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84 años de políticas de uso del suelo en México: reflexiones para la conservación de la biodiversidad
84 years of Mexico´s land use planning: reflections for biodiversity conservation

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Resumen

El presente trabajo tiene como objetivo conocer los cambios en la planeación y administración de los usos del suelo en México y explorar su posible relación con la crisis ambiental actual, esto dentro del contexto de las complejas relaciones sociedad-ambiente-política. La hipótesis del trabajo supone que México al igual que otros países latinoamericanos ha basado la planeación de los usos del suelo en las recomendaciones de organismos internacionales en pro- del beneficio social y esto ha erosionado su capital natural. Se presenta en general el panorama de la biodiversidad a nivel mundial y los antecedentes en la investigación de los factores cambio de uso del suelo en Latinoamérica. En los resultados se describe el complejo de cambios en la administración del uso del suelo y el estado de los recursos naturales en el periodo analizado. Finalmente discutimos los contextos internacionales y el papel de los actores sociales en la transformación del paisaje en México. Nuestro enfoque de análisis permitirá hacer una retroalimentación de los aciertos y errores en el diseño de las políticas públicas mexicanas con miras de abrir un debate en torno al tema y mejorar la planeación contemporánea de los usos del suelo.

Abstract

The present work objective is to understad the changes in the planning and administration of land uses in Mexico and to explore its possible relationship with the current environmental crisis, this is carried out within the context of the complex relations between society and environment and politics. The work hypothesis assumes that Mexico, like other Latin American countries, has based its planning of land uses on the recommendations of international organizations for the benefit of society as a whole and this has eroded their natural capital. It presents in general the

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panorama of the biodiversity at world-wide level and the antecedents in the investigation of the factors influecing the changes of land use of the soil in Latin America. The results describe the complex of changes in the administration of land use and the state of natural resources in the period analyzed. Finally, we discuss international contexts and the role of social actors in landscape transformation in Mexico. Our approach to the analysies will provide feedback of the successes and errors in the design of Mexican public policies in land use, hopefully providing a gateway to opening-up a more honest debate on the subject.

Introduction

Currently modified ecosystems dominate the environmental landscape in comparison to those that remain pristine and the trend predicted is towards loss of these and their environmental services (Vitousek *et al*., 1997; Mooney *et al*., 2009; Convention on Biological Diversity, 2014). The conversion of ecosystems to other land uses has happened in lock step with human presence on the planet. These changes generate disturbance regimes that vary depending on the social, cultural, economic and political processes that interact with them and can be contextualized with the main goals of economic and regional development of the countries (Turner *et al*., 2013; Jaraíz *et al*., 2013; Carter *et al*., 2014.). Currently, natural resources go through a period of degradation that is unprecedented and referred to as *Anthropocene* (Scherr and Yadav, 1996; Ellis, 2016). The over-exploitation of natural resources is directly linked to the demand for food and land for urban expansion, but both characteristics are indispensable for human development and survival, so a way must be found to obtain a true balance between environment-agriculture-urbanization.

Natural resources, settlements and agricultural areas share the same space and are essential for human survival their historical interaction has given rise to the territories. Urbanization has been identified as one of the major promoters of habitat loss for wild species (Nelson, 2005) and although some authors oppose this allocation because they suggest that human population, concentration allows the recovery of ecosystems (Klooster, 2003; Hecht, 2010; Vadell *et al*., 2016). The reality is that urban areas demand energy, food and economic services from other latitudes, and concentrate economic capital by generating development gaps (Chowdhury, 2010; Tenza-Peral *et al*., 2011; Ospina *et al*., 2015).

In the regions where food and energy come to urbanized areas, commercial monocultures are encouraged, which segregate small producers and their traditional crops. In turn, agricultural

areas are expanding and are intruding into now isolated areas where biodiversity is shared. Or that productive activities are carried out are in unsuitable places (ie, hillside agriculture) (Duranton, 2015, Ribeiro-Palacios *et al*., 2013). The medium- and long-term result of the disappearance of cultural territories seems to be the simplification of landscape structure (understood as a decrease in connectivity and land use), changes in species composition (increase in the proportion of exotic species) (Foster *et al*., 2003; Fialkowski and Bitner, 2008; Mastrangelo *et al*., 2014).

It is estimated that the most intense landscape transformations in Latin America began in the middle of the last century (Lambin *et al*., 2011; Modrego and Berdegué, 2015). Firstly, by investments towards industrialization, and secondly by their integration into the international economy (Janvry and Sadoulet, 2002). Latin America has maintained its historical legacy as a food producer, but at present, the most successful production in economic terms often corresponds to commercial crops from other latitudes (i.e., soybean and palm oil, Weinzettel *et al*., 2013). The rural population has remained an important part of the landscape but with gaps between the distributions of wealth, the results in the landscape have generally been two scenarios: some regions increase the agricultural areas while others leave it (Grau and Aide, 2008). Different studies in Latin America, regardless of the type of analysis or the scale of the information, detect economic changes related with neoliberalism as the main factors of change in landscapes (Duffy *et al.*, 2001; Gould *et al.*, 2006; Grau and Aide, 2008; Ramírez *et al*., 2009; Gobbs, 2010; Chowdhury, 2010; Robson and Berkes, 2011; Echeverría *et al*., 2012; Clark *et al.* 2012; Bonilla-Moheno, 2013; Gollnow and Lakes, 2014; Ospina *et al.*, 2015; Wittman *et al*., 2015; Maetteucci *et al.*, 2016). It should be noted that the economic changes come largely from the recommendations of the World Bank (Díaz *et al*., 2011; Ribeira-Palacios *et al*., 2012, Escobal *et al*., 2015; Modrego and Berdegué, 2015). It is clear that the promoters of change in Latin American landscapes at this time go hand in hand with global trade needs and with the number of international treaties that the different nationalities sign (Berdegué *et al*., 2015). Land use change are result of interaction between land tenants and government regulation. The intervention of government in land use, affect positive or negative in function of the planning objectives, an example of this is the agricultural surface increased from 1960s to 1980s in Latin America supported for state programs, this programs change tropical forest in agricultural lands (Grau and Aide, 2008, Gibbs *et al*., 2010; Meyfroidt, *et al*. 2013; Lapola, *et al*., 2014,). After the Brundtland

Report (1987), the land use policies and regulations has included sustainability principles into their strategies which included preventing fragmentation, habitat loss and ensure the development of cities with less environmental impact and adaptation measures to address climate change (Fisher *et al*., 2008; OECD, 2013).

Land use planning is a tool developed similarly around the world. It is based on the diagnosis of three components: population, economy and natural resources; and proposes land uses that are compatible with local environmental conditions to lessen the existing socio-economic conflicts (FAO, 1996; Randolph, 2004; Christou *et al*., 2006). There is a tendency to increase their incorporation into development strategies and conservation, nevertheless, their application and design has faced obstacles that have prevented quantify their achievements (Gurrutxtaga and Lozano, 2009; Brunson, 2014). In part, by the absence of established monitoring information and strategies (Lestrelin *et al*., 2011; Lambin *et al*., 2014). Land-use planning, desirably, must be consistent with sectoral policies and general development, since long-term activities are mandated to be carried out in a specific place. For this reason, the understanding of land use policies is vital for designing strategies and instruments for the management of public policies (FAO, 1996).

Mexico is a diverse country where the presence of species represents between 10 and 12% of the total worldwide (Mittermeier *et al*., 1997). It has 176 federal protected areas covering 12% of the total land area (CONANP, 2015). However, as in much of the world, there is a growing number of threats to its biodiversity and natural resources due to advancing agricultural encroachment and rapid urbanization and industrialization (Convention on Biological Diversity, 2014). In 2008, the Mexican scientific community made an exceptional effort to present a synthesis of the state of natural resources, highlighting trends and strategies for the conservation (Sarukhán *et al*., 2014). One of highlights was the need to carry out more research before implementing public policies since some can be harmful to the conservation of ecosystems. From 90´s to 00´s deforestation rates range between one thousand and six hundred thousand hectares per year varying among regions (Velazquez *et al*., 2002) with a tendency to cause the disappearance of tropical and temperate forests (Mas *et al*., 2004).

The planning of the territory in Mexico formally exists since 1930 making it one of the oldest in Latin America (Massiris *et al*., 2012). Throughout history there have been implemented several measures of planning and public policies that affect directly land use, the use of natural

resources, and human development. The objective of this work is to understand the evolution of the public policies of land use management in Mexico and to explore if their changes as it is related to the biodiversity crisis that currently exists in the national territory. It also aims to open a debate on the use of past experiences in the search for a better planning of the development of the territory.

We use the case of Mexico, as an example of evolution of land use planning policies and relate the phases of changes in policies with the reports of land use change and deforestation, with this we intend to support the rational and sustainable design of land use policies in countries that in the last decades have opted for neoliberal policies. The hypothesis of the study assumes that, like other Latin American countries, Mexico has based its planning of land uses and changes on the recommendations of international organizations for the benefit of society as a whole, setting aside preservation of local or national natural resources; if this is the case, where the administrations of land uses and its objectives are determined by outside interests, then the objectives carried out will be mirrored by negative impacts of resources.

Methods

An exhaustive review of the literature on territorial policy models in the country was carried out, using as keywords: territorial ordering, ecological ordering, regional development and planning of land uses, which are the terms with which different disciplines (conservation biology, social sciences, geography, urbanism and eco-nomy) refer to what we will define later on as territorial policies, defined as: the set of actions of the State that induce the presence of human activities in the territory (Hildenbran, 1999). At the end of the consultation a timeline was drawn up with the appearance of the territorial policies.

Subsequently, the decrees, regulations and public policy programs listed in the literature were consulted in the Official Gazette of the Federation (Official Gazette of the Federation, 2015), and the objectives and terms of reference for each program were extracted, to define the order of importance of the policies, the budgets of expenditures were consulted. The information was systematized and organized into tables, to facilitate their comparison and analysis, dividing into three territorial sectors: (1) Agricultural, (2) Urban-industrial and (3) Environmental. In order to contextualize the changes in the territorial policies with the state of the ecosystems, the environmental statistics published in the National System of Environmental Information and

Natural Resources (SNIARN) were consulted and completed with current reports published in The Natural Capital of Mexico (CONABIO, 2008, 2009, 2012, 2016). The information was ordered and analyzed and is presented chronologically in the results.

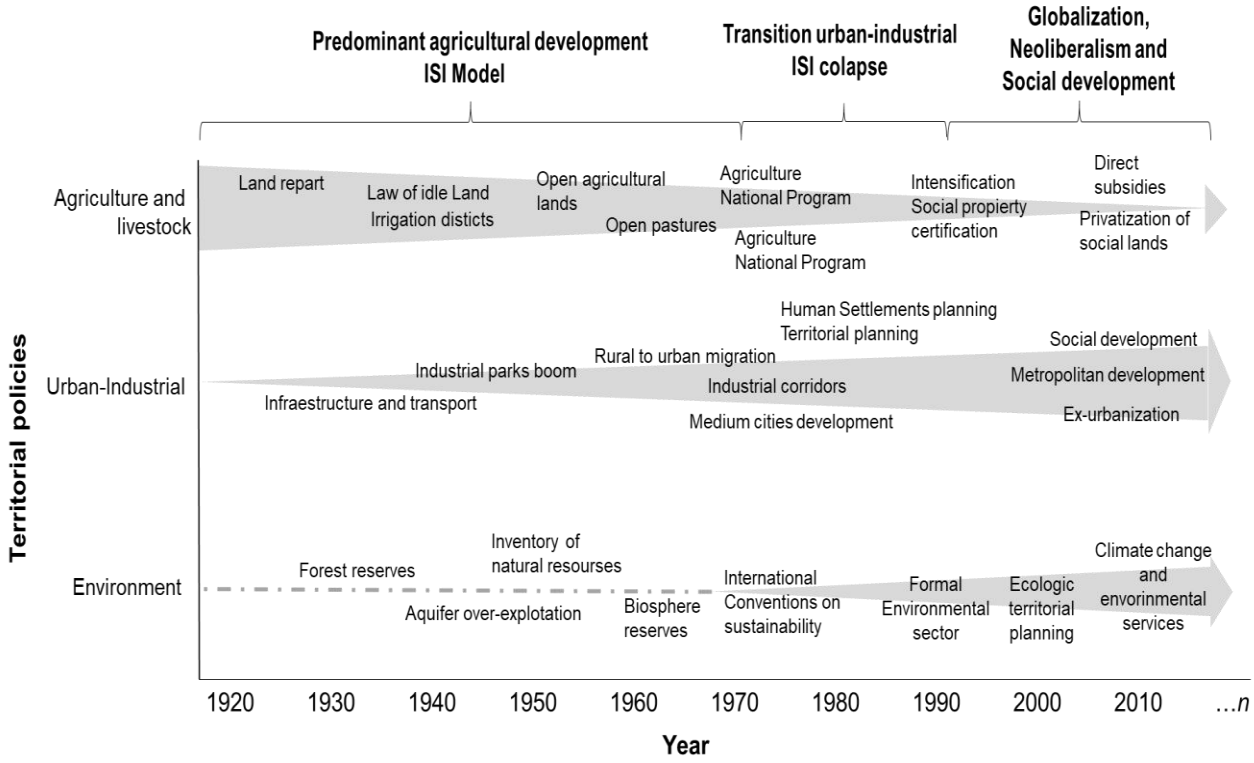
Results

The administration and control of land uses in Mexico is complex and has undergone changes throughout the study period, in order to achieve a better understanding of them, the changes are described below in chronological order. In the history of Mexico there are examples of land use planning and management of development from pre-Hispanic times, but it was not until 1917, after the Mexican Revolution that the administration of land use was formalized in the law (Garza, 2003). The Mexican Revolution, brought pressure from peasants to own their own farmland Mexico developed the Law of Endowments and Land and Water Restitutions, which was declared law (*Ley de Restitución y Dotación de Tierras y Aguas,* DOF, 1927), it ordered the distribution of land to meet the agricultural needs of a largely rural population. For the rest of the country the Planning Act (*Ley sobre Paneación General de la República*) was created; in it, the need to decentralize the population from the big cities of Mexico (Mexico City, Guadalajara and Monterrey) was recognized. This was done in order to promote economic development for the rest of the country (DOF, 1930). This document was avant-garde because it represented the economic planning of the country through a map of planning and zoning of the territory, in turn, it proposed the formulation of multidisciplinary diagnoses with the consensus of social, technical and governmental actors. Likewise, the idea of planning based on the benefits of the territory and the region emerged in the midst of the conjunctural needs caused by the "Great Depression" of 1929, the State devised the configuration of a national sovereignty project that had repercussions tionin the following four decades in relation to the development of Mexico (Arroyo-Ortíz, 2009).

Hence, land use planning in Mexico involved at least two aspects: planning in rural areas and planning in urban areas. In the first case, obeying the needs arising from land distribution and the formation of ejidos, and in the second as part of the fulfillment of the General Planning Project of the Republic. The natural resources since 1934 has been consider being national property as a means to satisfy the demands of the productive system and not as dynamic elements of the territory, where its role as the raw material for socioeconomic development is emphasized.

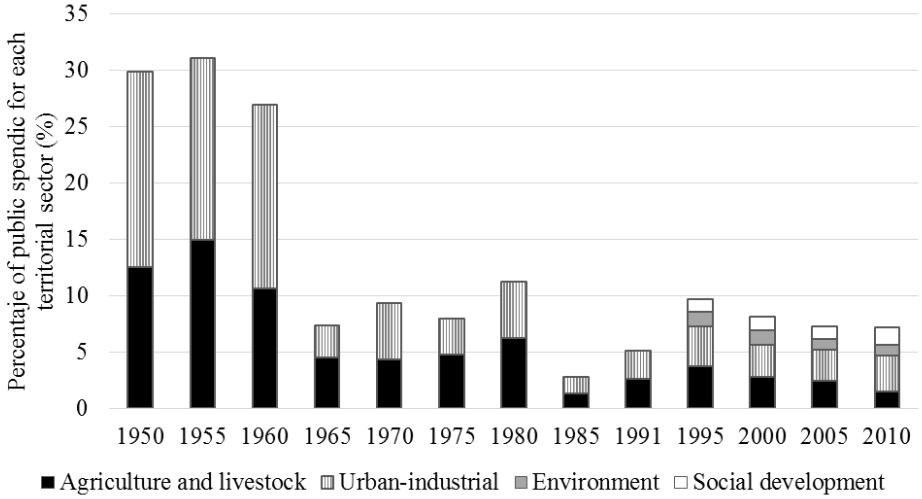
In this paper, we describe three stages of land management. The first from 1930 to 1970, which focused predominantly on agricultural policy and over time an economic model of import substitution (ISI), developed; another, is from 1970-1990, contextualized by the collapse of the ISI model and the rural transition to an urban-industrial model; and finally 1990 to the present which includes neoliberal policies, sectoral development and globelization (Figure 1; Figure 2).

Figure 1. Time line of changes in territorial sectors.



Source: The authors with information of analysis.

Figure 2. Percentage of public expenditure programmed for each land use-planning sector during the period of 1950-2010.



Note: The percentages required to sum to 100% relate to sectors not associated with land use planning policies; Data for spending before 1950 is not available**.** Source: The authors with information from Official Journal of the Federation.

A policy that favored strengthening agriculture and livestock farming (1930-1970)

The development strategy of Mexico and other Latin American countries was that of industrialization, with import substitution being the predominant model in the 20th century adopted by the recommendations of the Economic Commission for Latin America and the Caribbean (ECLAC). The context of 1914 to 1945 was the successive crises caused largely by fluctuations in exports and thus the capacity to import goods was reduced; therefore, greater importance was given to local production and market, on the basis of which it was essential that primary production had, first of all, the natural resources for sowing cropland and investment in the technological improvement of local industries (Guillén, 2013; Vazquez, 2017). The development strategy of Mexico and other Latin American countries was that of industrialization, with import substitution being the predominant model in the 20th century adopted by the recommendations of the Economic Commission for Latin America and the Caribbean (ECLAC). The context of 1914 to 1945 was the successive crises caused largely by fluctuations in exports and thus the capacity to import goods was reduced; therefore, greater importance was given to local production and market, on the basis of which it was essential that primary production had, first of all, natural resources for sowing and investment in the technological improvement of local industries (Guillén, 2013; Vaz-quez, 2017).

From 1930 on, in terms of rural development a process began of formation of *ejidos* (communal property). This involved distribution of land for agricultural production that ended in 1992 and which 111,816,780 ha was bequeathed, corresponding to the 52% of the national territory of the country (RAN, 2014; Fig. 3). The creation of credits for the production and the establishment of new settlements in pristine areas of the territory (Garza, 2003; García-Moctezuma, 2010) accompanied the process of formation of *ejidos*. Natural resources (water, soil and biodiversity) in this decade, and earlier, were considered critical raw materials to achieve economic development; this included the use of water and forests as a subsector of agricultural policies (DOF, 1934; 1943; 1946).

Mexico has grown very fast demographically and economically since 1940, and has created infrastructure for economic development that has focused on two areas: industrial development and increased agricultural production (Sobrino, 2011). The rapid industrialization of Mexico was funded by the agricultural sector, and the government was directly involved in the production of goods and services through state-owned industries (known in Spanish as "paraestatales"). This stage was called the Mexican miracle, during this period gross domestic product grew at a rate of 7.3%, the pace of economic growth continued until 1970 (Galindo *et al*., 2004).

The absence of an environmental vision in territorial policy was such that in 1941 the Law of Idle Land (*Ley de Tierras Ociosas)*, ordered that all regions with productive potential produce otherwise they were by decree to be seized and given to others, which led to the continuous use of the land for agriculture and pasture (DOF, 1941). In 1949 concern for the depletion of forest resources was added, thus preservationists legislative reforms were made into law, however they did not solve the deforestation trend (DOF, 1949). It has been estimated that in 1950 up to 34% of all forests in the country was exhausted (Villaseñor, 1956). During this decade 122 irrigation districts were built making productive 3,498,164 ha of land across the country. To safeguard the sustainability of the irrigation districts forest reserves were established in different regions and 8 areas for the protection of the irrigation districts was established with an area of 4,503,345 ha (DOF, 1949; CONAGUA, 2012) (Figure 3). The creation of irrigation districts and the digging of wells for irrigation led to the overexploitation of 71 aquifers in the period 1948 to 1969. In response to the aquifer depletion, decrees were issued in certain affected areas banning

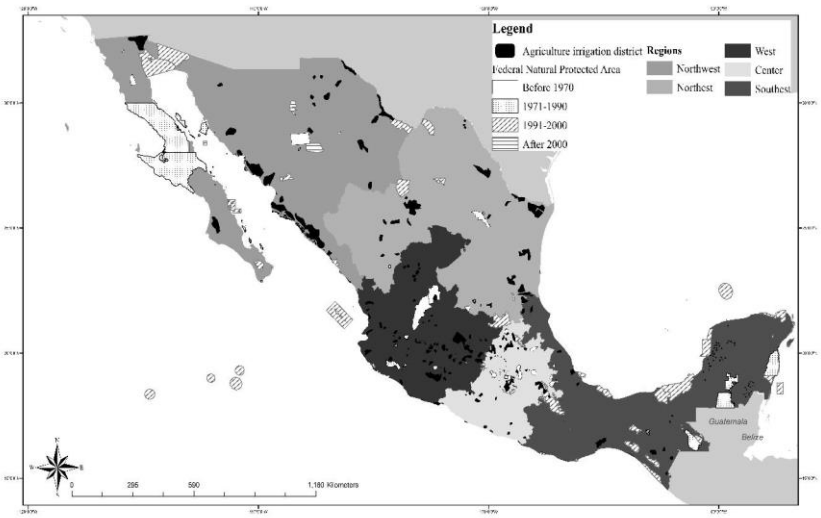
electrification in order to reverse this process, but nonetheless is still, continuing (CONAGUA, 2012).

Although the model of import substitution favored the industry and triggered the country's urban development, it opened a gap between the socioeconomic status of the population where the peasant, to whom most of the territory was given, remained the same most marginated sector of the population (Terán, 2008). This process became more acute in the following decades when the state prioritized the provision of services in urban áreas.

Priority change from the rural to urban-industrial (1970-1990)

From 1970 there were two processes of territorial policy the first from 1970-1976, where policies for regional development and the strengthening of the agricultural sector were issued and another in 1977 which is based on the organization of urban and industrial areas of the country. The mobilization of the population to the cities was facilitated by the generation of jobs and better conditions for human development than what existed in rural areas (Sobrino, 2011). The successful model of import substitution began to run out of steam at the beginning of the seventies, partly because of the paternalistic role played by the Mexican state. According to Guillén 2013, the protection of certain industries by the state, caused unbalanced regional development that persists today where there is an effect of concentration of services and infrastructure around cities.

Figure 3. Location of regions, irrigation districts and natural protected areas.



Source: The author win Information of CONANP, 2015; CONAGUA, 2012.

The end of the decade of the 70´s was characterized by the rapid urbanization of the developing country; in 1975, the Foundation of the United Nations Habitat and Human Settlements established the first international convention on Human Settlements. Mexico (ONU-Habitat, 2015) presented the General Law on Human Settlements, which among other things included cultural and social aspects as well as environmental and divided land use into four components: a) the center of town; b) spare area reserved for growth from the population center; c) rural d) ecological preservation area (DOF, 1976). Before in 1972 the Law of Agrarian Reform decreed the division of *ejidos* into four zones: 1) the development zone with space for additional growth available, located on forestry land with gentle slopes; 2) areas for agricultural work; 3) areas of rangeland; and 4) mountainous or hill-like areas, including forestry land and other productive resources without value (DOF, 1972). These zonifications obeyed the pressure of free thinking and visionary groups that struggled to maintain the principles of planning of the uses and destinies of the territory in favor of a rational and orderly development.

In the search for food sovereignty in the country, an ambitious agricultural development plan was launched. The Agricultural development policies in 1972 were the National Program for Cattle Raising, the National Program of Open Land for Farming and the National Program of Land Clearing; these programs converted forest areas with a "vocation" for being suitable for farmland and rangeland for the establishment of crops and livestock. In the period, 1972-1975 a 224,896 ha of forest were cleared for livestock rearing purposes as well as 350,342 hectares of natural grassland and scrub, where European and African grass species were introduced to feed cattle 103,631 heads of cattle (Table 2, Figure 4; SAG, 1975; DOF, 1982). Information on the duration and impact of these programs is scarce, and authors such as Toledo (1992) estimate that this policy contributed to the loss of 80% of the rainforests in the Southeast of the country.

The development of agricultural and livestock activities was strengthened through the early 80's. Agro-economic policies were promoted and continued with the expansion of the agricultural land, reaching an area of 14.7 million hectares in 1985. Additionally the generation of infrastructure for irrigation representing 5.6 million hectares (Comisión Nacional de Desarrollo Agroindustrial, 1982). Agricultural development policies were strengthened by providing cattle subsidies and guaranteed prices for livestock products (Bravo *et al*., 2010). Food sovereignty strategies certainly led to improved food production reaching its highest level with 28.6 million tonnes of basic grains in 1981 (Terán, 2008).

Table 2. Surface area cleared by the National Program of Clearance Application during 1972-1975.

Region	Area cleared (ha)	Area enabled for pastures and meadows (ha)	Cattle needed (head)	Existing cattle stock (head)	Actual livestock (head)
Northwest	20,656	8,149	10,530	0	10,530
Northeast	21,072	49,621	10,881	10,237	644
West	24,219	41,082	11,898	1,021	10,877
Center	3,825	18,826	1,933	716	1,217
Southeast	155,124	232,664	68,389	33,246	41,143
Total	**224,896**	**350,342**	**103,631**	**45,220**	**64,411**

Source: SAG, 1975.

In synergy, from the mid 70's a model of urban-industrial development favored the dominant concentration of the population in urban areas (Table 3) (Unikel *et al*., 1976; Sobrino, 2011). Urban policy proposed a system of cities based on regional development through: medium-sized cities, the decentralization of institutions, generating industrial corridors and promotion of tourism (DOF 1978; 1984b). In the early 80's economic imbalances fueled by fluctuations in oil prices occurred and in parallel an international boom in environmental policies were recorded. In response to international recommendations on environment and natural resources, incipient environmental policies materialized by the signing of agreements during the first United Nations Conference on the Human Environment in Stockholm in 1972 (Lezama, 2010). Although the first Mexican environmental law was enacted a year previously in 1971 (DOF, 1971), however it wasn´t until the modification of the law in 1982 that the importance of the attainment of a healthy environment is of public and social interest was recognized (DOF, 1982). One year later the regulation of productive uses of the environment for economic activities was defined (DOF, 1983). Five years later (1988) the General Law of Ecological Balance and Environmental Protection (*Ley General del Equilibrio Ecológico y la Protección Ambiental* LGEEPA) was approved, which is currently the main legal instrument in environmental protection and has instruments for the first time that include policies to improve the environment and prevent deterioration (DOF, 1988).

Table 3. Population census of Mexico and its degree of urbanization.

Year	Total population	Total population in cities*	% inhabitants in cities	Number of cities
1900	13,607	1,435	10.5	33
1910	15,160	1,783	11.8	36
1921	14,335	2,100	14.6	39
1930	16,553	2,982	18.0	45
1940	19,649	3,928	20.0	55
1950	25,779	7,209	28.0	84
1960	34,923	12,747	36.5	123
1970	48,225	22,730	47.1	174
1980	66,847	36,739	55.0	227
1990	81,250	51,491	63.4	304
2000	97,483	66,649	68.4	343
2010	112,323	81,231	72.3	384

Note: The population is expressed in thousands of inhabitants * Cities larger than 15,000 inhabitants. Source: CONAPO, 2010.

Natural resources in the 80's were administered as subsectors: related to water, forests and fisheries were managed from the agricultural sector while atmosphere and biodiversity were managed by the urban sector (DOF, 1988). Environmental policy emerged at a time of economic crisis, presumably slowed its positive effects on conservation (Ordoica and Prud'homme, 2010). Adding to the problems is the fact there are no longer any or very little resources available for administration (Figure 2).

In 1984, the first national ecology program recognized the role of agricultural policies as the main promoters of the degradation of ecosystems and proposed the creation of protected areas that would safeguard the emblematic ecosystems was published (DOF 1984a). Nevertheles, reforestation programs used exotic species and monocultures to repopulate the most eroded soils without taking into account restoration criteria (Cervantes *et al*., 2008). In 1989 a total of 77 natural protected areas were decreed covering a total area of 12,429,321 ha (CONANP, 2015; Fig 3).

The formalization of sectors and priorities for social development (1990 to present)

With the collapse of the model of import substitution the economy in the early nineties and is currently based on free trade, financial liberalization and the privatization of sectors such as banking and telecommunications. The new model favors private investment by eliminating public investments towards economic sectors (Fig. 2). International free trade agreements were signed, the most important being North America (NAFTA). This export model has benefited direct foreign investment and its results have been centralized and has mainly benefitted a modest business group and once again the development gap between the rural and urban population has been opened (Gollás, 2003; De la Rosa and Contreras, 2012). In the early 90s, the Mexican government put into practice the national development and sector programs. Although the economic sectors were already defined in previous periods, there was at a certain amount of horizontal congruity among the policies with common developmental objectives; however, this did not happen with the sectoral programs of the nineties, where there was no link between them (Fig. 5). Thus, for agricultural policy the priority was to increase the production areas to urban policy priority was to develop housing and ensure the growth of human settlements while minimizing environmental pollution in order to combat and stop the degradation processes in ecosystems (Table 4). The year 1992 is considered to be the beginning of a poverty crisis in the countryside, largely due to the entry of food with prices more competitive than those produced in the country, where policies such as guarantee prices disappeared. The support for agricultural activities were divided into: agriculture directed to the Program of Direct Support to the Countryside (PROCAMPO), which aims to further economic development of the farmers and provides support for opening land, forming cooperatives and direct support for the conservation of natural resources (DOF 1994b). In addition, those who promote livestock with ALCAMPO and PROGAN program that provided support for the revival of production and infrastructure. These programs give priority to intensive production systems, while maintaining their roots to the open pastures (DOF 2001b). A certification program of land began that marked a reserve of urban growth preferably located in mountainous or hill-like areas as unproductive lands to allow the sale of properties for urban plots (DOF, 1992).

Table 5. Objectives of sectoral programs for the period 1990-2013.

Period	Agriculture/Livestock farming	Environment	Urban
1988-1994	Modernize farming	Improve regional environmental quality	Regional and urban development Increase communications and transport infrastructure
1995-2000	Increase productivity Modernize commercialization Reform/reorganize production	Curb the trend in ecosystem deterioration	Promote land management of economic activities and population Meet housing needs Expand transport infrastructure and communications
2000-2006	To promote sustainable economic and productive development in rural areas	Conserve and improve natural resources	Promote balanced regional economic development
2007-2012	Raising the level of human development by improving the income of farmers	Conserve and sustainably exploit ecosystems to stem the erosion of natural capital	Promote infrastructure and services to meet social needs
2013-2018	Ensuring food sovereignty	Facilitate the sustainable growth of the population Increase resilience to climate change Halting the loss of natural capital	Control the spread of urban sprawl and improve the quality of life of its inhabitants

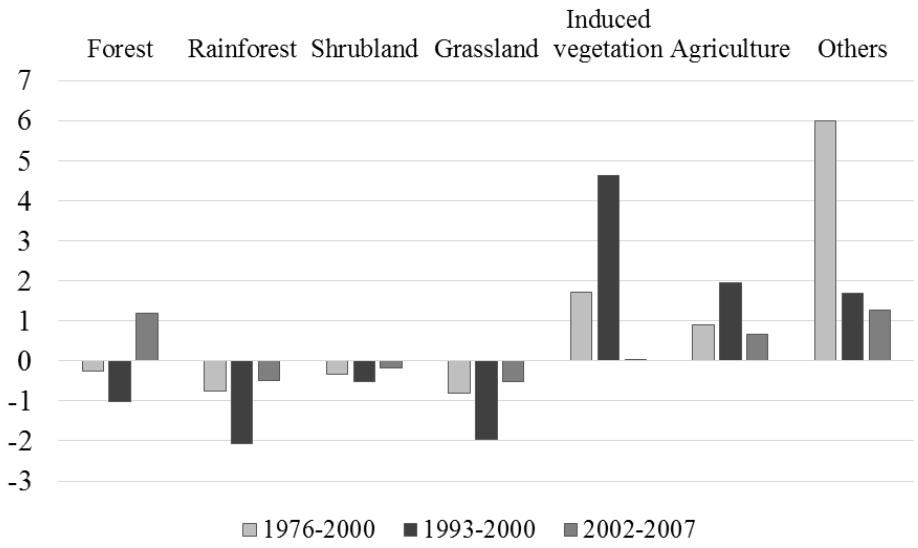
Source: The authors with information of national development programs.

The environmental sector achieved its administrative autonomy in 1994 when the Ministry of Environment, Natural Resources and Fisheries (in 2000 fishing rejoined agricultural policies) was created. However, in early 1995 financial crisis broke out as a result of globalizing economic model and priority was given to urban development in medium-sized cities, which received financial support totaling 22% of the budget set by the government (DOF 1994a). The environmental sector has never been considered a source of wealth and therefore is not a priority in times of economic crisis. Even so, the weight of environmentalists and academics linked to the environment has favored the creation of regulatory instruments in the area of natural resources. (Micheli, 2001).

In 1996 reforms were made to LGEEPA in order to incorporate environmental regulations (DOF, 1996) aimed at regulating land use and to implement planned strategies that preserve

natural resources that are far from human settlements, which in his case would be regulated by urban development programs under the General Law on Human Settlements. Consequently, efforts were doubled for planning the territory: some regions opted to develop ecological systems while other programs to generate urban development (Sánchez-Salazar *et al*., 2013.). It should be noted that the only governmental body with the authority to define land uses are municipality, which do not have the economic resources and trained personnel to ensure good land planning (Pérez-López, 2000; Díaz, 2011).

Figure 4. Annual land use change in Mexico (%).



Source: The authors with information from Velázquez *et al.,* 2002 and FAO, 2010.

From 2000, sectoral programs included the word "sustainable" (DOF, 2001a), mechanisms of competition between sectors, economic instruments to promote pollution reduction, mitigation were created to climate change and degradation of natural resources (DOF, 2011). They emerged the National Program of Environment and Natural Resources, the National Reforestation Program and the Crusade for Forests and Water; with them 2.62 million hectares were reforested in 2000-2006 (SEMARNAT, 2007).

In early 2000 social policies played central role in shaping territorial policies due to concerns about combating poverty, which were largely driven by the Millennium Development Goals (United Nations, 2014). The first project developed to combat poverty was the National Solidarity Program, transformed into *Progresa*, *Oportunidades* and *Prospera* (DOF, 1995; 2001;

2007; 2013), which became the integrator of sector territorial policies, and provided the direction for the operation of existing sectoral programs, hence projects were prioritized if they develop areas that have high marginalization and poverty (DOF, 2013).

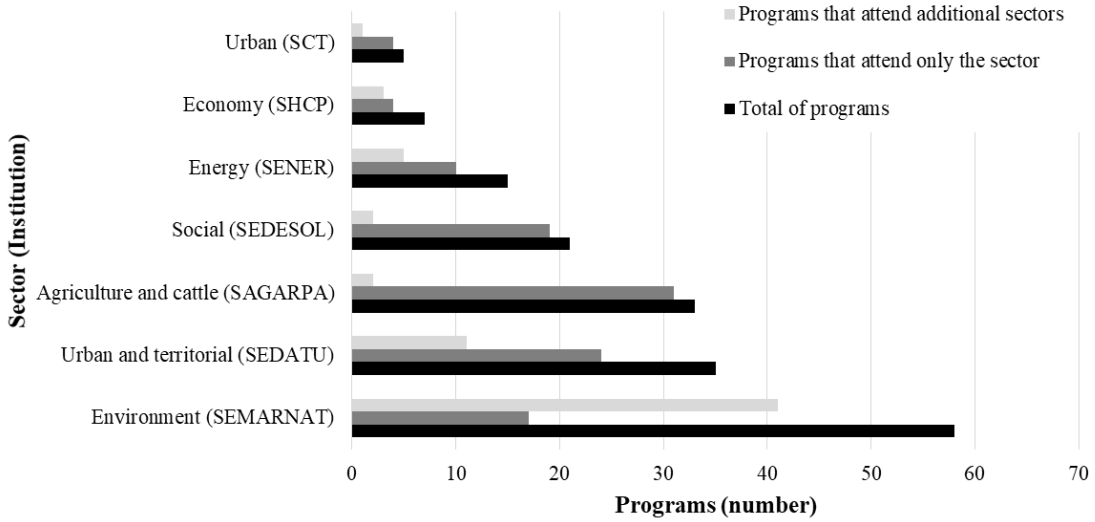
At present, exist 174 programs from seven governmental institutions with effects on the land use. The environmental sector programs are the most numerous, but most of they are transversal with the social sector (Figure 5). Environmental programs are design for alive the social conditions and generate alternative and sustainable employees. Only the programs for biodiversity conservation are exclusive to environment protection, their application is for concourse and economic resources are limited. For example in 2017, the Program for priorities species (PROCER) that attend vulnerable and populations in extinction status species and ecosystems are limited to protect the "Vaquita marina", the rest of species (jaguar, eagle, otter, prairie dogs, etc.) not receive subsidies for conservation. This affect negative the rest of ecosystems. Difference of subsidies from social and productive sector that are supplied directly to the population identified as vulnerable, the environmental programs are evaluated and a reducer number of proposes are accepted, does guarantee that the projects receiving the federal resources are the highest priority or regional impacts.

The urban and productive programs, support mainly to vulnerable population or marginalization regions with subsidies for production and construction, this contribute positively with social development. Two sectors are transversals programs with environmental conservation, urban sector supports homes construction with energy and water saving; the productive sector proposes livestock management schemes with low impact on natural resources.

Land use urbanization impact on sustainability

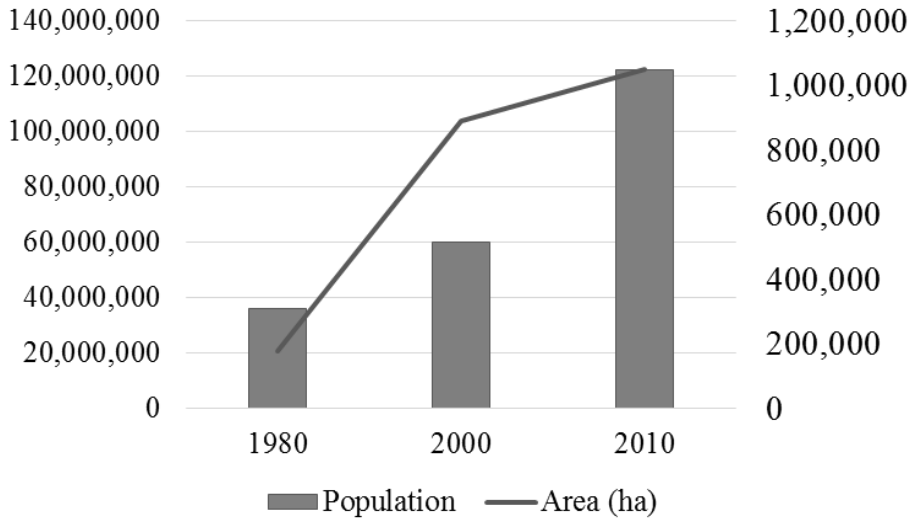
In the current decade the phenomena or process of urbanization supports the world population and its growth, however in Mexico like the rest of the world it is one of the main promoters of biodiversity loss and this impact continues to propagate as world population grows (United Nations Human Settlements Program 2011; 2012). In the case of Mexico, 69.2% of the population is concentrated in 367 cities of which 93 are metropolitan areas that have increased five times its size with reference to area from 177,109 ha to 1,048,908 ha during the period 1980-2010 (SEDESOL, 2011) (Figure 6).

Figure 5. Number of federal programmes in 2017.



Source: The autors.

Figure 6. Increase in population and surface areas in cities of Mexico.



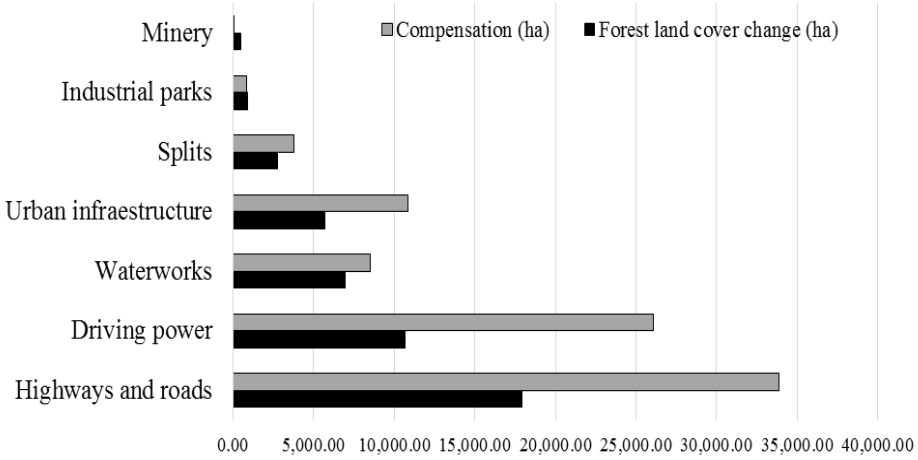
Source: SEDESOL, 2011.

From 2005 to 2015 in Mexico 1,743 applications for change of land use in forestry lands, of which 791 (45.4%) were authorized and 49.3% of cases the procedure was not completed and 5.3% were declined despite the fact that the Sustainable Forestry Act emphasizes that changes in uses of forest land in the country are granted without exception. This means that during the last decade, 37,713 ha have been deforested, of which 47% were for construction or expansion of

highways and roads, despite the advantage of the authorization to change land use includes the ability to be compensated for environmental damage, which in this case has amounted to about 72,374 ha (Figure 7) (SEMARNAT, 2015).

Unlike the expansion of the agricultural frontier and mismanagement of rangelands, the growth of cities leads to irreversible changes in land use. In Mexico, as in other Latin American countries, mitigation of environmental impacts by the growth of cities is regulated by environmental compensation mechanisms that seem to balance the environmental, but involve the possibility of exercising the compensation in a very different place where the impact occurred, so its effect on local biodiversity worsens (DOF, 2014b).

Figure 7. Surface area (ha) of authorized forestry land use change and forestry land surface area compensated by the change in Mexico for the period 2005- 2015 by nature of project.



Source: SEMARNAT, 2015.

In the context of climate change and globalization, the trend is to bestow economic value to natural resources (Costanza *et al*., 2014), and seems to be the greatest opportunity for environmental policies in Mexico to be strengthened (Dirzo *et al*., 2009). In early 2010 the climate change component of the instruments of regional development, currently called National Strategy for Reducing Emissions from Deforestation and Forest Degradation Forests was signed into law (DOF, 2014a). Payment for environmental services in Mexico work for ten years has been well accepted by the population and has political backing for it to continue (Sims *et al*., 2014; Skutch *et al*., 2015). Such policies are positive, but need to be accompanied by mechanisms of land use planning that are more effective at local level and ensure public

participation and academic institutions (Mohar and Rodriguez-Aldabe 2008;. Caro-Borrero *et al*., 2015).

Discussion

After 84 years of changes in territorial policies from a natural resource perspective, there have been successes and failures. In the beginning, the visionary planning of territory policy stands out with the rational use of each region of the country. However, this holistic idea was quickly abandoned without giving space to its application, natural resources have been depleted as economic development advances, in the first years by the opening of agricultural crops, later on a smaller scale but greater impact by the needs for infrastructure, communications, services and housing (Fig. 4, Table 6). These phenomena show that the protection of natural resources is superfluous to the needs of economic development, as is the case in the rest of Latin America. And Mexico facing a future in the midst of a global environmental crisis linked to climate change, it will be necessary to return to a territorial vision similar to that of the 1930s. This type of planing is more consensual with the participation of all stakeholders and specialists to determine the best use and destination of the land, in order to ensure not only livelihood of the people, but its preservation to achieve sustainable development.

Table 6. Changes in land use coverage directly linked to public policies.

Year	Loss (-) or win forestal Surface (+)	Cause
1950	- 34 % total forest	Deforestation for rain-fed agriculture
1949	+ 4,503,345 ha	Irrigation district protection
1956-1960	- 3,498,164 ha of forest land	Rain-fed agricultural lands and new settlements
1975	-224,896 ha	National Program of Clearance
1975	-350,342 ha	Introduction of forage species
1979-1981	- 80 % topical forest	Introduction of livestock
1989	+ 12,429,321 ha	Nature Protected Areas
2005-2015	-37,713 ha	Land use change with authorization

Source: The authors.

The Mexico development model is organized as a nation-state under a centralized government system, which is the only legally entity authorized to regulate land use in the territory and the development of economic activities, but also regulates the social and environmental impact of such activities (Azuela, 2013). This model has led to the land use planning policies in Mexico that has a clear sectoral nature which, despite including instruments for coordination and cooperation of the sectors, in practice each sector exercises its programs and resources available to them independently (FAO and SAGARPA, 2010; Azuela *et al*., 2008; Massiris *et al*., 2012).

Policies of land use planning have been successful from the perspective of each sector in terms of planning and programming budget but could not be design and implemented in the local environment. Because federal programs are applied in the same form and terms in an arid region that in tropical regions although the needs and problems of the regions are opposite (Liscovsky *et al*., 2012; Lopez-Hernandez *et al*., 2012). However, natural resource use pressure for economic development is a relentless pressure, it's up to local, state, and federal governments, institutions, academia and the public that have a stake to find solutions of sustainability. Either by the application of existing planning instruments or by participating in the development of new laws that allow for harmonious development (De Camino *et al*., 2008; Ugalde, 2010; Mills *et al*., 2014). This implies that different actors and decision-makers understand that it is necessary to balance and establish mixtures of land uses. For example, cities should include green belts and urban forests in their design, so that the urban environment is not completely an artificial entity and outside of environmental services. For their part in rural areas establish polyculture systems that integrate commercial varieties with traditional crops in a way that maintains regional identity and is not favoured exclusively by large food producers.

It is undeniable the historical pressure from economic sectors for natural resources, but progress has been made since 2000 when environmental sustainability was incorporated into the principles of national development plans in Mexico. These have had beneficial changes; actions of environmental regulation operate with three types of financial instruments. Those which punish polluters, subsidies for production and payments to reward environmental performance, and existing National System of Protected Natural Areas that includes environmental compensation, have presumably reduced the pressure on natural resources, but is difficult monitoring the success of compensation because the polygons of reforestation it is not available (Figueroa *et al*, 2011; OECD, 2013; Fig. 3 and 4). However, natural resources, which only

represent 1.3% of total federal spending, are more vulnerable than others due to economic development pressures (Fig. 2) as they are applied as pilot programs, unlike rural or industrial program financing that tend to be more extensive (Bravo *et al*., 2010).

Besides of the limited economic resources for environmental sector the most part of there are destined for social development actions, it is true that better people life conditions is positive for natural resources, but this programs are duplicated and did not demonstrate that contribute positively to the conservation of natural resources. A best scenery will be if the rest of sectors coordinate his program or employ environmental criteria. Some solutions in the design of public policies entail directing environmental compensations in places close to where environmental impacts occurred in a way that actually mitigates the damage caused to the environment, it has been shown that payments for environmental services are adequate tools for conservation of ecosystems but must be accompanied by good management of other economic activities. There is a need to increase investments in the sustainable education of natural resources, to eliminate bad agricultural and livestock practices. To this must be added the accompaniment and technical training to producers and the abandonment of activities incompatible with the natural vocation of each region.

It is difficult to define a scenario based on the current priority for social development as a central focus of sectoral policies, but the terms of reference indicate that it will continue with the strategy of direct subsidies that emerged in the 80's (Behre, 2003; DOF -2014). So far, there is no evidence that the improvement in the living conditions of population is attributable to the implementation of the sectoral programs (CONEVAL, 2016). Fortunately, there are no massive projects like in the 70's, where in a decade a large area of total forest area was eradicated, however there is a slow but continuous process of degradation of natural resources where public policies play a prominent role (Anta-Fonseca *et al*., 2008). According to different authors, poverty reduction policies fail to become additional income for families that do not provide options for innovation and a real transformation in the livelihoods. With the natural resource loss scenarios, it is a fact that programs that offer environmentally friendly production options have not been successful either. Likewise, the environmental proposal of the urban and productive sectors revolve exclusively around the reduction of energy demand but do not focus on the best use of space. Giving greater strength to the Programs of Ecological and Territorial Ordering, and to use them as a basis for the application of productive or urban programs, would allow a more

rational use of space; however, these types of policies are not obligatory. Natural capital forms the reservoir and support of all economic activities in the country; it is time to be part of a priority sector in development. The implementation of well-intentioned recommendations from international organizations must be strictly tropicalized to local needs and cultures. So that the public policies contribute to maintain the identity of the cultural territory and subscribe to the global targets of mitigation and adaptation to the climatic change

To improve the trend of incorporating essential environmental issues into regional policies will require the following suggested steps be taken: 1) modify the tendency to create new programs or legislation to address environmental problems, instead incorporate an evaluation scheme and praxis of public policy; 2) increase the cooperation of universities, research organizations and local civil society in decision-making or making judgments of value to the vocation of land uses; 3) changes the approaches to land use planning by integrating one territory planning tool that eliminates duplication of policies and minimize the gap of rural-urban development; and 4) change the focus of environmental policies, not only for the protection of ecosystems, but as the appropriation of natural capital while also providing a real valuation of ecosystem services, in a manner that natural resources are recognized as a priority not only for human development, but for survival.

Conclusion

The beginnings of land use planning in Mexico were cutting-edge, included and considererd all economic sectors, and took into account all stakeholders, as well as concepts such as soil conditions and sustainable development, through the programming of long-term goals. However, these principles were lost by giving priority to economic development via industrialization where natural resources directly funded public spending, this led to a contradictory development of the territory planned early in 1930.

The greatest loss of forest area and water use occurred in the period from 1930s to 1980s with the needs for agricultural and livestock expansion that were strengthened by the food sovereignty policy. Currently, land use change trends are mainly due to infrastructure and communications and are less intense but have greater impact because they are typically nonreversible.

At present, territorial policies include elements of sustainability and there are advances in the incorporation of principles of environmental conservation in the economy and the rest of the development sectors. The greatest challenge is to have efficient mechanisms of cross-sectoral transparency, whereby the natural capital is integrated into the global economy through environmental services.

The administration and planning of land uses would be radically improved if the duplication of land use planning programs (Ecological Planning and Territorial Ordering) were eliminated, leaving a single mandatory guiding instrument in the planning of the uses and destinies of the land. The changes in land use are presented in a holistic and multidisciplinary approach to the territory. Given the complexity of the socio-environmental fabric in Mexico it is desirable that the planning of land uses as well as the applicability of sectoral programs take into account the particular characteristics of each region.

The retrospective analysis of the territorial policies of Mexico and the changes in economic models are adequate to understand what was the context that produced the current environmental crisis, take up the positive aspects of planning and eliminate harmful practices with the environment.

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