critical, and very critical are concentrated in the States of Chiapas, Oaxaca, Guerrero, Puebla, Veracruz, Michoacán, Tamaulipas and parts of Jalisco (Pacific coast), Yucatán, and Quintana Roo, and account for 40.48% of the national total. For the 2033 scenario, categories indicating environmental stability drop to 8.96% of the national total, and are located mainly in the Baja California península, and parts of Coahuila, Chihuahua, and Nuevo León, while categories indicating critical environmental conditions represent 51.34% of the Central and South-Southeast region of Mexico.

In the face of these national trends, the strategic or environmental policy scenario considered criteria relating to intersectorial synergy and conflict, biophysical degradation, level of anthropogenic modification, social and economic development level characteristics in each UAB, and the analysis of the percentage and type of federal protected natural areas per UAB, in order to determine the application or not of protection policy and – by means of analyzing the categories of the management of protected natural areas – identify those which require a protection policy, since they have potential value for environmental services, such as forest use or aquifer recharge. Of course, given the diverse environmental situations, the strategic scenario included 18 combinations of policies, stemming from the four basic policies provided in the LGEEPA: sustainable exploitation, preservation, protection and restoration.

The application of the methodology of the analysis of environmental condition by environmental biophysical units, based on the space-time analysis of indicators of environmental degradation, anthropogenic modification, and conditions of social and economic development, together with the influence of future climate changes, reveals alarming scenarios for Mexico, which require the immediate application of environmental and public policies, to help mitigate the pernicious effects on environmental quality, on social equity and on economic growth, by means of appropriate land use management, improved federal, state and municipal budget distribution, in the interests of national requirements and the needs of the most marginalized sectors.

The analysis of the strategic or environmental policy scenario indicates that of the 18 combinations of environmental policies for Mexico, those with the greatest coverage and need for immediate implementation are sustainable exploitation and restoration (26.09% of the country), sustainable exploitation (24.76%), restoration and sustainable exploitation (14.99%) protection, sustainable exploitation and restoration (6.11%), and preservation and protection (5.29%); the remainder have a value of less than 5%.

Both environmental regionalization (ecological-sectorial) and the general environmental land management model examine the evaluations of predominant sectorial aptitude or most efficient territorial vocation, together with the level of priority attention of the land, as a robust federal instrument to carry out sectorial activities compatible with the natural vocation of the UABs, and their future adjustment to changing national dynamics. The presentation and the consensual debate of the MOEGT in the workshops with experts and officials of the APF, together with the two national public consultation (2010, 2011), enriched this governmental instrument, improving its capacity to direct the country's sectorial development and safeguard its environmental patrimony.

For the next updates of the POEGT, it is essential to develop preceding projects with the different sectors of the APF, aimed at organizing sectorial and environmental digital information, to provide the basis for the design of GIS which guarantee the safer, more precise

and efficient storage of information, and which allow cartographic practices to be extended among institutions, and which thus enable projects of a territorial nature, especially in terms of the sectorial reorganization of space.

The Mexican general environmental land use management program (POEGT) was an analytical, synthesised, multidisciplinary and intersectorial process, carried out in the context of the geographic-environmental and productive conditions in Mexico, and targeted towards national sustainability, through the Federal Public Administration. It was based on a broad-based strategic territorial vision, combining scales of state, municipal and more local, tactical, operative actions also vital in the optimization of land use and environmental conservation.