1997 PRELIMINARY REPORT ON THE DEVELOPMENT OF ENVIRONMENTAL PERFORMANCE INDICATORS IN MEXICO

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PRESENTATION

With the publication of the Report on the Development of Environmental Performance Indicators in Mexico, the National Institute of Ecology (INE) is committed to publishing a document that contains scientific information supported by empirical data and statistics, which in turn can be reviewed and analyzed by any individual or institution. The document will in turn be used as a tool in the evaluation of Mexico's environmental policy performance.

At the same time, the INE is obligated to promote the concept of "public information access", as it is stipulated in Mexico's General Law of Ecological Equilibrium and Environmental Protection. In essence, this publication is part of an even greater effort than the INE itself; the collection and consolidation of the Environmental Information System of Mexico, a key instrument in environmental policymaking intended to organize and expand the nation's knowledge of the environmental problems it faces.

In the past, a lack of reliable environmental information created uncertainties for Mexico's policymakers during the planning and evaluation stages. The development and publication of the Environmental Indicators by the INE, as a presentation of Mexico's policy performance, offers a public and accessible solution to this problem. At the same time, the indicator program is intended to provide other sectors, such as universities and non-governmental organizations, with the opportunity to participate in the analysis and publication of environmental information relative to the program and thereby insure the document's transparency.

Finally, it is our hope that the objectives of this publication meet the expectations, which have promoted its establishment and mark the next step towards a new informational era.

Enrique Provencio

INTRODUCTION

The development of the environmental indicators is an essential tool for the methodological study of determining the status and developing trends associated with environmental media variables. However, while nations may value the publication of environmental indicators, the organizations and individuals developing the information must never lose sight of the environmental problem at hand since a clear focus is vital for the endeavor's success.

This publication is a first step in the construction of an Environmental Indicator System which basic objectives are:

- To present validated environmental information;
- To create an open system to permit a constant process of updating; and
- To provide information for policy decisionmakers, the scientific community and the general public.

Environmental performance indicators are created in the context of the country's reality and reflect the policies and planning that are associated with the examined media. At the same time, an indicator does not contain the type of in-depth examination associated with the technical or biophysical aspects of the phenomena and instead attempts to give a simplified overview of the problem's general characteristics.

The aforementioned concepts are derived from the methodological framework for the development of environmental performance indicators as part of the proposals adopted by the Organization of Economic Development and Cooperation (OECD) of which Mexico is a member. The OECD model gives a status report of the environmental conditions for the country under review using the following three basic parameters:

- Pressure: The anthropogenic activities that impact the media.
- State: The media's present condition according to its level of preservation and/or environmental deterioration.
- Response: The measures taken by society (especially by the government) to combat the environmental problem.

Without entering into another discussion, it is acknowledged that this system does have limitations. However, it is important to remember that the benefits in presenting environmental problems from such a perspective offers a unique panorama which can aid policymakers to identify cause and effect relationships and in the analysis of effective policy trends.

In the past, especially for the public sector and in particular their environmental departments, Mexico did not have a strong information culture. In short, access was limited and information rarely circulated outside the individual departments where it was generated.

Although several notable examples of environmental information resources exist, such as the INE's Environmental Status Report of Mexico or the INEGI's Environmental Statistics, no periodic publication describing the environmental conditions in the country exist to date.

In this spirit, the Environmental Indicators act as a tool in the analytical process of evaluating Mexico's environmental status by providing objective information so that the reader is able to make an individual judgement concerning the environmental media's problem.

The reader must remember that besides being a landmark document, since it is the first of its kind, it is also the first concrete example of the indicator concept applied to Mexico's environmental policy. Likewise, as the format used in the indicator report develops over time, standards and terminology will be interrelated to illustrate increasingly complex relationships.

In this document, the first chapter presents the methodological framework, as mentioned earlier, in a simple and clear manner, yet without losing the concept's essence.

In addition, several international experiences related to environmental indicator development are illustrated in order to give a perspective on Mexico's effort.

From the second to seventh chapter, the environmental performance indicators for air quality, hazardous waste, municipal solid waste, wildlife and natural resources, ozone depletion and climate change are presented.

Each indicator contains a brief textual explanation and a series of supporting statistics, normally presented in the form of a graph or a table. In particular, this report provides information that is already available yet unpublished or has been previously published by other official sources. In order to demonstrate a continuation of environmental policies and performance, Mexico's indicators will be consistently updated in the future as the proper information is made available.

It should be mentioned that the information presented here is the result of a coordinated effort among the various departments of the INE, which have not only provided their statistical analysis and expertise during the technical writing stage but also assisted in the document's final revision.

The Environmental Indicator Program is designed and structured to present information so as to facilitate future public participation in the document's constant transformation. In fact, one of the inherent aspects of the program, the information's usefulness to the general public so that they may understand the society's environmental problems, depends on their participation in order to improve the content and quality of information included in the program.

My hope is that the reader thinks of this publication as an open invitation to submit all relevant comments and suggestions to the INE so that they may be considered in the future.

Adrian Fernandez Bremauntz

1. CONCEPTUAL FRAMEWORK

The structure of the Environmental Indicator Program includes theoretical and conceptual frameworks which illustrate abstract models through contemporary case studies. In the first chapter of this presentation, a general description of the Pressure-State-Response (PSR) conceptual model is given, which itself has led to significant advances in the development of environmental indicators worldwide.

In Chapters 2 through 7, the environmental indicators for each of the following media are presented:

- Air
- Hazardous Waste
- Municipal Solid Waste
- Wildlife and Natural Reserves
- Ozone Depletion
- Climate Change.

Each chapter establishes a group of indicators with the objective of creating tools to measure the efficiency of environmental policies, as well as to establish a baseline for future publications and other informational media. It should be noted that the list provided above is not definitive and rather serves as a starting point for new indicators as more information is made available. On the other hand, the list of environmental media indicators does serve as a mechanism to identify the information gaps and alternative resources, which will only strengthen the content and utility of future indicators.

Each chapter includes an introduction, or a brief description of the environmental problem at hand, followed by three sections illustrating the performance dynamic of the problem. First, the pressure indicators or causative agents are presented. Second, a status report or quantification of the environmental problem is detailed. Finally, the society's action or the government's response (completed or currently in progress) towards the problems are mentioned.

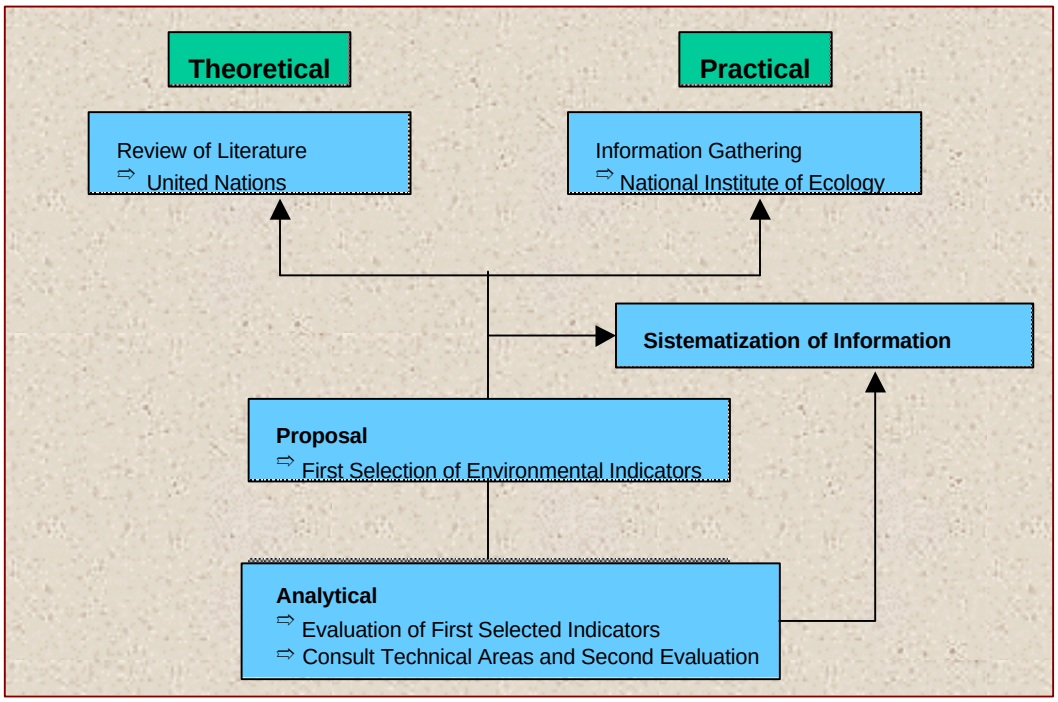
The strategy used to present the indicator's development also consists of the following points:

The first step included a group of general "ideal" indicators in order to develop dynamic media models based on the international indicators of the OECD, the United Nations Environment Program (UNEP) as well as the technical advise from the National Institute of Ecology (INE).

The second stage included an extensive review of the media bibliography and the development of departmental requests within the INE to receive any additional information.

Once these two steps were concluded, an evaluation was undertaken to determine which of the indicators would be included in the program.

Required Steps for Document Completion



1.1. General Outline

The development of environmental performance indicators began whit Group Seven (G7) Meetings in 1988-1989 when members there solicited the Organization for Economic Cooperation and Development (OECD) to develop indicators in the context of decisionmaking dynamics taking into consideration the environmental and economic factors (Environment Canada, 1996).

In October 1993, the first steps in developing the environmental indicators by the National Institute of Ecology (INE) were undertaken during the North American Environmental Information Workshop in Mexico City. The INE, Environment Canada and the Environmental Protection Agency (EPA) all participated at the Workshop with the objective of developing an environmental status report for North America. Despite the establishment of the indicators was initially prompted from a necessity to meet international commitments and generate global indicators, national indicators have been developed by Mexico to be used for internal and regional planning and environmental policy performance projections.

What are Environmental Indicators?

Environmental Indicators are statistics or parameters that provide information and/or trends concerning the environmental conditions and phenomena. The significance transcends the simple statistical application by providing information that creates a tool to measure the effectiveness for environmental policies or what is known as “environmental performance”. The indicators are usually presented in the form of “bites” of information or summaries of statistical analysis using tables, graphs, maps and minimal amounts of text.

Importance of Environmental Indicators

The importance of Environmental Indicators is derived from the necessity to provide decisionmakers and the general public with a tool to present concise and scientifically supported information in a simple and easily understood format.

The development of indicators has been directed towards the achievement of three environmental objectives in order to reach sustainable development:

- Protect human health and the general population's welfare;
- Guarantee sustainable development of resources;
- Conserve ecosystem integrity.

The development of indicators also attempts to act as a fundamental tool:

- to expand the environmental information database in Mexico;
- to improve the public's perception of environmental problems;
- to evaluate the environmental conditions and trends at regional, national or global scales;
- to promote the integration of environmental factors in environmental policies;
- to fulfill international environmental commitments;
- to undertake regional and national analysis.

1.2. Conceptual Theoretical Framework

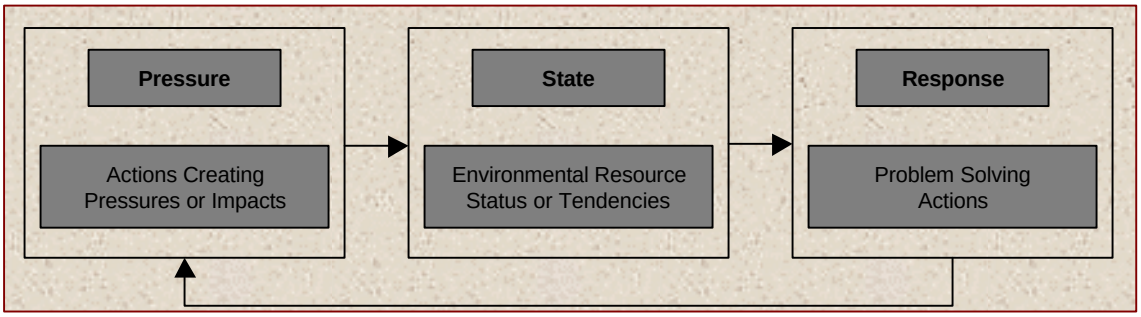
Information used in the development of environmental indicators requires a conceptual framework to structure the information in a more accessible and intelligent manner. The "Pressure-State-Response" model, designed from Environment Canada and OECD proposals, provides a satisfactory framework to achieve this objective and will be explained further in the reading.

The "Pressure-State-Response" model is based on causal logic, action-response relationships between the economy and environment, and from the following questions:

- What environmental impacts exist?
- What is the current status of the environment?
- What is being done to resolve and mitigate environmental problems?

Each one of these questions is answered with a variety of indicators.

Pressure-State-Response Diagram

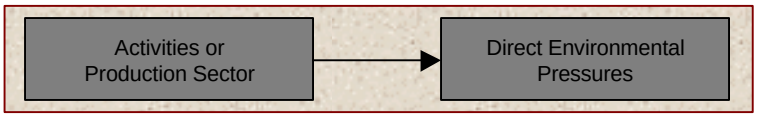


1.2.1. Pressure Indicators

Pressure indicators essentially describe environmental pressures as results of human activities. An example of such an indicator is the amount of industrial air emissions from metropolitan areas.

Pressure indicators are classified in two groups (direct or indirect) according to their impact levels. The first category corresponds to the externalities caused by human activities, for example the volume and type of generated waste and atmospheric pollution emissions. The second category relates to tendencies in activities that create environmental externalities, for example characteristics of mobile or fixed source pollution. The indirect pressure indicators are seen as particularly important since they provide insights for forecasting environmental problems.

Components of Pressure Indicators

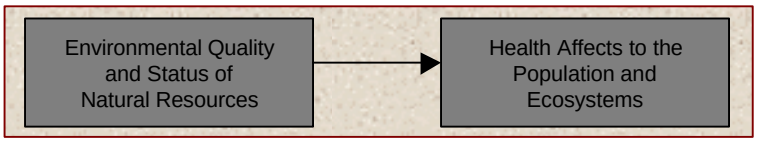


1.2.2. State Indicators

State Indicators refer to environmental quality conditions as derived from an examination of the quantity and state of natural resources, for example the evaluation of air quality through the measurement of suspended particulate concentrations.

This type of indicator includes the health effects caused by environmental quality deterioration upon the population and ecosystem.

Components of State Indicators

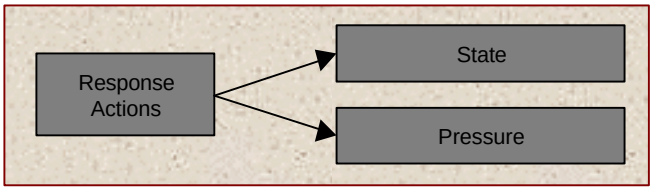


1.2.3. Response Indicators

Response Indicators present the efforts undertaken by society and or an institution to reduce or mitigate environmental degradation. These indicators have not been extensively developed due to the fact it is quantitatively difficult to measure how a response action may solve a problem.

Response actions are directed towards two objectives: first, towards the “pressure” agents, for example, establishing low emission technologies and secondly, towards the state variables, for example the establishment of turtle hatcheries.

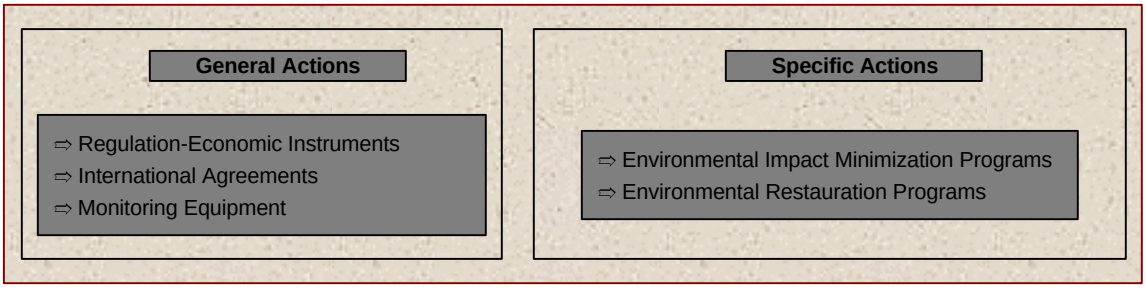
Components of Response Indicators



There do exist response actions where it is difficult, for the moment, to determine the degree (or impact) as to which the problem is being solved. Examples of such phenomenon are seen in the ability to quantify the response impacts of the environmental Official Mexican Standards (NOMs), the industrial voluntary response agreements or the air quality monitoring networks. Although these actions may not solve the problem immediately, they are fundamental for addressing the problem and support long-term solutions. These types of responses are classified as *general* and are distinguished from specific actions.

An example of a general response action is the Montreal Protocol signed by various countries to decrease ozone-depleting emissions. On the other hand, a specific response action is the quantity of alternative substances used in the production processes to substitute those that damage the ozone layer.

Types of Response Actions



1.3. Criteria for Indicator Selection

The importance of the message that an indicator transmits is limited by the quality of data it contains. This fact requires careful selection of the criteria, ultimately assuring the information gathered will meet certain standards of reliability. The indicator criteria selection varies according to the institution or the objectives. The OECD, in particular, establishes the guidelines in the following format (Bakkes, J.A., 1994):

Criteria for Indicator Selection

An Indicator should:

- provide a vision of the environmental conditions, pressures and responses.
- be presented in a simple format, which illustrate tendencies over time.
- respond to environmental changes and human activity.
- provide a theoretical framework for international comparisons.
- apply to a national, regional scale, according to the case.
- contain quantifiable components used in comparative studies.

Technical Criteria:

- based on theory and science.
- based on international consensus.
- have the capability to relate to economic forecasting models.

The characteristics of the necessary data used to evaluate the indicators must:

- have a cost / benefit ratio.
- be documented and have an established level of quality.

For this project's development only in some cases does the information meet all the aforementioned criteria. Therefore it was decided that as a first requirement, all information must originate from an official source or be provided directly by the responsible technical areas. In the future, the

establishment of information quality assurance mechanisms is planned. On the other hand, one must remember that this is a long-term process and environmental management information systems are currently being introduced with policy decisions.

1.4. International Experience

In the international arena, no broad consensus exists as to the accepted theory, definitions and methodology concerning environmental indicator design. A review of the literature shows that the use of indicators is specifically focused towards national policies. However, most writers do agree on the necessity of more general indicators used to evaluate environmental indicator actions and various project scales and quantify natural capital (Hammond et al, 1995).

The World Bank states that indicators, as measurements of performance, supply useful information, yet they do not address fluctuations, temporary variations and factors of uncertainty (World Bank, 1995). All the organizations involved in the development of indicators appear to agree that they are useful tools for policy design and evaluation purposes.

Additionally, it is apparent that the international institutions that work with the indicators agree that the benefits go beyond just the direct results obtained from the observations and that the indicators should be clear, simple, scientifically supported, verifiable and reproducible. Ideally, the indicators should represent a minimal measuring effort which in turn achieves a maximum impact for policy instrumentation (OECD, 1994a).

Indicators can measure the success of a course of action and even create a stimulus or a catalyst in solving specific problems but they can never indicate which policy should be followed. More so, the policy decisionmakers are responsible for choosing the appropriate alternatives which will achieve the desired and most efficient results.

Events Relative to the Development of Environmental Indicators Worldwide

1987	• Development of environmental indicators begins in Canada and Holland.
1989	• G7 Economic Summit solicits the OECD to work on the development of environmental indicators according to a Canadian proposal.
1991	• OECD publishes a preliminary report on environmental indicators. • Canada publishes its preliminary report on environmental indicators. • Holland publishes its preliminary report on environmental indicators.
1992	• Development of environmental indicators is supported at the United Nations Environmental and Development Conference.
1993	• Statistics Division and Environmental Program of the United Nations call upon environmental and scientific experts to discuss the status of environmental indicators and sustainable development. • Canada publishes a complete volume of environmental indicators, the first in a periodical series.
1994	• OECD publishes the "Core Set" of environmental indicators. • World Bank organizes a technical workshop to determine common fundamentals for sustainable development indicators. • Conference for Sustainable European Cities marks an important step in the development of concepts and tasks relative towards environmental indicators.

Government Initiatives

Holland

- Applies environmental indicators to global issues of national interest, such as ozone depletion, climate change and acid rain.
- Since 1991, the Dutch government publishes indicators showing changes in public policy initiatives towards environmental problems.
- Development and publication of environmental performance indicators helps Holland progress towards sustainability, increase public awareness and promote public policy and planning decisions to decrease the environmental impacts throughout the country. (OECD, 1994b)
- Social welfare, community safety and citizen participation indicators are used in response to levels of social sustainability.

Canada

- In January 1991, Environment Canada, the Canadian environmental agency, publishes a preliminary collection of national environmental indicators. (Bakkes et al, 1994)
- Canadian environmental indicators are selected through public and private sector consultation, opinion polls and bibliographical analysis.

Organization for Economic Cooperation and Development (OECD)

The OECD has not only gained experience in the definition, harmonization and development of indicators, but also in the use of analytical and diagnostic tools.

The OECD environmental performance exams employ environmental indicators that support and illustrate the undertaken analysis. In the short and mid-term (3 years), the following goals are expected to be achieved:

- Improve the quality and comparability of existing indicators.
- Reach uniformity among published indicators.
- Fill information "gaps" where needed.
- Develop detailed indicators oriented towards results and performance. (OECD, 1996)

Conclusions from International Experiences Related to Indicator Development

To conclude this chapter, after giving a brief description of the international experience with environmental indicators, without a doubt the program will aid Mexico in the following tasks:

- The environmental indicators will be integrated into Mexico's environmental policy. A proper planning, implementation and evaluation of environmental policy first requires the development of environmental indicators.

- Coordination, systemization and public access of information have been identified as priorities for environmental statisticians and authorities.

- Only as the environmental indicators develop and as information is made available will society understand their usefulness. This phenomenon will also increase the public's interest to participate and improve the quality and the utility of the information being presented. As a process requiring more and more precision, the indicators will also serve as an exercise in planning and open new information channels.

In the following chapters, this report presents various environmental indicators related to specific national problems. While reading the document, please refer to the conceptual framework since it is designed to aid you, the reader, to clearly understand the concrete examples pertaining to Mexico's development of its own environmental indicators.

2. AIR QUALITY

This section presents a group of pressure, state and response indicators relative to urban air quality and pollution especially for the metropolitan areas of Mexico City (ZMVM), Guadalajara (ZMG) and Monterrey (ZMM). The selection of these particular urban centers was not only based on the fact that they are some of Mexico's largest but because they also contained the most available information. Of course, as information becomes available for other cities, this analysis approach will encompass those areas that have similar or potential air quality problems.

In the pressure indicators, the primary information from the diagnostic inventories relates to pollution emissions for the production sectors. The identification process is important since the response actions are orientated towards these sectors. In fact, standards and programs established in Mexico already acknowledge the pressure that mobile and fixed sources have upon national and regional air quality.

The section addressing state indicators describes the current situation and air quality trends for lead (Pb), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), total suspended particulates (PST) and particulates less than 10 microns (PM10). Until recently, information for all measurable parameters in the Mexico City metropolitan area existed, while Guadalajara and Monterrey lacked results for several of the same parameters. In the future, it is hoped that these information gaps will be addressed with increases in air quality monitoring infrastructure.

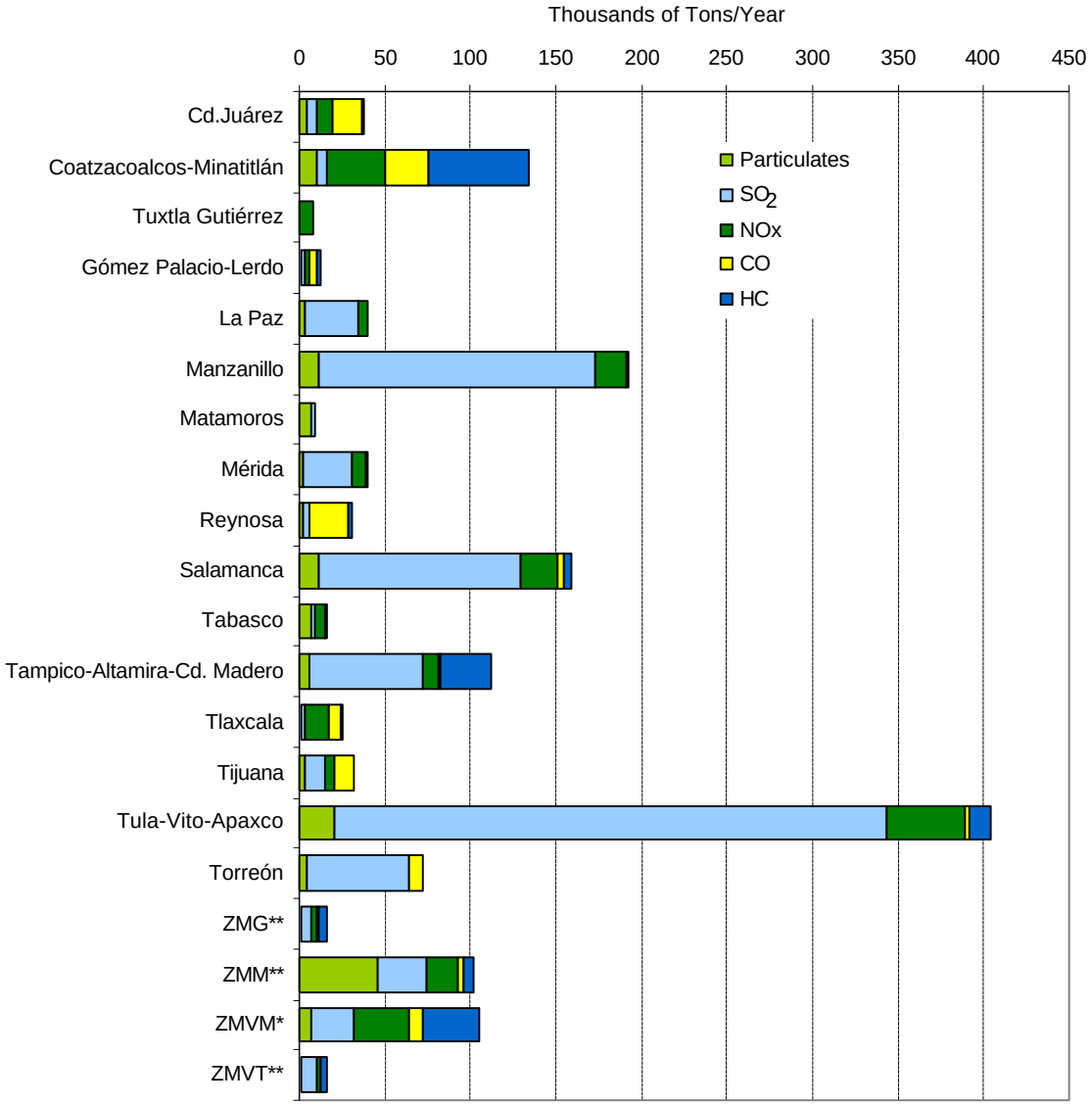
The response indicators are classified in two types; legal and voluntary compliance. The first group consists of automobile verification programs, industrial inspections and oversight, fuel improvements and the expansion of urban air quality monitoring stations. In the second group, industrial voluntary compliance is addressed through environmental audits and self-regulating agreements.

2.1. PRESSURE

2.1.1. Inventories of Pollution Emissions in Priority Zones

Emission inventories are a strategic instrument for environmental management that permit authorities to identify the polluting agents and their contributing factors.

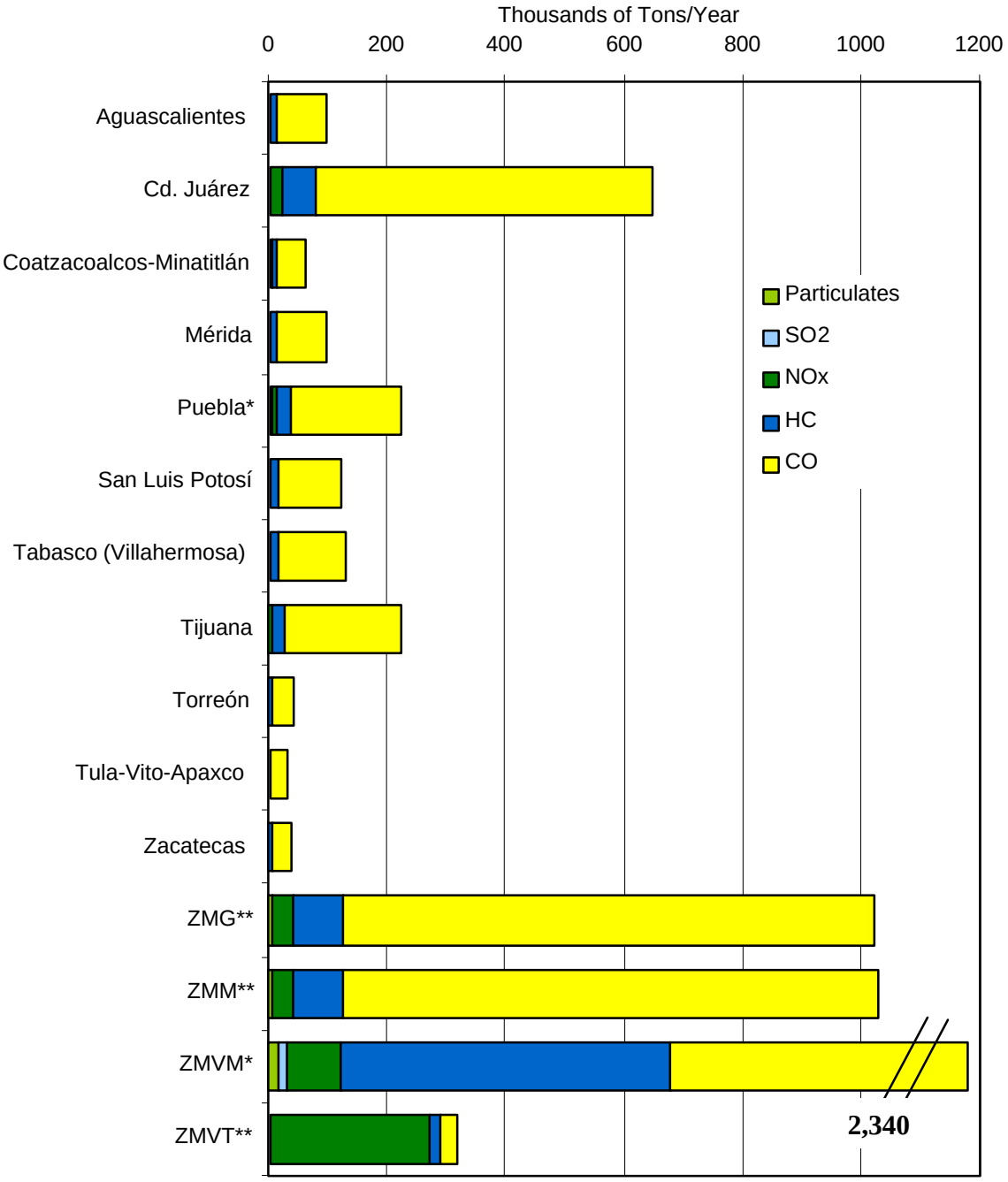
1994 Estimated Industrial Emissions in Priority Zones



Note: *: 1995, **: 1996.
ZMVM: Mexico City Metropolitan Area, ZMG: Guadalajara Metropolitan Area, ZMM: Monterrey Metropolitan Area, ZMVT: Toluca Metropolitan Area.
PST: total suspended particulates, SO_2 : sulfur dioxide, CO: carbon monoxide, NO_x: nitrogen oxide, HC: Hydrocarbons.

In accordance with the inventories for the transportation and industrial sectors in 18 urban-industrial centers in Mexico, fixed-source pollution is at its highest level in the Tula-Vito-Apasco, Manzanillo and Coatzacoalcos-Minatitlán regions. Mobile source pollution is at its greatest concentrations in the metropolitan areas of Mexico City, Guadalajara and Monterrey.

1994 Estimated Vehicle Emissions in Priority Zones

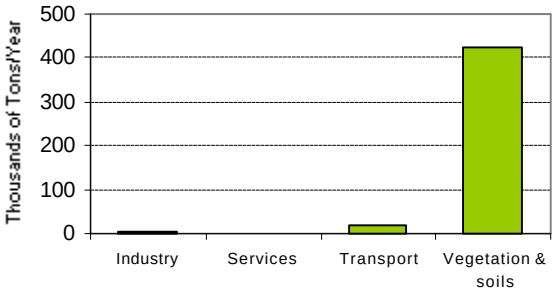


Note: *: 1995, **: 1996.
ZMVM: Mexico City Metropolitan Area, ZMG: Guadalajara Metropolitan Area, ZMM: Monterrey Metropolitan Area. ZMVT: Toluca Metropolitan Area.
PST: total suspended particulates, SO_2.: sulfur dioxide, CO: carbon monoxide, NO_x: nitrogen oxide, HC: hydrocarbons.

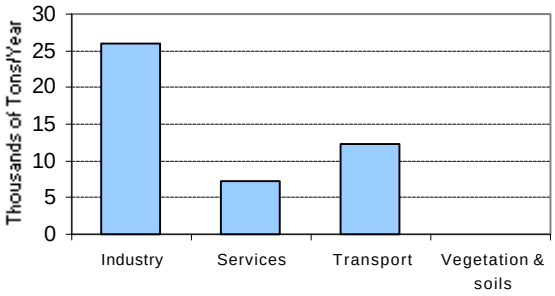
2.1.2. Emission Inventories in Mexican Metropolitan Areas

Mexico City Metropolitan Area, 1994

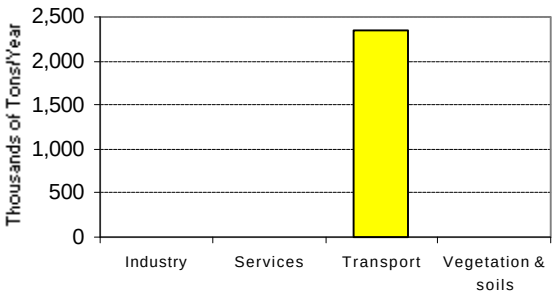
Particulates



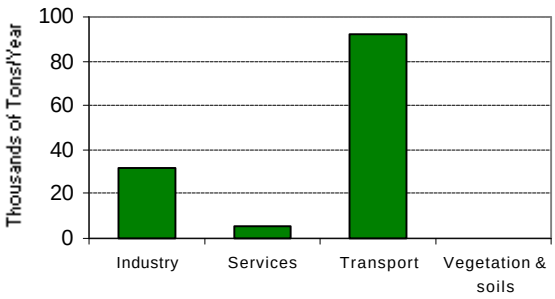
Sulfur Dioxide



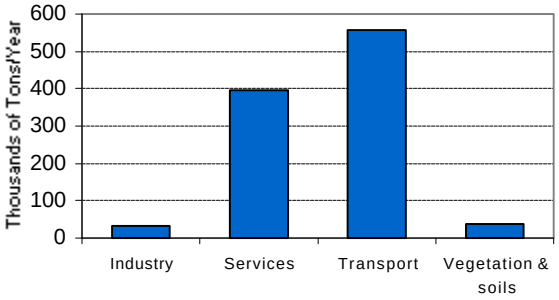
Carbon Monoxide



Nitrogen Oxide

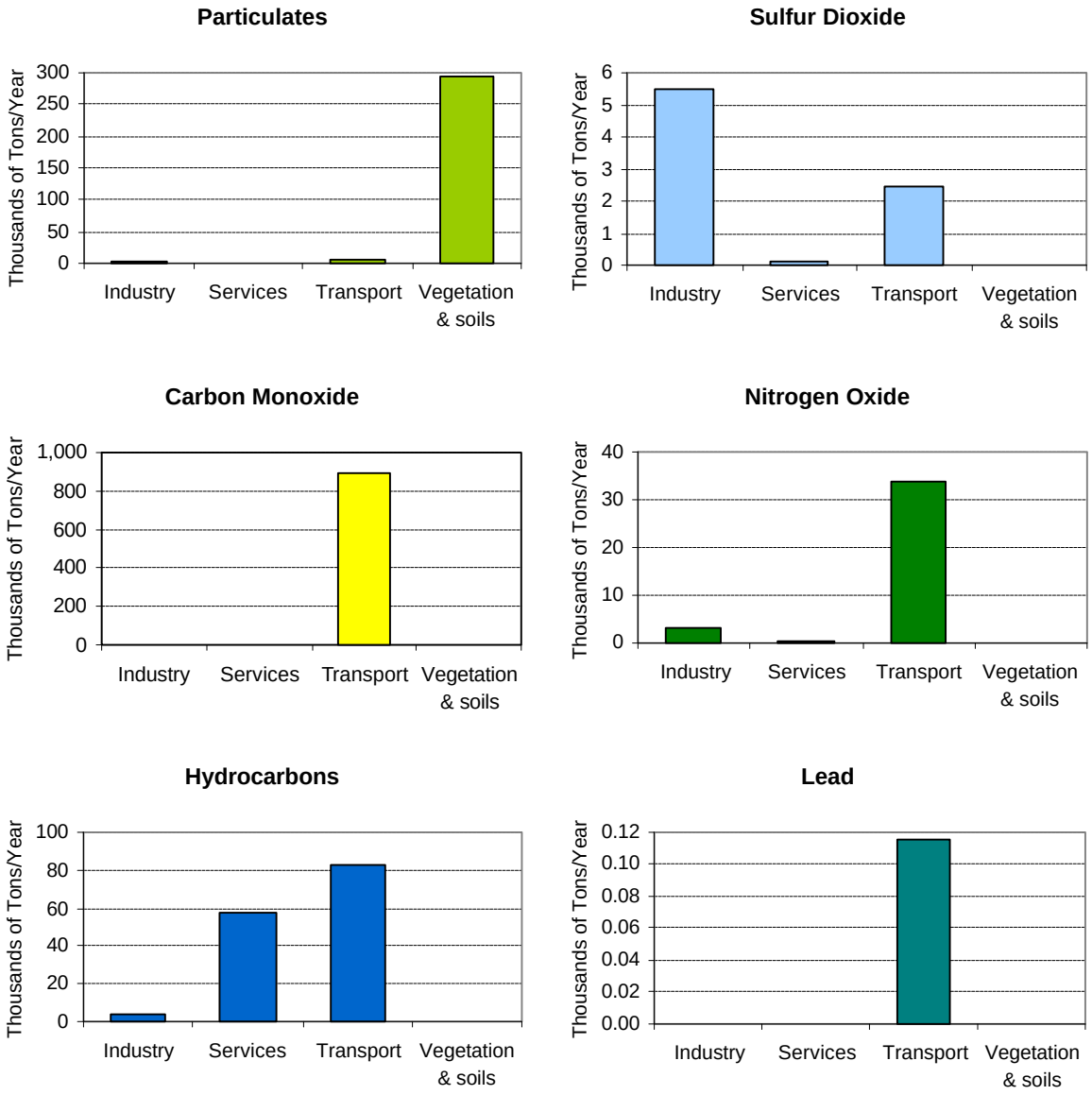


Hydrocarbons



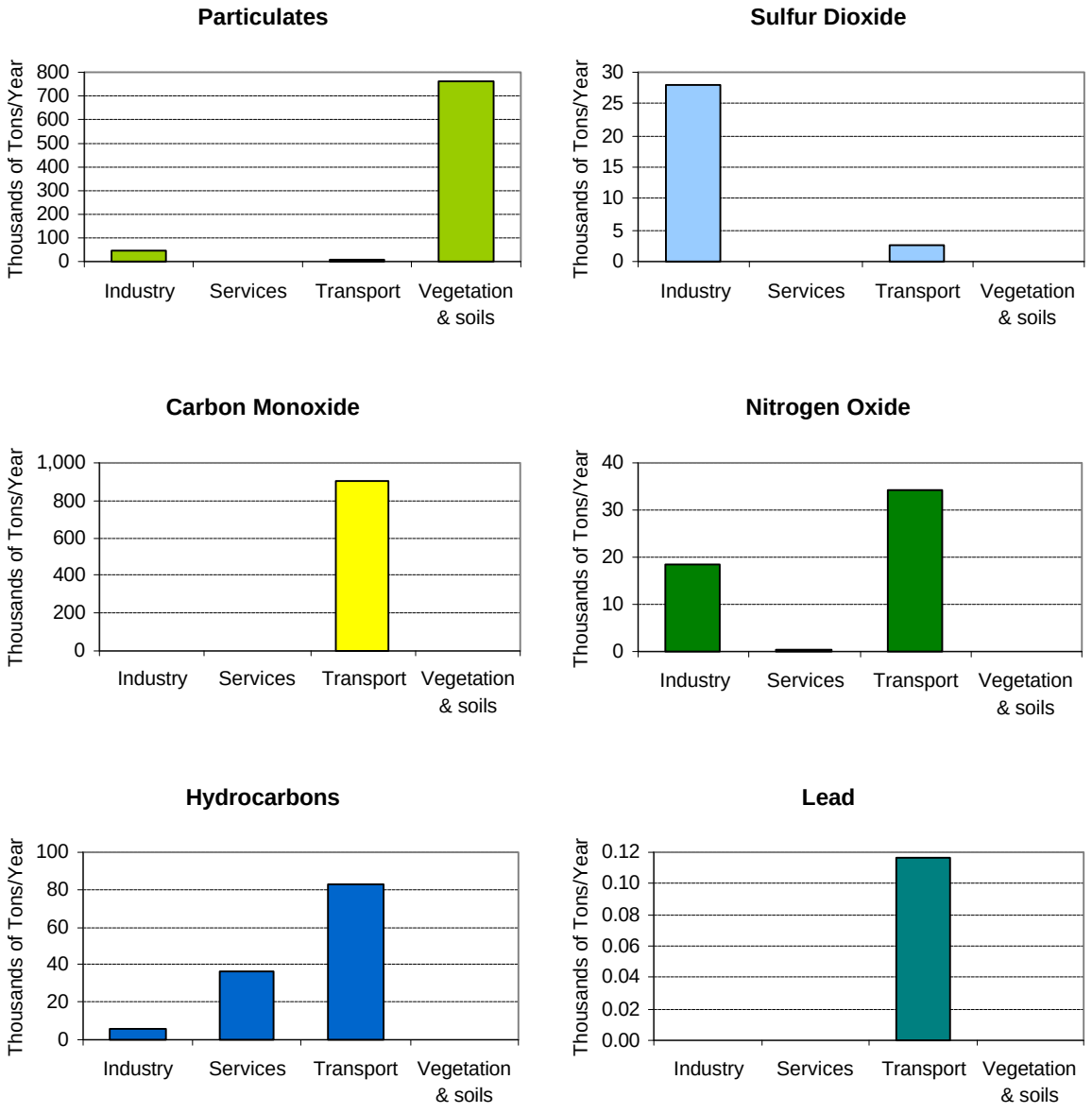
Source: D.D.F; Government for the State of Mexico, SEMARNAP and SSA, 1995. Programa para Mejorar la calidad del Aire en el Valle de México 1995-2000, Page 74.

Guadalajara Metropolitan Area, 1995



Source: State Government of Jalisco; SEMARNAP and SSA, 1997. Programa para el mejoramiento de la Calidad del Aire en la Zona Metropolitana de Guadalajara, Page 111.

Monterrey Metropolitan Area, 1995



Source: State Government of Nuevo Leon; SEMARNAP and SSA, 1997. Programa de Administración de la Calidad del Aire del Area Metropolitana de Monterrey 1997-2000, Page 76.

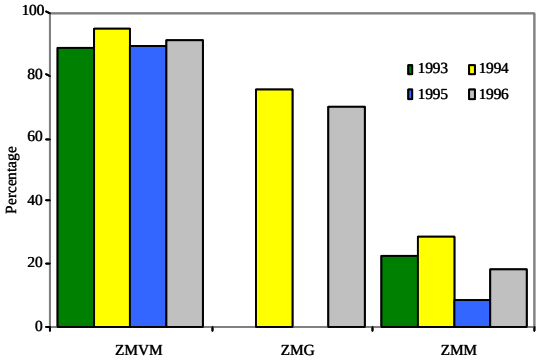
One of the main focuses of these inventories is that in the three aforementioned cities the transportation sector is considered one of the largest polluters, contributing 71% of the nitrogen oxides in the ZMVM, 91% in the ZMG and 64% in the ZMM. Hydrocarbon emissions from mobile sources reach 54% in the ZMVM, 57% in the ZMG and 66 % in the ZMM. Additionally, it should be mentioned that in the ZMVM and the ZMG, transportation accounts for 75% and 74% respectively. In the rest of the country, transportation normally accounts for 50 % of total emissions.

2.2. STATE

2.2.1. Air Quality Comparisons for Large Metropolitan Areas

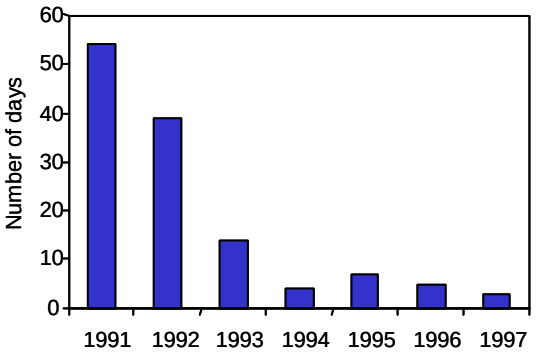
In Mexico, the Metropolitan Air Quality Index (IMECA), a quantification of pollution concentration, has been developed. An IMECA reading of 100 points equals the maximum permissible limits allowed by the corresponding air quality standards. Air quality is not considered satisfactory when the IMECA ratio measures between 100 and 200 points, poor between 200 and 300, and very poor beyond 300 points.

Percentage of Days Exceeding Mexican Official Standards



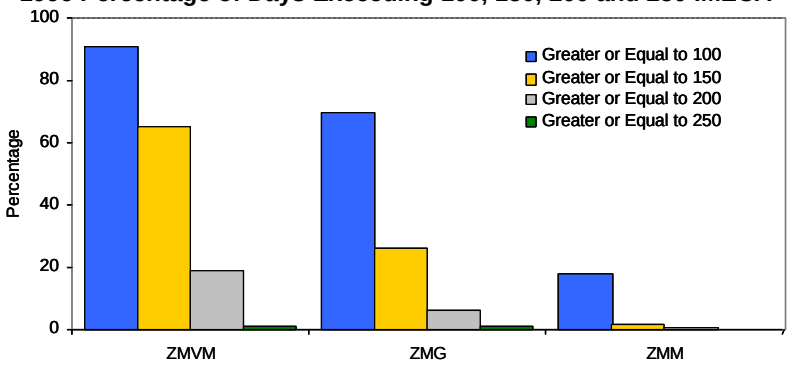
Source: INE, SEMARNAP, 1997. Dirección General de Gestión e Información Ambiental.

Number of Days with Contingencies in the ZMVM, 1991-1997



Source: INE, CENICA, SEMARNAP,1996. Primer Informe sobre la Calidad del Aire en Ciudades Mexicanas, Page 28.

1996 Percentage of Days Exceeding 100, 150, 200 and 250 IMECA



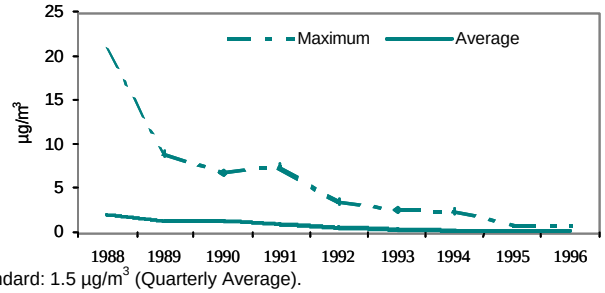
Note: ZMVM: Mexico City Metropolitan Area, ZMG: Guadalajara Metropolitan Area, ZMT: Toluca Metropolitan Area, ZMM: Monterrey Metropolitan Area.

Noticeably, in terms of the frequency for standard violations, air pollution problems in Guadalajara can be considered as poor as in Mexico City, while in Monterrey the situation is much less critical. However, when the same type of frequencies are compared for the highest registered IMECAs, Guadalajara rarely exceeds the 200 IMECA level, while Mexico City surpasses this standard several times per year. Monterrey air pollution does not exceed the 200 IMECA mark.

2.2.2. Pollution Concentrations and Violations of Mexican Official Standards

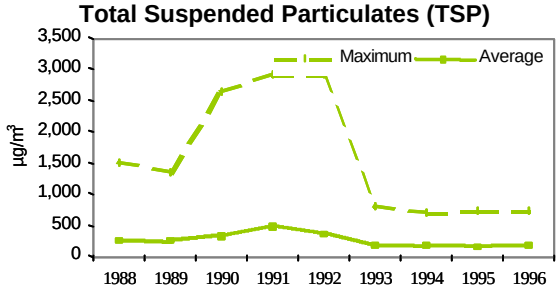
Mexico City Metropolitan Area

Lead



Standard: 1.5 µg/m^3 (Quarterly Average).
Source: D.D.F., 1996. Compendio Estadístico 1986-1995.
D.D.F., 1996. Informe General de la Calidad del Aire en el Valle de México 1990-1996.

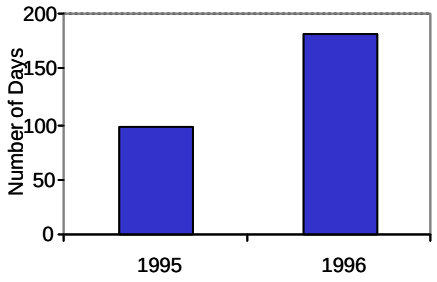
Total Suspended Particulates (TSP)



Standard: 260 µg/m^3 (24 hr. Average); 75 µg/m^3 (Annual Average).
Source: D.D.F., 1996. Annual Statistics, 1986-1995.
D.D.F., 1996. Informe General de la Calidad del Aire en el Valle de México 1990-1996.

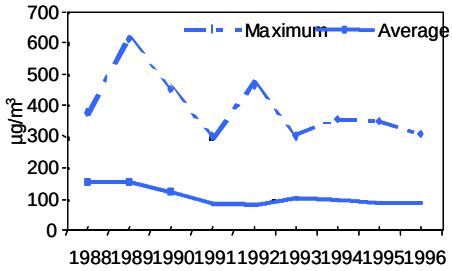
Particulates less than 10 microns (PM10)

Number of Days Exceeding Standards*



Standard: Not exceeded more than once per year.
Source: INE, CENICA, SEMARNAP, 1997. Primer Informe sobre la Calidad del Aire en Ciudades Mexicanas,1996.
* Measurements with Periodic Monitoring Equipment.

Annual Concentrations*

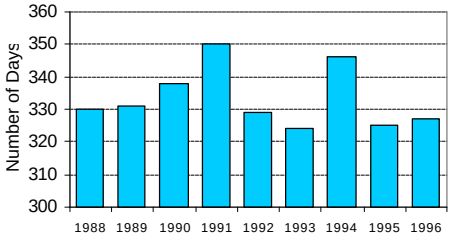


Standard: 150 µg/m^3 (24 hr. Average); 50 µg/m^3 (Annual Average).
Source: D.D.F., 1996. Compendio Estadistico, 1986-1995.
D.D.F., 1996. Informe General de la Calidad del Aire en el Valle de México,1990-1996.
* Monitoring with Manual Equipment; Sampling once every 6 days.

Mexico City Metropolitan Area (Continued)

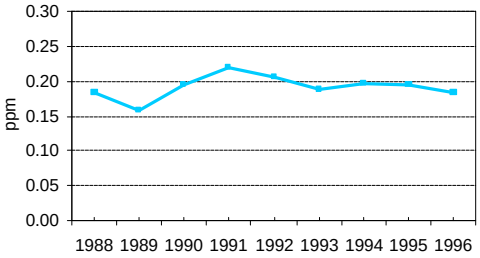
Ozone

Number of Days Exceeding Standards



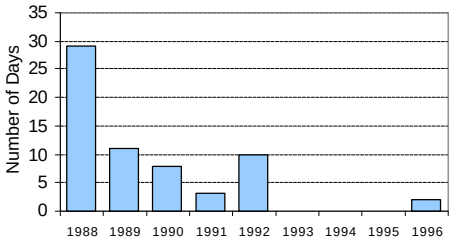
Standard: Not exceeded more than once every three years.

Annual Average of Daily Maximum Concentrations

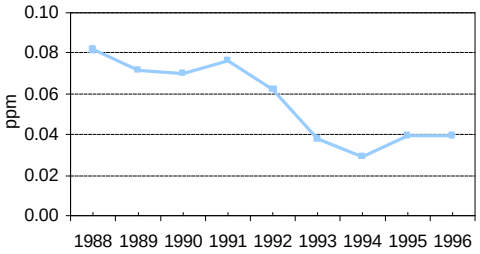


Standard: 0.11 ppm (1 hr.).

Sulfur Dioxide

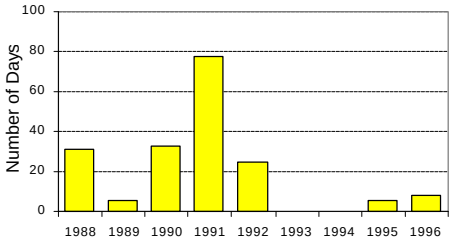


Standard: Not exceeded more than once per year.

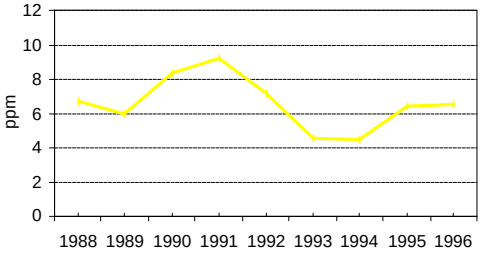


Standard: 0.13 ppm (24 hr.); 0.03 ppm (Annual Average).

Carbon Monoxide

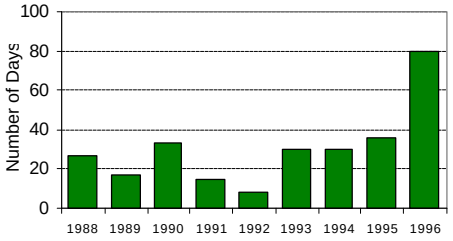


Standard: Not exceeded more than once per year.

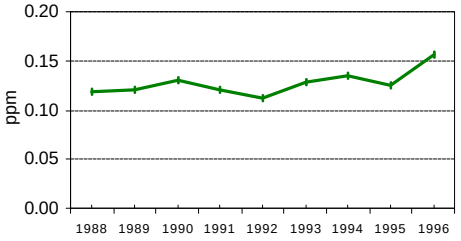


Standard: 11 ppm (8 hr.).

Nitrogen Dioxide



Standard: Not exceeded more than once per year.



Standard: 0.21 ppm. (1 hr.).

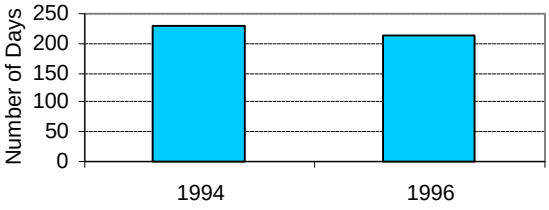
Source: INE, SEMARNAP, 1997. Dirección General de Gestión e Información Ambiental.

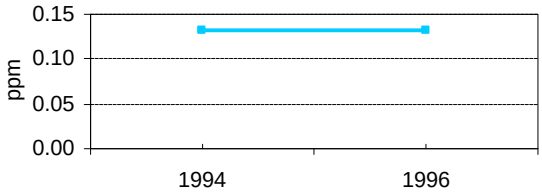
Guadalajara Metropolitan Area

Number of Days Exceeding Standards

Annual Average of Daily Maximum Concentrations

Ozone

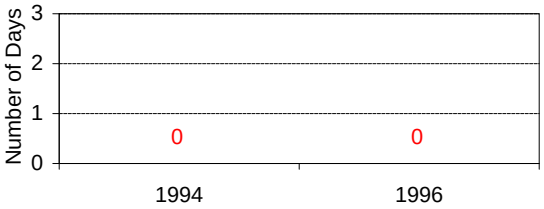


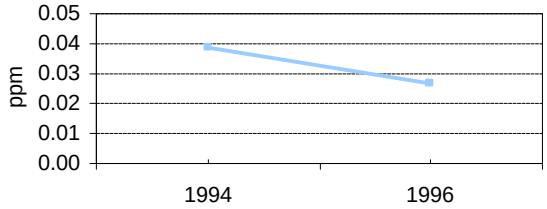


Standard: Not exceeded more than once each three years.

Standard: 0.11 ppm (1 hr.).

Sulfur Dioxide

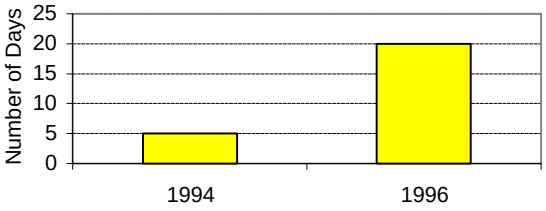


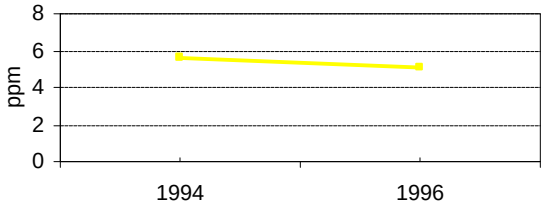


Standard: Not exceeded more than once per year.

Standard: 0.13 ppm (24 hr.); 0.03 ppm (Annual Average).

Carbon Monoxide

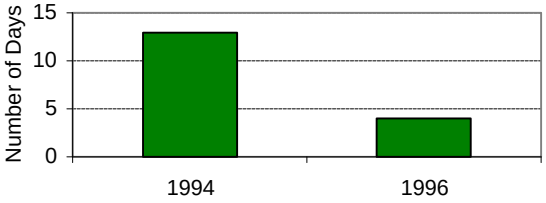


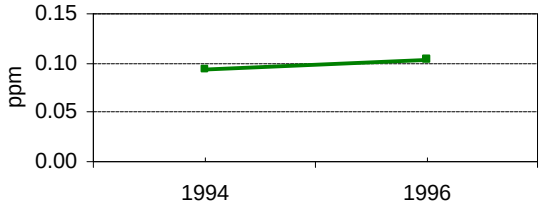


Standard: Not exceeded more than once per year.

Standard: 11 ppm (8 hr.).

Nitrogen Dioxide

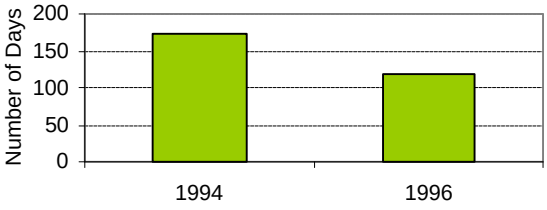


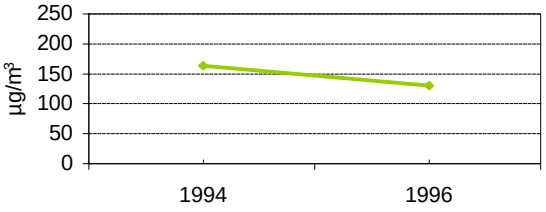


Standard: Not exceeded more than once per year.

Standard: 0.21 ppm (1 hr.).

Particulates less than 10 microns (PM10)





Standard: Not exceeded more than once per year.

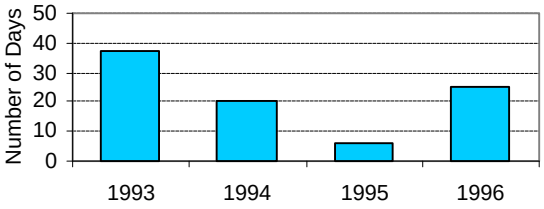
Standard: 150 µg/m^3 (24 hr); 50 µg/m^3 (Annual Average).

Source: INE, SEMARNAP, 1997. Dirección General de Gestión e Información Ambiental.

Monterrey Metropolitan Area

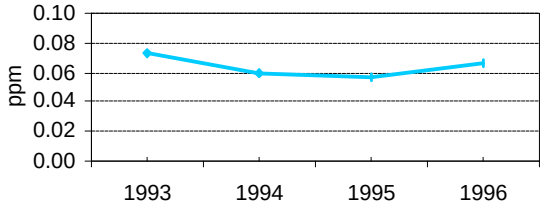
Ozone

Number of Days Exceeding Standards



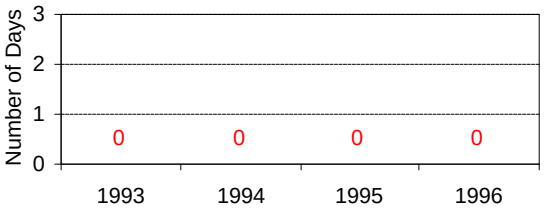
Standard: Not exceeded more than once every three years.

Annual Average of Daily Maximum Concentrations

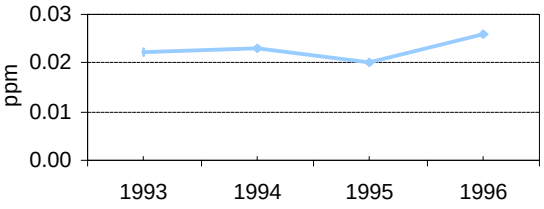


Standard: 0.11 ppm (1 hr.).

Sulfur Dioxide

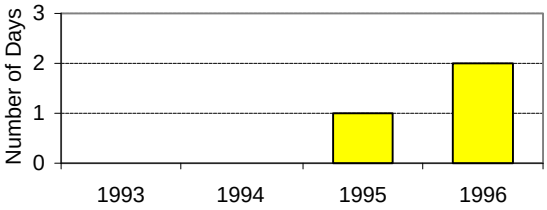


Standard: Not exceeded more than once per year.

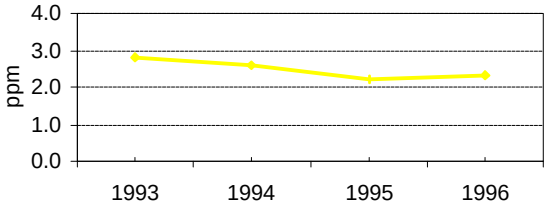


Standard: 0.13 ppm (24 hr.); 0.03 ppm (Annual Average).

Carbon Monoxide

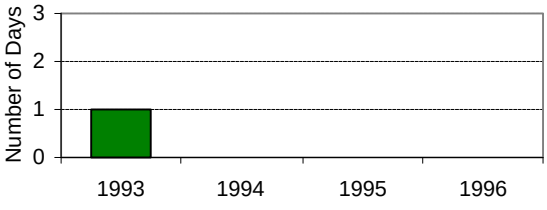


Standard: Not exceeded more than once per year.

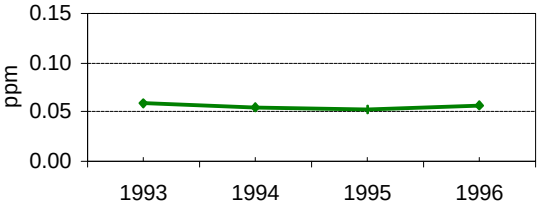


Standard: 11 ppm (8 hr.).

Nitrogen Dioxide

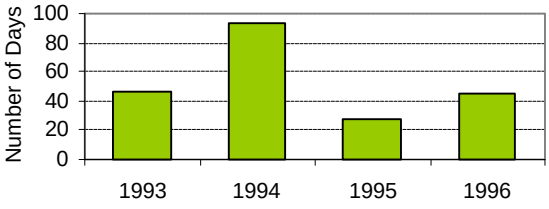


Standard: Not exceeded more than once per year.

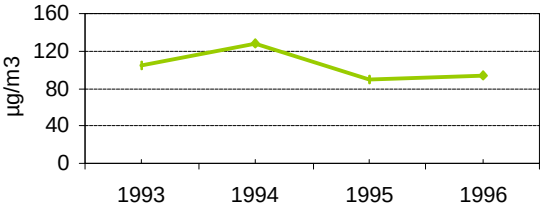


Standard: 0.21 ppm (1 hr.).

Particulates less than 10 microns (PM10)



Standard: Not exceeded more than once per year.



Standard: 150 µg/m^3 (8 hr.); 50 µg/m^3 (Annual Average).

Source: INE, SEMARNAP, 1997. Dirección General de Gestión e Información Ambiental.

2.3. RESPONSE

The air quality response actions for the metropolitan areas are directed principally towards lowering emissions and creating monitoring infrastructure within the following format:

- **Regulatory Instruments**

Drafting Regulations and Compliance:

- Control of Mobile Source Emissions (new and circulating vehicles)
- Improvements in Mobile Source Technologies
- Control of Fixed Source Emissions (inspections of industry)
- Improvements in Fuel Quality for Industry and Transportation
- Air Quality Monitoring Infrastructure

- **Non Regulatory Instruments**

- Voluntary and Environmental Audits

2.3.1 Drafting Regulations

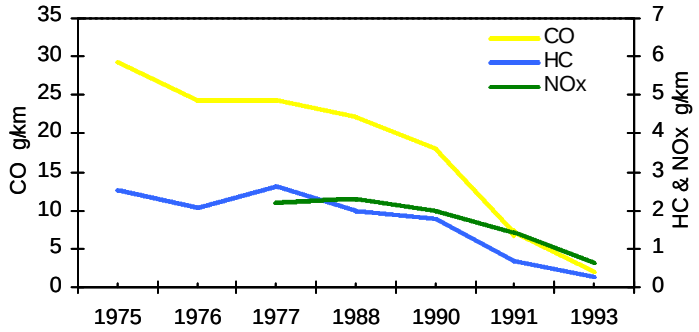
The creation and drafting of standards as an environmental indicator has been internationally polemic. Opponents argue that simply creating a standard does not supply enough information to quantify the standard's impact towards solving the problem. Meanwhile, proponents defend the effort as a substantive action. Despite the debate, the creation and implementation of standards are important mechanisms since they dictate the practical aspects of environmental management policies.

Air quality standards have been established for the following areas:

- Mobile source verification,
- Maximum permissible limits for mobile source emissions,
- Vapor recovery systems for gas stations,
- Fuel specifications,
- Pollution measurement methods,

The reader should note that the specific actions listed as response indicators are defined in the aforementioned order.

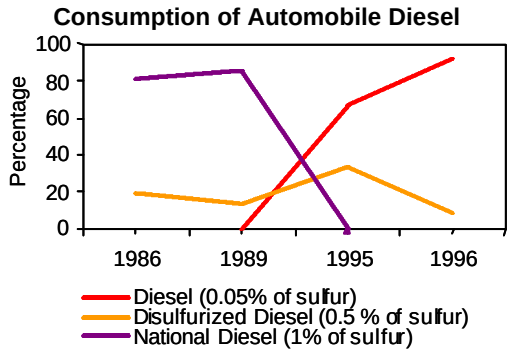
2.3.2. Historical Evolution of Maximum Permissible Limits for Automobile Emissions from New Vehicles in Mexico

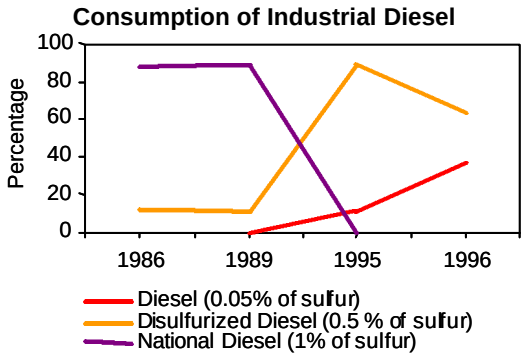


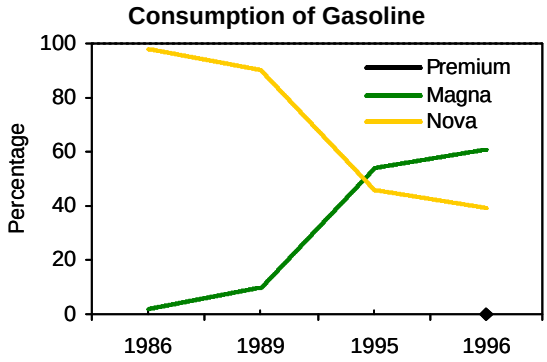
Source: COMETRAVI, 1997. Definición de Políticas de Modernización, Inspección, Eliminación Definitiva, Adaptación Vehicular y Combustibles Alternos. Mexico.

2.3.3. Nationwide Changes from Improved Fuel Consumption

Fuel quality standards have been improved under the Mexican Official Standard, NOM-086-ECOL-1994.



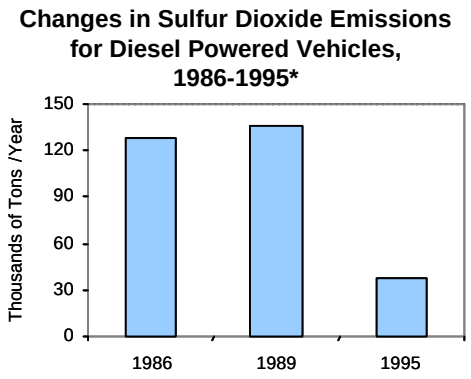


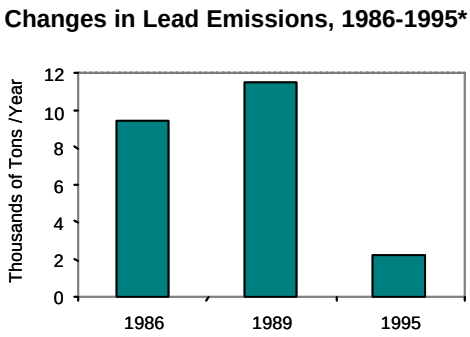


Source: PEMEX, 1996. Calidad de combustibles y proyectos especiales, PEMEX, Refinación, Pages 9 and 15.

2.3.4.Nationwide Changes in Emissions due to Improved Fuel Consumption

The reduction in lead and sulfur emissions are derived from fuel quality improvements. This is reflected in the reduction of concentrations of such pollutants as demonstrated in the state indicators. Such changes in fuel quality standards, accompanied with increased consumption of the new fuels, have produced a reduction in lead emissions by 81%, while sulfur dioxide emissions have been reduced by 71% due to diesel consumption.[1]



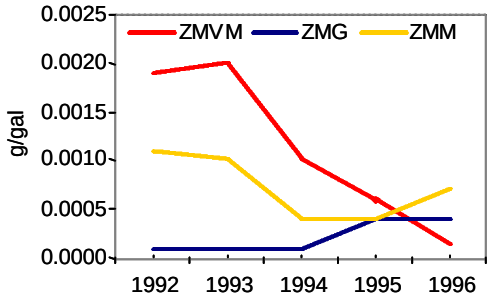


Source: PEMEX, 1996. Calidad de combustibles y proyectos especiales, PEMEX, Refinación, Pages 11 and 17.

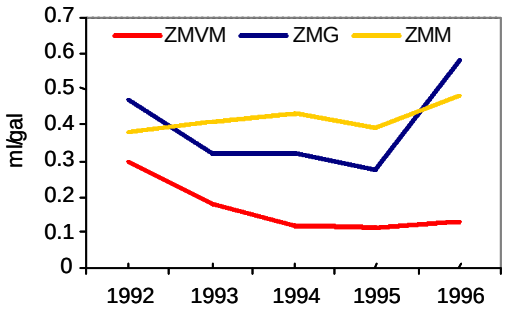
[1] Pemex, Refinación, 1996. Calidad de combustibles y proyectos especiales.

2.3.5. Improved Fuel Consumption for Metropolitan Areas

Maximum Levels of Lead in Unleaded Gasoline



Content of Tetraethyl Lead in Gasoline

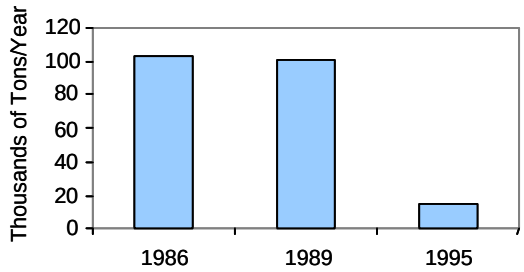


Source: PEMEX, Refinación, 1996.

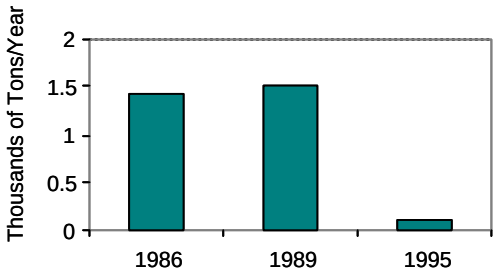
2.3.6. Changes in Emissions from Improved Fuel Consumption in Mexico City (ZMVM)

In the Mexico City Metropolitan Area, fuel improvements have reduced lead and sulfur dioxide emissions by 92% and 85%, respectively.

Changes in Sulfur Dioxide Emission, 1986-1995



Changes in Lead Emission, 1986-1995

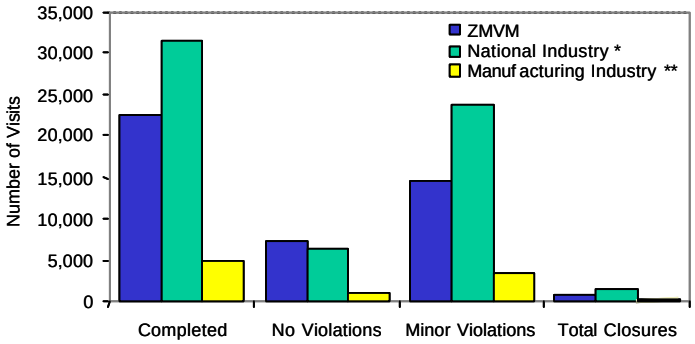


Source: PEMEX, 1996. Calidad de combustibles y proyectos especiales, PEMEX, Refinación, Pages 11 and 17.

2.3.7. Compliance of Standards for Fixed Sources

Mexican environmental authorities inspect industry with the objective of overseeing the adequate compliance of the established legal requirements.

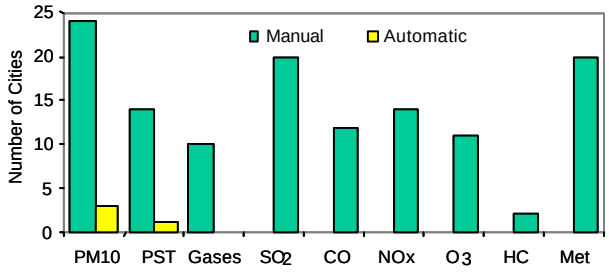
Results from Industrial(1) Inspections (August 1992 - December 1996)



*: Industries located outside the Mexico City Metropolitan Area (ZMVM).**:Located principally in Mexico's northern border region.
(1) Only in reference to air and hazardous waste pollution.
Source: Subprocuraduría de Verificación Industrial, Dirección General de Asistencia Técnica Industrial, PROFEPA, SEMARNAP (http://www.semarnap.gob.mx/profepa)

2.3.8. Air Quality Monitoring Stations

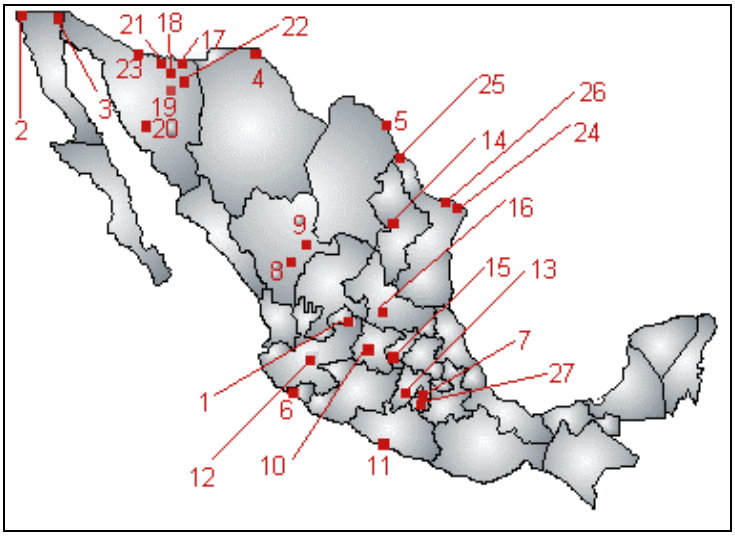
Air Quality Monitoring Infrastructure by Pollutant Type, 1997



Met: Meteorological Variables
Source: INE, SEMARNAP, 1997. Dirección de Gestión e Información Ambiental.

Air quality monitoring stations are managed by different institutions as shown in the map. Since the information generated by each administration is not in a central database, the INE has signed collaborative agreements with these institutions in order promote an integrated effort to analyze the information.

Urban Centers with Operational Monitoring Stations



1. Aguascalientes (E)
2. Tijuana(S)
3. Mexicali (S)
4. Cd. Juárez (M)
5. Piedras Negras (E-M)
6. Manzanillo (E-CFE)
7. ZMVM (DDF)
8. Durango (E-M)
9. Gómez Palacio (E-M)
10. Silao (GM)
11. Petacalco (CFE)
12. ZMG (COESE)
13. Toluca (E-S)
14. ZMM (E-S)
15. Querétaro (S)
16. San Luis Potosí (I-S)
17. Agua Prieta (Min-S)
18. Cananea (Min-S)
19. Cumpas (Molimex)
20. Hermosillo (S)
21. Naco (S-M)
22. Nacozari (Min-S)
23. Nogales (S-E)
24. Matamoros (E-M)
25. Nuevo Laredo (E-M)
26. Reynosa (E-M)
27. Cuernavaca (S-E)

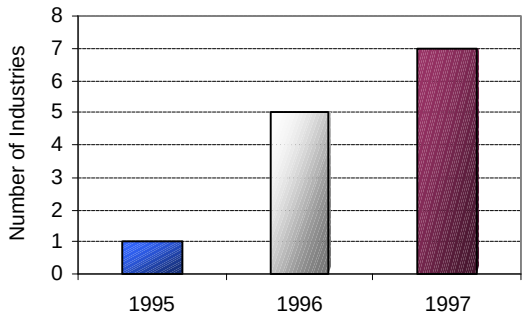
Note: S: Ministry of Environment, Natural Resources and Fisheries, E: State Government, M: Municipal Government, DDF: Department of the Federal District, CFE: Federal Electricity Commission, COESE: State Ecology Commission, Min: Mining Companies, Molimex: Molibdeno de México, GM: General Motors, I: Industrial Minera México.
Source: INE, SEMARNAP, 1997. Dirección de Gestión e Información Ambiental.

2.3.9. Voluntary Audits

The General Law of Ecological Equilibrium and Environmental Protection (LGEEPA) defines the voluntary audit as a process in which businesses improve their internal environmental performance standards both respecting the legal minimum requirements and in addition the violation of these standards. This mechanism is achieved through coordination between industry and environmental authorities to define compliance actions, as well as the installation of combustion control and maintenance equipment, etc.

As part of this policy, Mexico City (ZMVM) is applying the "Self Regulatory Audit Program", which functions in conjunction with current efforts to improve air quality contingency standards. The objective of this program is to issue non-voluntary standards that establish NOx and VOC emission limits which are more strict than obligatory standards.

Environmental Self Regulatory Agreements (Accumulated Total)



Source: INE, SEMARNAP, 1997. Coordinación Sector Industria.

3. HAZARDOUS WASTE

The growth of Mexico's industrial sector has been combined with an increase in the amount of generated hazardous waste. At the same time, it is acknowledged that such levels of generated waste have been accumulating without the proper treatment and disposal infrastructure.

Environmental policymakers are aware that they must implement diverse development strategies to avoid such hazards since this situation endangers both human health and safety, as well as provokes potential dangers to Mexico's ecosystems.

In Mexico, a list of hazardous substances has been established under the Official Mexican Standard, NOM-052-ECOL/1993. However, a large volume of hazardous waste is disposed of clandestinely in both landfills and municipal drainage systems, abandoned cliffs and bodies of water. This trend has provoked serious risks to the public's health and to the nation's natural resources. The issue becomes even more complex if we consider that 90% of the hazardous waste is in a liquid or semi-liquid form and easily passes through the food chain once mixed with surface and subsurface bodies of water. Hazardous waste can also be airborne and humanly ingested from inhalation or by being absorbed through the skin's pores. Finally, the transportation of hazardous waste can create a potential risk due to accidents in which dangerous chemical substances may be involved (SEMARNAP, 1996).

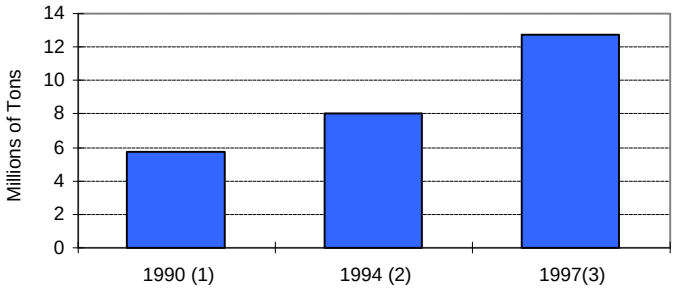
It should be noted that Mexican federal environmental legislation prohibits the importation of hazardous waste for final disposal or storage in Mexico.

In the first part of the chapter, pressure indicators include the estimates of generated hazardous waste at the national and regional levels. In the second part, within the state indicators, the relationship between generated waste and adequate management, as well as the potential risk priorities, are examined. Finally, the response indicators are the actions taken by environmental authorities and the civil society in response to the problem, which includes the installed capacity of the waste management, the sites currently under restoration and the amount of repatriated waste to the United States by the maquiladora industry.

3.1. PRESSURE

3.1.1. Hazardous Waste Generation Nationwide

Total Waste

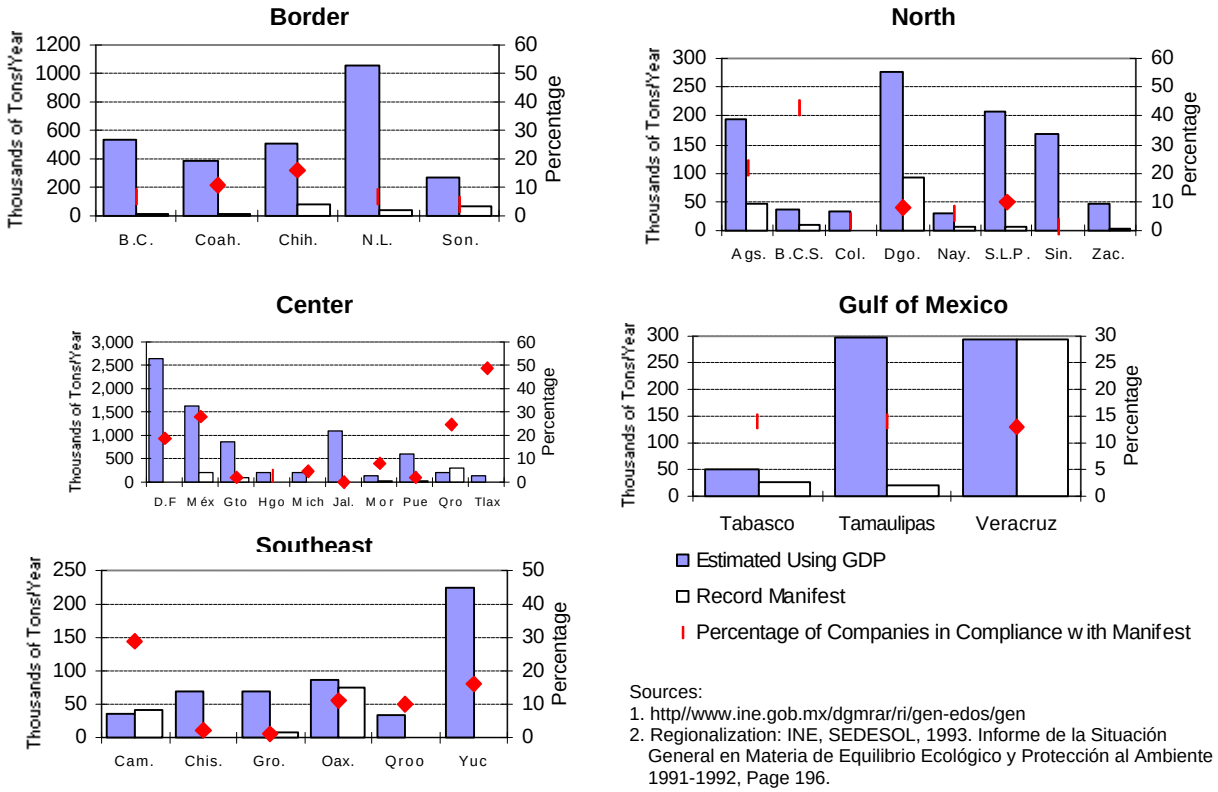


Sources:
1. INE, SEDESOL, 1993. Serie de Monografías No. 3, Residuos Peligrosos en el Mundo y en México, Page 118.
2. INE, SEMARNAP, 1996. Programa para la Minimización y Manejo Integral de Residuos Industriales Peligrosos en México 1996-2000, Page 44.
3. INE, SEMARNAP,1997. Dirección General de Residuos, Materiales y Actividades Riesgosas (Estimated in accordance with Gross National Product), (www.ine.gob.mx/dgmrar/ri/grg-giro/sld001.htm).

3.1.2. Regional Hazardous Waste Generation

At this time, there is no complete inventory illustrating the amount of generated hazardous waste in Mexico. Yet inventory estimates have been made based on some pilot studies and the Gross Domestic Product (GDP) associated with the manufacturing industry (dark column). Additionally, the level of generated waste has been calculated in accordance with the number of businesses presenting a hazardous waste manifest (clear column). The notable difference between both estimates in the graph is also correlated with the number of companies in Mexico that comply with the requirements stipulated in the manifest (red rhombus).

Estimated Hazardous Waste Levels and Compliance Statistics from the Presentation of Environmental Manifests by Region



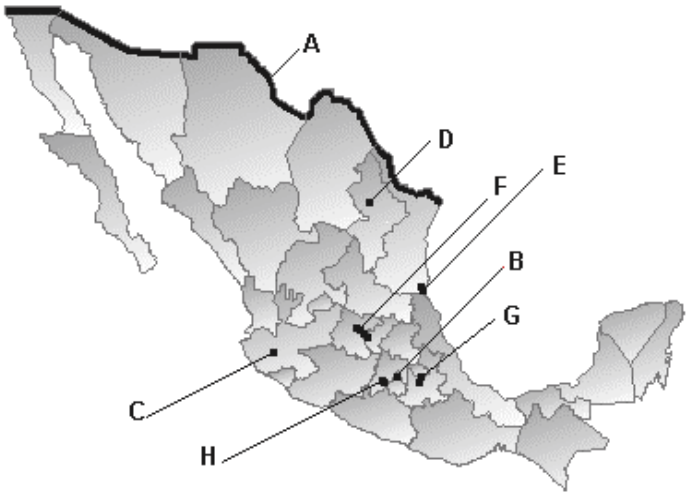
Sources:
1. http//www.ine.gob.mx/dgmrar/ri/gen-edos/gen
2. Regionalization: INE, SEDESOL, 1993. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente 1991-1992, Page 196.

3.2. STATE

3.2.1. Prioritized Regions Requiring Increased Hazardous Waste Management

The number of prioritized regions in Mexico that require increased hazardous waste management was defined in relation to the region's industrial infrastructure base, waste type and vulnerability. High priorities include Mexico City (ZMVM) and the Lerma-Toluca, Querétaro-León and Gulf of Mexico industrial zones. In addition, Monterrey (ZMM), which has a large amount of industry, and Guadalajara (ZMG), with its high population density, are also considered priorities. The border region is considered a priority in accordance with international agreements and rapid growth rates associated with the area's export manufacturing sector and recent population increases.

Regional Priorities



A. Northern Border
B. ZMVM
C. ZMG
D. ZMM
E. Gulf of Mexico
F. Querétaro-León
G. Puebla-Tlaxcala
H. Lerma-Toluca

Source: INE, SEMARNAP, 1996. Programa para la Minimización y Manejo Integral de Residuos Industriales Peligrosos en México 1996-2000, Page 125.

3.2.2. Prioritized Urban Areas Due to Geohydrological Vulnerability

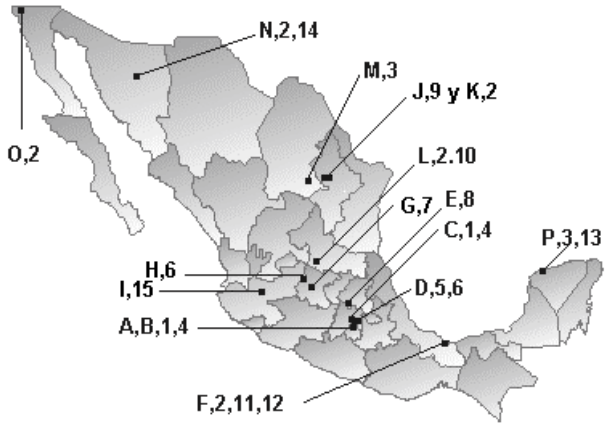
Many companies have disposed of their waste in municipal collection or disposal systems where geohydrological vulnerability present environmental risk conditions.

Due to this phenomenon, the following urban areas are considered "vulnerable" and therefore require increased measures in order to lower potential risk factors:

- Celaya, Aguascalientes, Irapuato, León, Salamanca and Silao.
- Colima and Lázaro Cárdenas.
- Guadalajara, Tlaquepaque, Tonalá, Zapopan, Morelia and Zitácuaro.
- Cuernavaca, Toluca, Puebla, San Juan del Río and Querétaro.
- Metropolitan Area of México City.
- Mérida and Campeche.
- Tapachula , Villahermosa, Coatzacoalcos, Poza Rica and Veracruz.
- Chihuahua, Monclova, Torreón, Ciudad Juárez, Gómez Palacio and Monterrey.
- Delicias and Hermosillo.
- Mexicali, Piedras Negras, Nogales, San Luis Río Colorado and Nuevo Laredo.

3.2.3. Areas Affected by Improper Hazardous Waste Disposal

The disposal of hazardous waste without any form of control presents significant risks to the general population, as well as increases the possibility of aquifer contamination. In fact, many of these sites are located near population centers or transportation routes. In this indicator, the number of sites which may present severe contamination due to inadequate hazardous waste management has been identified to prioritize future remediation efforts.



Source: INE, SEMARNAP, 1996. Programa para la Minimización y Manejo Integral de Residuos Industriales Peligrosos en México 1996-2000, Page. 59.

Location	
Municipality or Delegation	**State Level**
A. Miguel Hidalgo	Federal District
B. Azcapotzalco	Federal District
C. Ecatepec	State of Mexico
D. Tultitlán	State of Mexico
E. Tula	Hidalgo
F. Coatzacoalcos	Veracruz
G. Salamanca	Guanajuato
H. San Francisco del Rincón	Guanajuato
I. Guadalajara	Jalisco
J. Santa Catarina	Nuevo León
K. Monterrey	Nuevo León
L. San Luis Potosí	San Luis Potosí
M. Saltillo	Coahuila
N. Cumobabi	Sonora
O. Tijuana	Baja California
P. Progreso	Yucatán

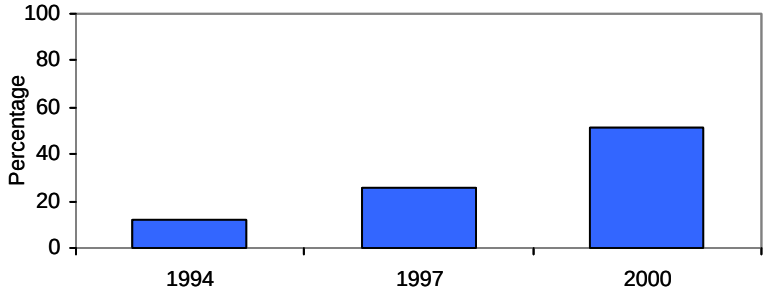
Type of Pollutant		
1. Hydrocarbons, Heavy Metals and PCB's	2. Lead	3. Diesel
4. Solvents	5. Phosphoric Acid, Hexametaphosphate, Tripoliphosphate, Sodium Carbonate	6. Chrome
7. Agrochemical and Contaminated Agricultural Sulfur	8. Used Catalysts	9. Combustible Fuels
10. Arsenic	11. Liquid Sulfur, Oils, Solvents and Sludge with Chrome	12. Phosphorous Chalk
13. Gasoline	14. Cadmium	15. Hydrocarbons

3. 3. RESPONSE

3.3.1. Estimates of Adequately Managed Hazardous Waste

Presently there exists an installed capacity for potential management of 26% of Mexico's hazardous waste total. No complete information exists concerning how much of the installed capacity is being utilized (SEMARNAP, 1997).

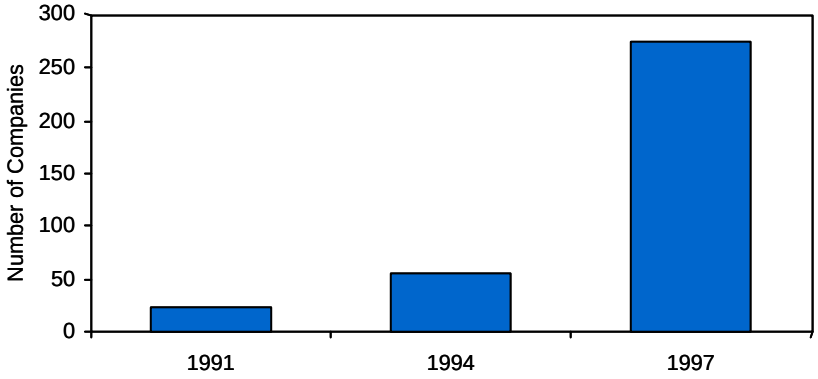
Current Situation and Management Projections for Hazardous Waste in Mexico.



Sources:
1994: INE, SEMARNAP, 1996. Programa para el Manejo Integral y el Aprovechamiento de los Residuos Industriales en la Región Central de México. 1996a.
1997: INE, SEMARNAP, 1996. Programa para la Minimización y Manejo Integral de Residuos Industriales Peligrosos en México 1996-2000, Page 103.

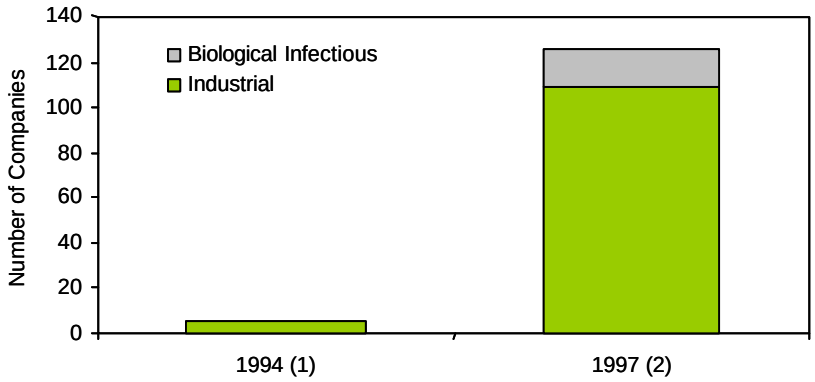
3.3.2. Hazardous Waste Management Infrastructure

Number of Hazardous Waste Management Service Providers.



Sources:
1991: INE, SEDESOL, 1993. Informe de la Situación General en Materia del Equilibrio Ecológico y la Protección al Ambiente 1991-1992, Pages 204-205.
1994: INE, SEDESOL, 1994. Bases para una Política Nacional de Residuos Peligrosos, Page 10
1997: Updated to November, 1997. Internet: http://www.ine.gob.mx/dgmrar/ri/list-ea

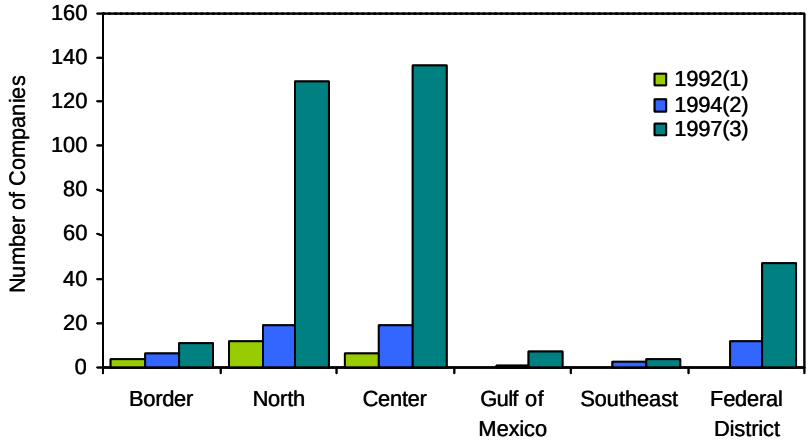
Number of National Service Providers for Hazardous Waste Transportation



Note: It should be noted that in 1994, the 70 authorized transportation companies by the Ministry of Communications and Transportation (SCT) lacked the corresponding authorization from the National Institute of Ecology (INE) and thus operated outside of official standards dumping their waste over cliffs and vacant lots.

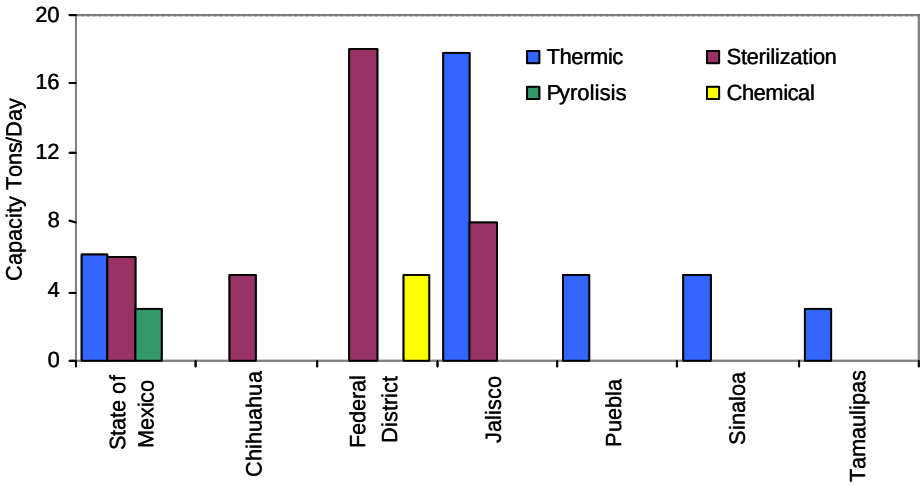
Sources:
(1): INE, SEDESOL, 1994. Bases para una Política Nacional de Residuos Peligrosos, Pages 8-12. Informe de la Situación General en Materia del Equilibrio Ecológico y la Protección al Ambiente 1991-1992, Pages 204-205.
(2): Updated to November, 1997. Internet:http://www.ine.gob.mx/gmrar/ri/list-ea

Number of Hazardous Waste Service Providers by Region



Sources:
(1): INE, SEDESOL, 1993. Informe de la Situación General en Materia del Equilibrio Ecológico y la Protección al Ambiente. 1991-1992, Pages 204-205.
(2): INE, SEDESOL, 1994.Bases para una Política Nacional de Residuos Peligrosos, Page 10.
(3): Updated to November, 1997. Internet: http://www.ine.gob.mx/dgmrar/ri/list-ea.

Biological Infectious Waste Management Capacity by State

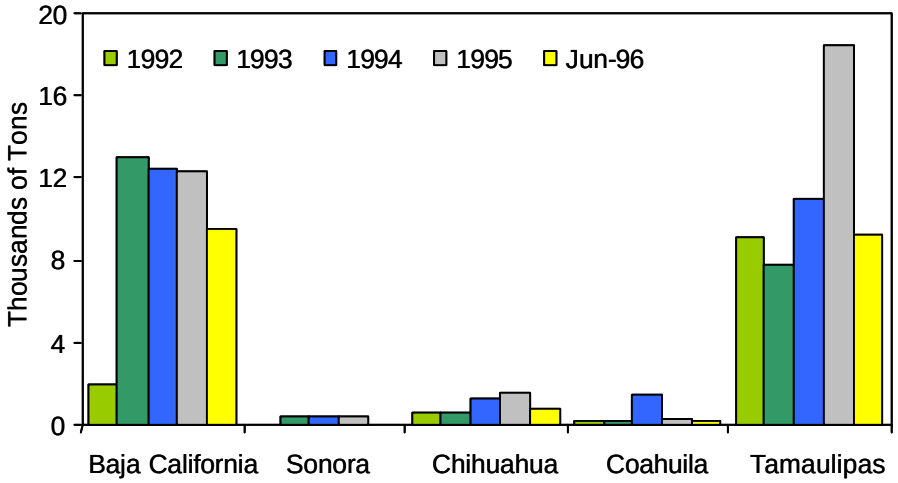


Source: INE. SEMARNAP.1997. Dirección General de Residuos, Materiales y Actividades Riesgosas.

3.3.3. Regulation of Hazardous Waste Transborder Shipments

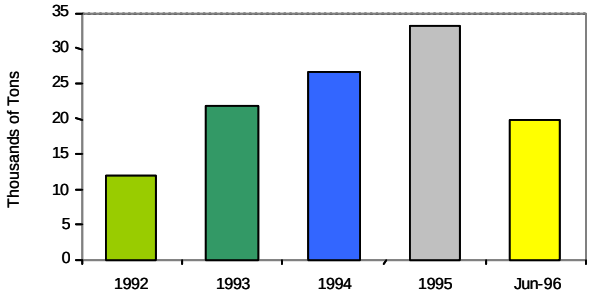
For several years, the legal and illegal management of hazardous waste along the U.S.-Mexican border has caused public concern. As a result both countries have sponsored programs containing consulting and oversight measures that have increased transborder reporting for hazardous waste (SEDESOL, 1993a).

Repatriated Hazardous Waste to the United States from the Maquiladora Industry by State



Source: INE, SEMARNAP, 1996. Programa para la Minimización y el Manejo Integral de Residuos Industriales Peligrosos, 1996-2000, Page 83.

Repatriated Hazardous Waste to the United States from the National Maquiladora Industry



Source: INE, SEMARNAP, 1996. Programa para la Minimización y el Manejo Integral de Residuos Industriales Peligrosos, 1996-2000, Page 83.

3.3.4. Site Remediation

The following are examples of mismanaged disposal sites detected during official inspections, which have been prioritized for remediation.

Contaminated Sites in the Process of Remediation after Completed Inspections (1994 and 1996)

Source: INE, SEMARNAP, 1996. Programa para la Minimización y el Manejo Integral de Residuos Industriales Peligrosos, 1996-2000, Page 83.

1. **México-Pachuca Highway, Hidalgo** (km 30) - Lead waste originating from automobile batteries was discovered (19,000 tons).
2. **Chimalhuacán Municipality, State of Mexico** - Asbestos waste was discovered (672 tons).
3. **Huixquilucan Municipality, State of Mexico** - Various types of pharmaceutical waste were found (13 tons).
4. **Atotonilco Municipality, State of Hidalgo** - Lead waste originating from automobile batteries was discovered (474 tons).
5. **Acolman Municipality, State of Mexico** - Solvents and wastewater treatment sludge originating from paint manufacturing were discovered in 16 brick foundry facilities (9,639 tons).
6. **Iztapalapa Delegation, D.F** - Expired and inadequately stored pesticides were discovered at a warehouse (111 tons).

4. MUNICIPAL SOLID WASTE

One of the environmental problems that has been called to the public's attention is the generation, management and final disposal of municipal solid waste. Municipal solid waste is classified as non-organic and/or organic waste which originates from domestic sources, public and private services, demolition and construction sites and commercial establishments. Municipal solid waste is usually not considered as a reusable resource or a potentially positive form of economic income and instead is simply deposited in the local open-air landfill. Yet at the same time, increases in generated levels surpass current management capacities in Mexico thereby creating a human health hazard and endangering the nation's ecosystems. In this light, Mexico acknowledges the fact that this problem must be addressed appropriately and efficiently.

The problems facing solid waste management have increased in Mexico due primarily to the economic and social transformation of an agrarian society, operating until the 1970´s, to now become a predominately urban-industrial society. Additionally, the health problems associated with the improper management capabilities are becoming acute as Mexican urban centers become increasingly populated.

National generated levels of solid waste in Mexico reach 88,676 tons/day. Demographic analysis shows, population's with less than 100,000 inhabitants constitute 46% of the nation's population centers and generate 43% of Mexico's total solid waste. Meanwhile, populations with more than 100,000 inhabitants generate 57% of Mexico's total solid waste. (INE, 1997)

On the other hand, it is estimated that in 1995, *per capita* generated levels of solid waste averaged 0.899 kg/day, which in recent years has begun to saturate landfills with mostly organic waste and a smaller percentage of non-organic waste. (INE, 1995)

In the first part of this chapter, pressure indicators are presented, which include the volumes of generated municipal solid waste at the national and regional levels.

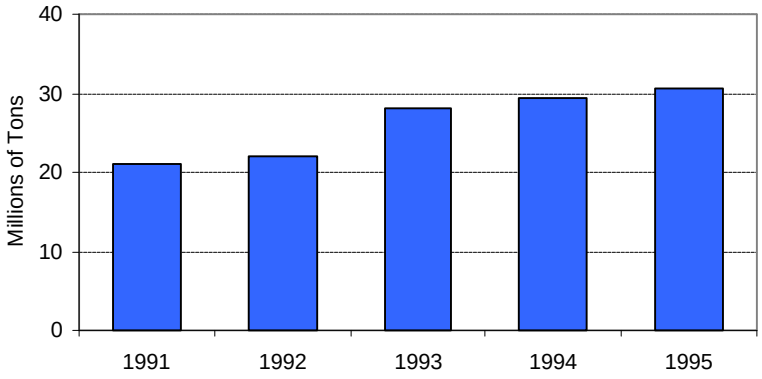
In what is referred to as state indicators, generated solid waste statistics are placed in the context of the amounts of adequately managed waste; this ultimately suggests that the solid waste disposal infrastructure capacity is insufficient. Finally, the response indicators present the current installed disposal infrastructure capacity in Mexico and other treatment efforts such as reuse and recycling.

4.1. PRESSURE

4.1.1. Generation of Solid Waste Nationwide

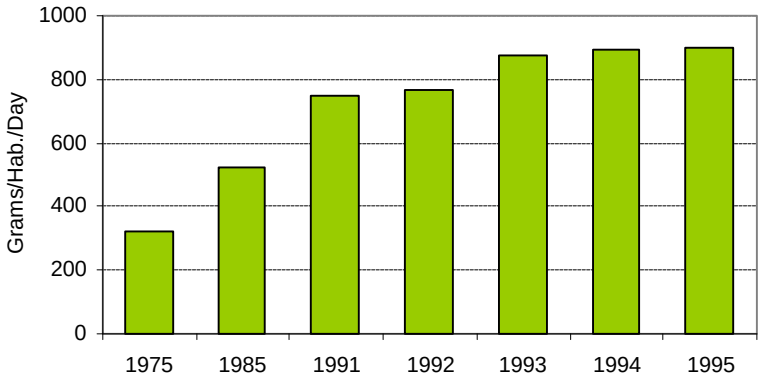
Since there has been an increase in the per capita generation of municipal solid waste and population's size nationwide, Mexico faces challenges concerning solid waste management and treatment and must create mechanisms to meet growing demands.

Total Waste Generation



Sources:
1991 and1992: INE, SEDESOL, 1993. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1991 and 1992, Page 185, Mexico.
1993 and 1994: INE, SEDESOL, 1994. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1993-1994, Page 238, Mexico.
1995: INE, SEMARNAP. Dirección General de Residuos, Materiales y Actividades Riesgosas.

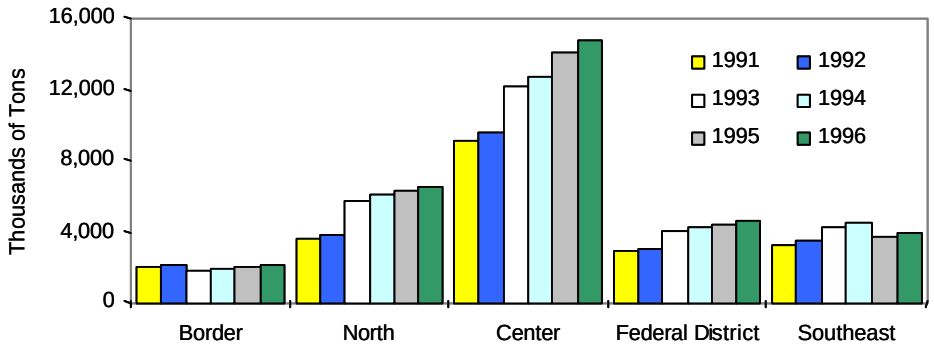
Per Capita Solid Waste Generation



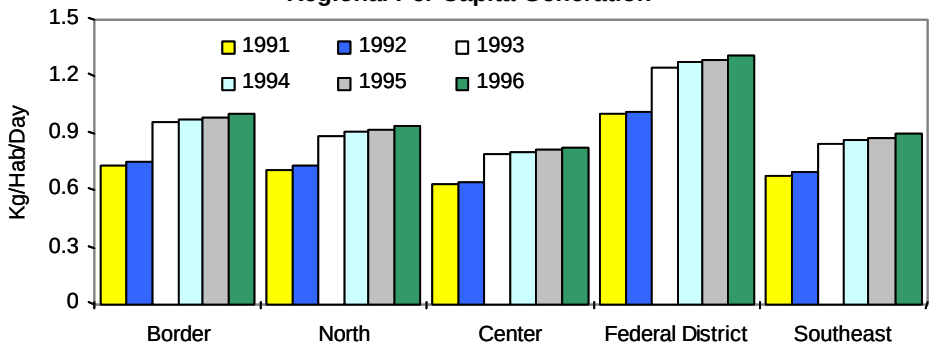
Sources:
1975 and 1985: SEDUE, 1986. Informe sobre el Estado del Medio Ambiente, Page 48, Mexico.
1991 and 1992: INE, SEDESOL, 1993. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1991 and 1992, Page 185, Mexico.
1993 and 1994: INE, SEDESOL, 1994. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1993-1994, Page 238, Mexico.
1995 and 1996: INE, SEMARNAP, 1996. Dirección General de Residuos, Materiales y Actividades Riesgosas.

4.1.2.Regional Generation of Solid Waste

Regional Generation



Regional Per Capita Generation



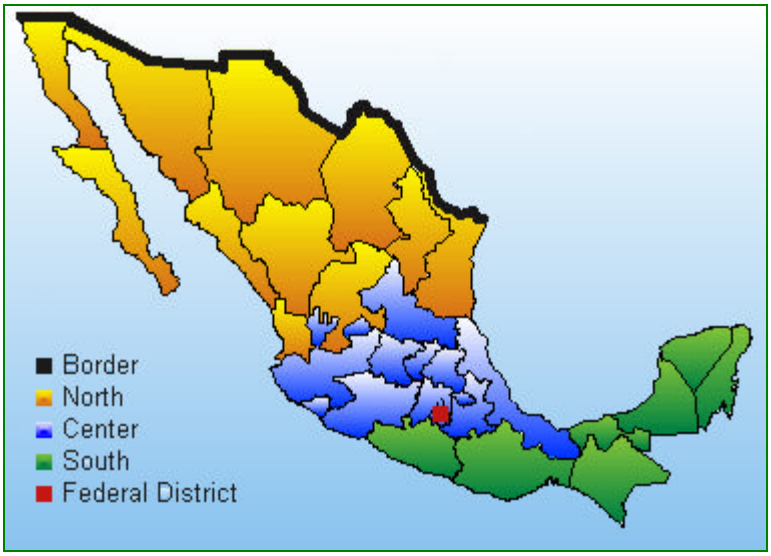
Sources:

1991 and 1992: INE, SEDESOL, 1993. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1991 and 1992, Page. 185, Mexico.

1993 and 1994: INE, SEDESOL, 1994. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1993-1994. Page. 238, Mexico.

1995 and 1996: INE, SEMARNAP, 1996. Dirección General de Residuos, Materiales y Actividades Riesgosas.

Regionalization

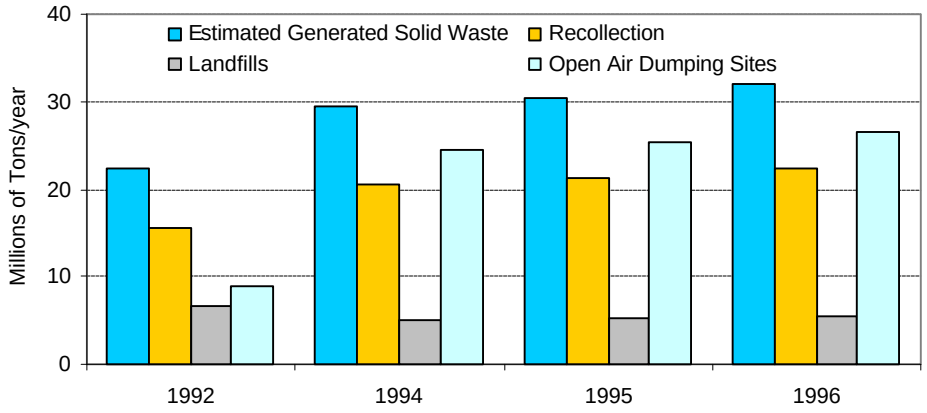


4.2. STATE

4.2.1. Generated Waste Relative to Properly Managed Waste

Since 1992, generated levels of municipal solid waste and collection efforts have increased, while solid waste disposal infrastructure has remained constant. This in turn has created human health problems since a portion of the total generated waste has been disposed of in open-air landfills.

Management and Final Disposal Status of Municipal Solid Waste



Sources:

1992: INE, SEDESOL, 1993. Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1991-1992, Page 186.

1994: INE, SEDESOL, 1994: Informe de la Situación General en Materia de Equilibrio Ecológico y Protección al Ambiente, 1993-1994, Page 238.

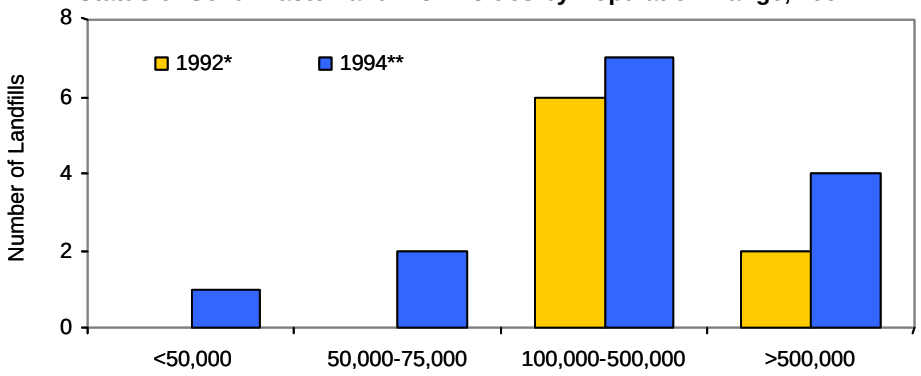
1995 and 1996: INE, SEMARNAP, 1996. Dirección General de Residuos, Materiales y Actividades Riesgosas.

4.3. RESPONSE

4.3.1. Current Infrastructure Capacity for Solid Waste Disposal

Despite the amount of landfills have increased from 8 in 1992 to 14 in 1994, it is clear that the number is insufficient if we consider that 77 cities have between 100,000 and 500,000 inhabitants and 21 cities have more than 500,000 (INEGI, 1995). On the other hand, besides the facilities presented in the graph, there are 90 others in 1992 that did not meet the all the necessary requirements of the Ministry of Social Development (SEDESOL). Additionally, in 1994, 4 solid waste disposal facilities, which were under construction at the time of the information's publication, are not included in the graph.

Status of Solid Waste Landfills in Cities by Population Range, 1994



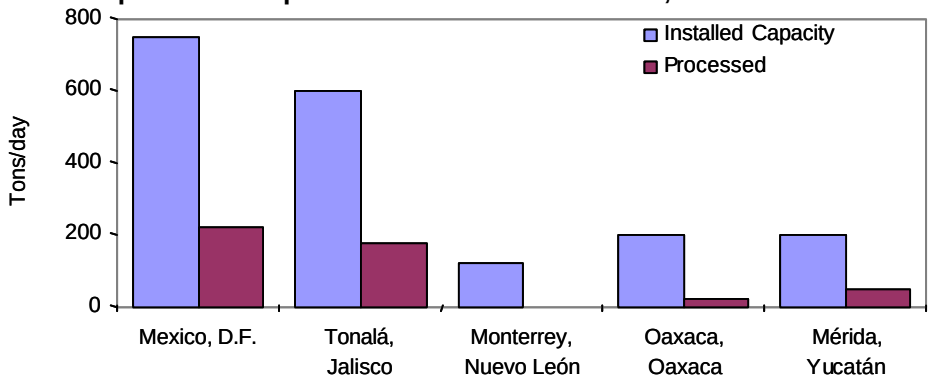
* Catalogued as landfill by PRONASOL, 1992.
**In operation.

Source: 1992: INE, SEDESOL, 1993. Informe de la Situación General en Materia de Equilibrio Ecológico y la Protección al Ambiente, 1991-1992, Page 187.
1994: INE, SEDESOL, 1994. Informe de la Situación General en Materia de Equilibrio Ecológico y la Protección al Ambiente, 1993-1994, Page 239.

4.3.2 Current Infrastructure Capacity for Solid Waste Treatment

One of the options for waste management is provided by treatment plants. Treatment plants have for the most part begun operating in the large urban zones such as Mexico City.

Specific Metropolitan Area Treatment Plants, 1992

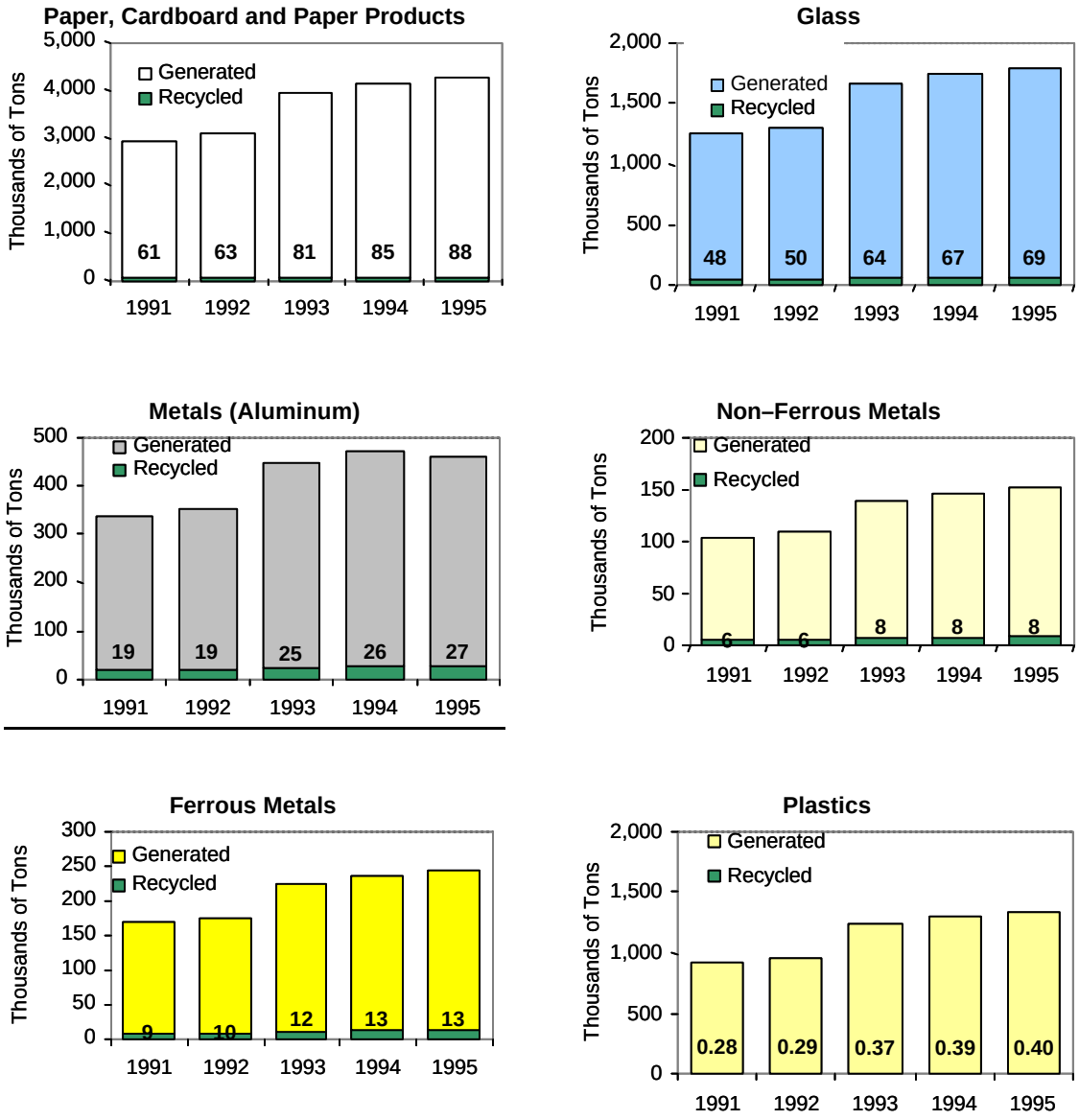


Note: The Nuevo Leon plant was not functioning in 1992 due to fire.
Source: INE, SEDESOL, 1993. Informe de la Situación General del Equilibrio Ecológico y la Protección al Ambiente 1991-1992, Page.188.

4.3.3. Recycling

Presently only 2 to 5% of the generated waste is recycled by garbage collectors. It should be noted that municipal governments do not economically benefit from this practice.

Nationwide Recycling Efforts by Substance 1991-1995



Source: INE, SEDESOL, 1994. Informe de la Situación en Materia del Equilibrio y la Protección al Ambiente. 1993-1994, Page 240.

5. WILDLIFE AND NATURAL RESERVES

The Pressure-State-Response (PSR) model applied to biodiversity issues is particularly complex since one ecosystem alone may contain many components, all of which directly or indirectly depend on one another to sustain the ecosystem. More importantly, in countries like Mexico, where a variety of environments and species can be found, it is even harder to describe such a dynamic problem using relatively simplistic modeling. Explained below are several points to illustrate this problem;

- The PSR model is based on the assumption that simple and definite causal relationships can be defined concerning a single problem. However when addressing topics such as biodiversity, the causal chains become complex with numerous forces which can act or impact this area in ways we are just beginning to learn about.
- The existence of this interdependent phenomena requires that all relevant information must contain a combination of various indicators and not only one indicator or mathematical formula.
- Due to the difficulties presented in explaining the impacts to biodiversity, it should be made clear that the PSR model refers more so to a system of organization for taxonomic information and not necessarily to illustrate a cause-effect relationship.
- In the areas of biodiversity, the living universe is so diverse that topical information gaps are widespread (Winograd, 1996)

For these reasons, the PSR model is used in this section as a means of organizing information more than as a diagnostic model.

The principal causes of wildlife pressure, among others, are habitat destruction and fragmentation, overexploitation of species, the introduction of exotic species, the impact of noxious chemical substances and the use of inadequate technologies in soil fertilization, plant fumigation, urban development projects, fires and floods, etc. Currently, there is no system to record the impact of all of these factors and the pressure indicators in this section only describe changes in land use that create habitat alteration and non regulated or illegal practices such as the introduction of exotic species.

The state indicators are represented by two fundamental aspects ecosystems, which is represented by current vegetation and land use coverage on and species, by the number status of groups and endemic species.

Response indicators address the regulatory actions as well as the established efforts in wildlife and natural reserve protection and conservation.

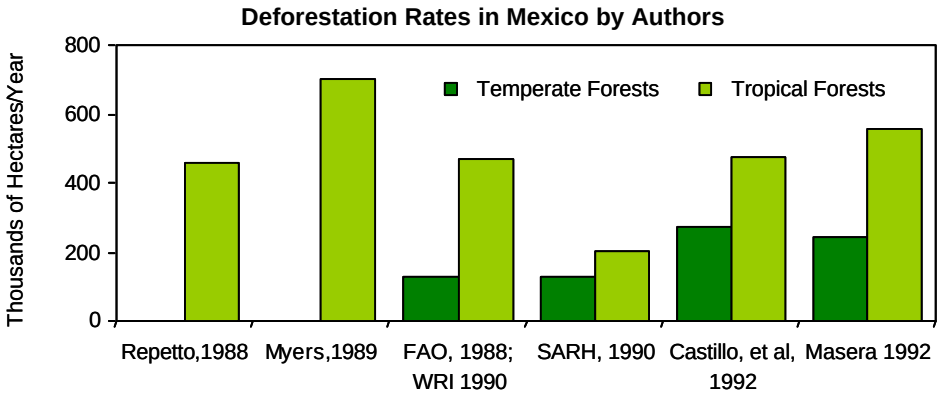
5.1. PRESSURE

5.1.1. Changes in Land Use Causing Habitat Alteration

Changes in Land Use by Forest Type

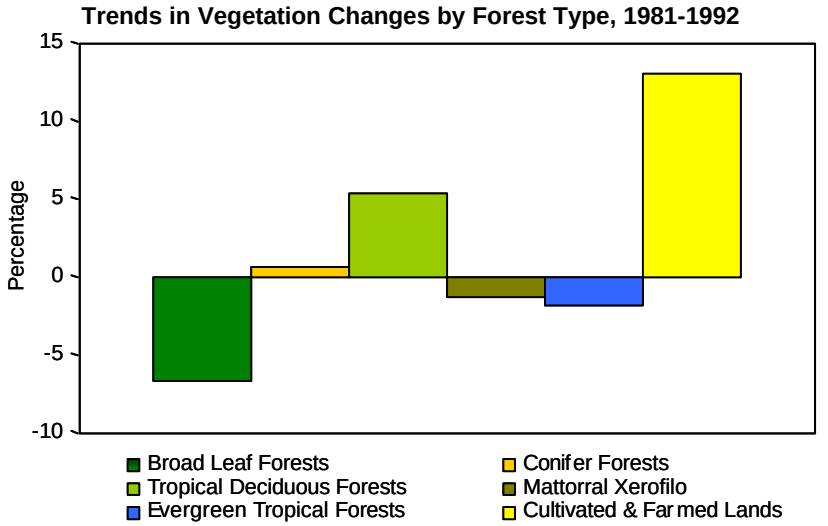
One of the principal pressure indicators refers to wildlife habitat destruction, an activity which is primarily associated with agricultural and urban development. Habitat destruction normally implies a fragmentation of the ecosystem and may include other debilitating characteristics such as erosion, among others.

Deforestation rates represent the velocity at which natural vegetation is being lost. In Mexico, no consensus exists concerning the exact magnitude of the destruction yet most experts agree the tropical forests suffer the most from this phenomena.

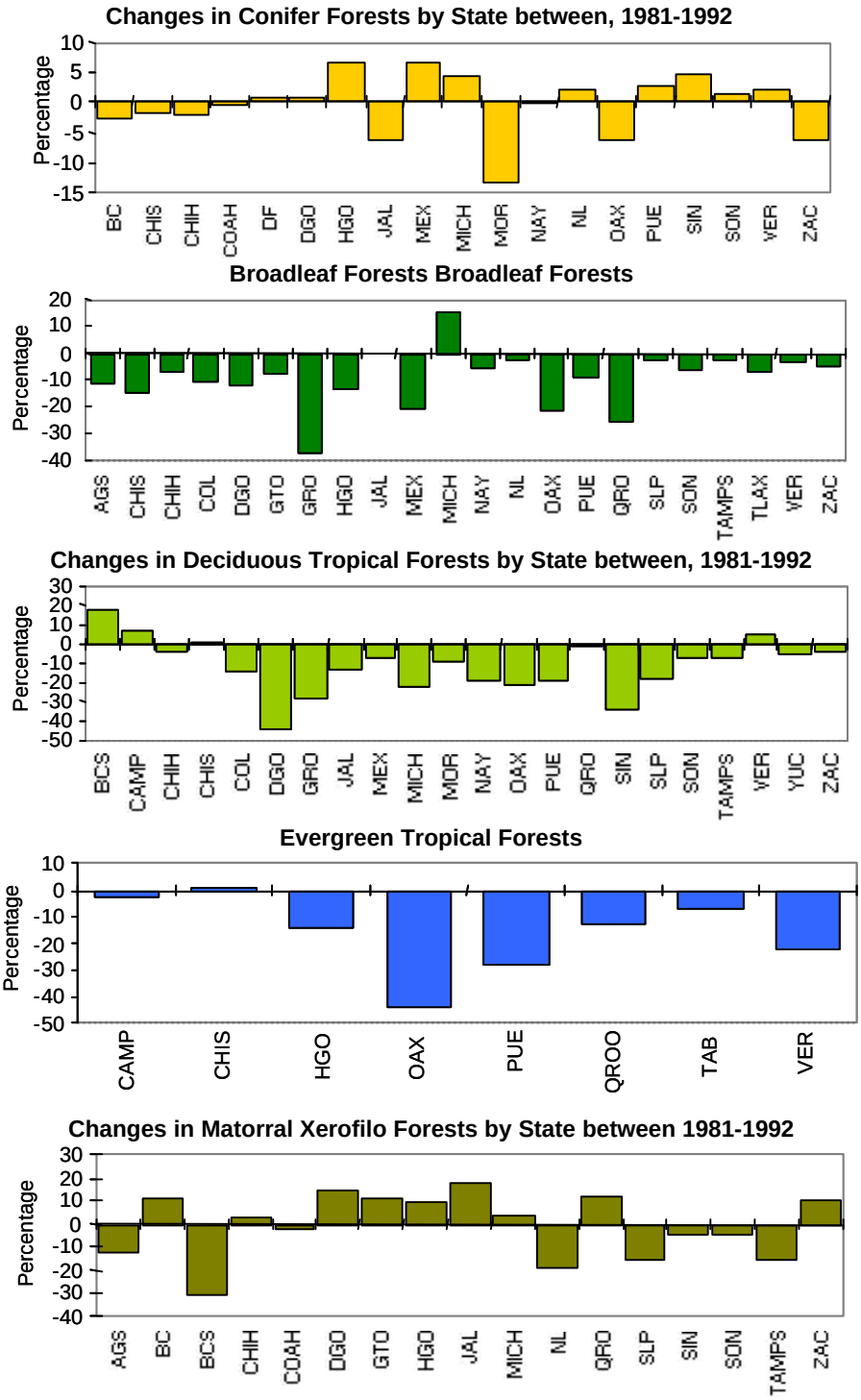


Source: INE, SEMARNAP; PNUMA & USCSP, 1995. *Preliminary National Inventory of Greenhouse Gas: México,* Page 85.

According to Masera (1992), the annual deforested surface area for tropical evergreen forests is 237,000 hectares, 322,000 hectares for deciduous forests, 163,000 for conifer forests and 82,000 for broadleaf forests.



Source: Selected from Flores, O and P. Geréz, 1994. Biodiversidad y Conservación en México: Vertebrados, Vegetación y Usos del Suelo, Page 88.

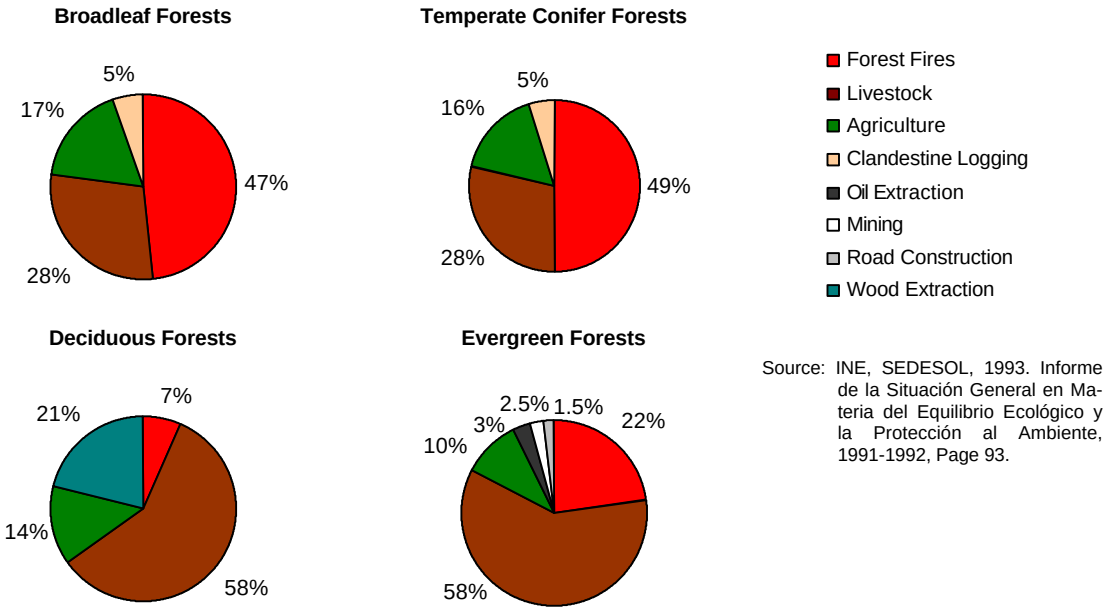


Source: Selected citations from Op. Cit, Pages 94, 99,104, 110, 115, 122, 127, 132, 137, 141, 147, 151,157,162,168, 174, 180, 185,190,195, 201, 207, 212, 218, 224, 229, 235, 241 and 263.

5.1.2. Principal Causes for Deforestation by Forest Type

Extensive livestock practices, agriculture, forest fires, road construction, mining and oil extraction are among the principal causes for deforestation as demonstrated below.

Principal Causes for Deforestation by Forest Type during, 1992

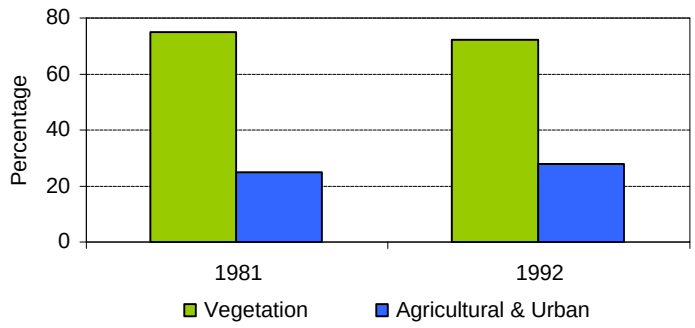


Source: INE, SEDESOL, 1993. Informe de la Situación General en Materia del Equilibrio Ecológico y la Protección al Ambiente, 1991-1992, Page 93.

5.1.3. Changes in Vegetation Coverage by Agriculture

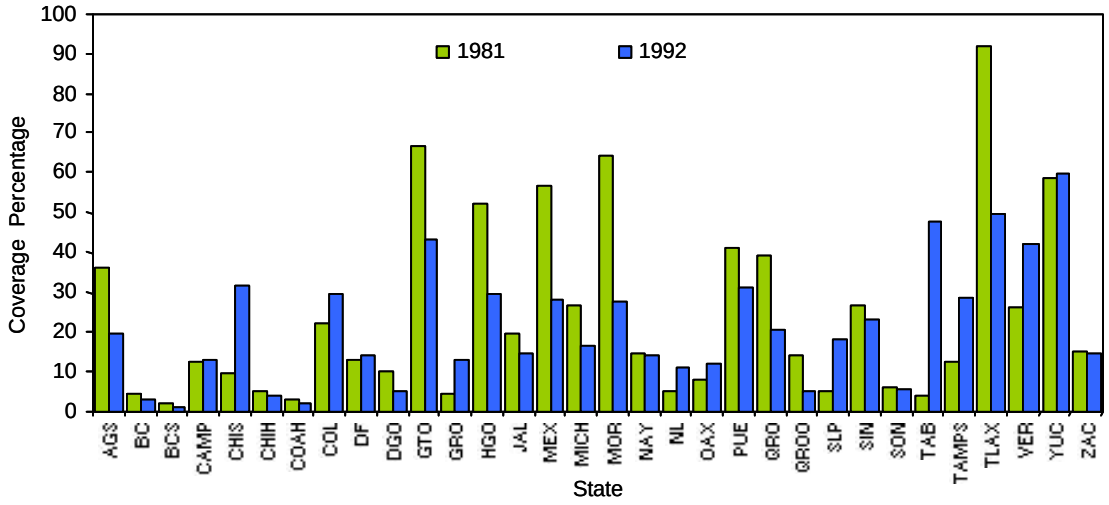
Agricultural practices decrease forest coverage by replacing the natural vegetation with crops, destroying wetlands, using of chemical fertilizers, insecticides and herbicides. Anthropogenic activities have not only decreased the total area dedicated to natural vegetation and fragmented original habitats but they have also increased the area dedicated to agriculture and urban development.

Comparisons in Land Use, (1981 and 1992)



Source: Flores O. and P. Geréz. Op. Cit., Page 22.

Comparison of Agricultural Use by State, (1981 and 1992)



Source: Selected citations from Op. Cit. Pages 94, 99,104, 110, 115, 122, 127, 132, 137, 141, 147, 151,157,162,168, 174, 180, 185,190,195, 201, 207, 212, 218, 224, 229, 235, 241 and 263 and, INEGI, 1996. E.U.M. Atlas Agropecuario 1991, Pages 21 and 35.

5.1.4 Illegal and Non Regulated Practices

Due to the nature of these activities, no precise statistics exist nor is there complete information concerning poaching, illegal logging and illicit commerce.

The illegal traffic of species primarily takes place to satisfy markets abroad such as the United States.

It is estimated that more than 100 species[1] of flora and fauna are targets of illegal commerce. In addition, species that are nationally traded include live specimens and their byproducts such as meat, furs, eggs and skins.

The strongest illegal commercial demand in Mexico is for endemic birds, cactuses and orchids due to the high international black market price and restricted distribution of these specimens.

Flora and Fauna Species with Highest Illicit Commercial Demand ,1996

Flora

Common Name	Scientific Name	Market Price (Local Currency)	International Market Price USD
Orchids(Various Species)	Familia Orchidaceae	30-300	10,000
Cactus (Various Species)	Familia Cactaceae	100-200	2-2,000
Palms	Género *Brahea, Erythea*		
Cícades (Various Species)	Familia Cicadaceae Géneros *Ceratozamia, Dioon* y *Zamia*		

[1] INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural. National Institute of Ecology, Page 25.

Fauna

Common Name	Scientific Name	Market Price (Local Currency)	International Market Price USD
Birds			
Red-Crowned Parrot	*Amazona viridigenalis*	400	1,500
Yellow-Headed Parrot	*Amazona oratrix*	1,000	3,000
Small Parrot	*Amazona ochrocephala*	300	1,500
Red Macaw	*Ara macao*	6,000	5,000
Green Macaw	*Ara militaris*	3,000	4,000
Yellow-Breasted Tucan	*Ramphastus sulfuratus*	500	6,000
Red-Tailed Sparrow Hawk	*Buteo jamaicensis*	500	
Peregrine Falcon	*Falco peregrinus*	1,000	1,500
Spider Monkey	*Ateles geoffroyi*	2,500	1,500
Howling Monkey	*Alouata palliata*	2,500	1,500
Mountain Goat	*Ovis canadensis*	400,000	50,000
Deer (Various Species)	Fam. Cervidae	400-45,000	60-6,000
Reptiles			
Boa Constrictor	*Boa constrictor*	400	200
Invertebrates			
Red-Footed Tarantula	*Brachypehma smithi*	40	35

Other Fauna Related to Illegal and Non-Regulated Practices, 1996

Common Name	Scientific Name	Common Name	Scientific Name
Mammals			
Spider Monkey	*Ateles geoffroyi*	Black Bear	*Ursus americanus*
Ocelot	*Leopardus pardalis*	Temazate	*Mazama guazaubira*
Red Lynx	*Linx rufux*	Squirrel	*Sciurus sp.*
Coatí	*Nasua narica*	Jaguar	*Panthera onca*
White-Tailed Deer	*Odocoileus virginianus*	Grey Fox	*Urocyon cinereoargenteus*
Pecarí	*Pecari tajacu*	Coyote	*Canis latrans*
Martucha	*Potos flavus*		
Racoon	*Procyon lotor*		
Birds			
Great Curassow	*Crax rubra*	Barn Owl	*Tyto alva*
Plain Chachalaca	*Ortalis vetula*	Magpie Jay	*Callocitta colliari*
Crested Guan	*Penelope purpuracens*	Keel-Billed Toucan	*Ramphastos sulfuratus*
Peregrin Falcon	*Falco peregrinus*	White Heron	*Egretta thula*
White-Tailed Sparrow Hawk	*Buteo albicaudatus*	Green Macaw	*Ara militaris*
Grey Sparrow Hawk	*Buteo nitidus*	Red-Crowned Parrot	*Amazona viridigenalis*
Red-Tailed Sparrow Hawk	*Buteo jamaicensis*	Yellow-Crowned Parrot	*Amazona oratrix*
Sparrow Hawk	*Buteo sp.*	White-Fronted Parrot	*Amazona albifrons*
Wide-Winged Sparrow Hawk	*Buteo sp.*	Lilac-Crowned (Pacific) Parrot	*Amazona finschi*
Bay-Winged (Harris) Hawk	*Parabuteo unicinctus*	Red-Lored (Yellow-Cheeked) Parrot	*Amazona autumnalis*
Crested Caracara	*Poliborus plancus*	Green Parakeet	*Aratinga holochlora*
Kestrel	*Falco sparverius*	Orange Fronted Parakeet	*Aratinga canicularis*
Black Vulture	*Coragyps atratus*	Orange Chinned Parakeet	*Brotogeris jugularis*
Black Shouldered Sparrow Hawk	*Elanus caeruleus*		
Reptiles			
Crocodile	*Crocodylus moreletti*	Desert Turtle	*Gopherus berlandieri*
Black Iguana	*Ctenosaura pectinata*	Lizard Turtle	*Chelydra serpentina*
Green Iguana	*Iguana iguana*	Land Turtle	*Terrapene mexicana*
Camaleon	*Phrynosoma sp.*	Guau Turtle	*Dermatemys mawii*
Water Snake	*Tamnophis sp.*	Three-Keeled Turtle	*Staurotypus triporcatus*
Cincuate	*Pituophis deppei*	Painted Turtle	*Rhinoclemmys sp*
Boa Constrictor	*Boa constrictor*	Japanese Turtle	*Trachemys scripta elegans*
Turtle	*Kinosternon bauri*		
Helmut Turtle	*Kinosternon leucostomum*	Wasp-Shaped Turtle	*Trachemys scripta*

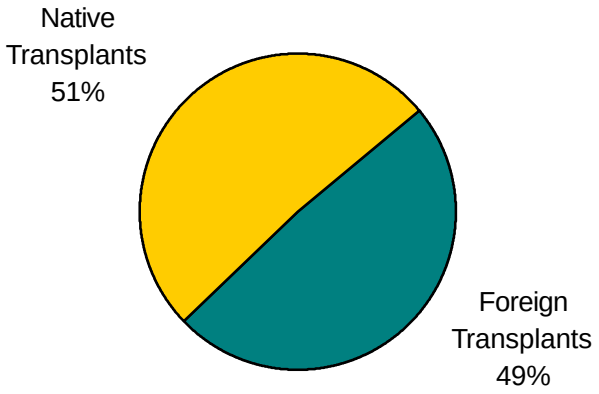
Source: INE, SEMARNAP, 1997. Dirección General de Vida Silvestre.

5.1.5. Introduction of Exotic Species

The introduction of exotic species is normally associated with ecological disruptions. Some authors have even termed this phenomenon as a type of "biological pollution," which in some cases manifests itself as a plague, (Lachner et al., 1970. En: J.A. Torales, 1994).

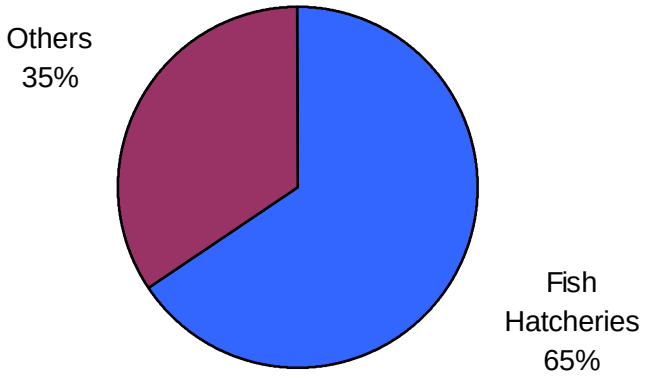
The statistics to date refer only to introductions of exotic aquatic species.

Introduced or Transplanted Species



Number of introduced species: 83

Motivations Introduction of Exotic Species



Source: Torales, J. A. 1994. La Piscicultura en México: Análisis de la problemática ecológica por la introducción de especies, Pages, 15, 16 and 17.

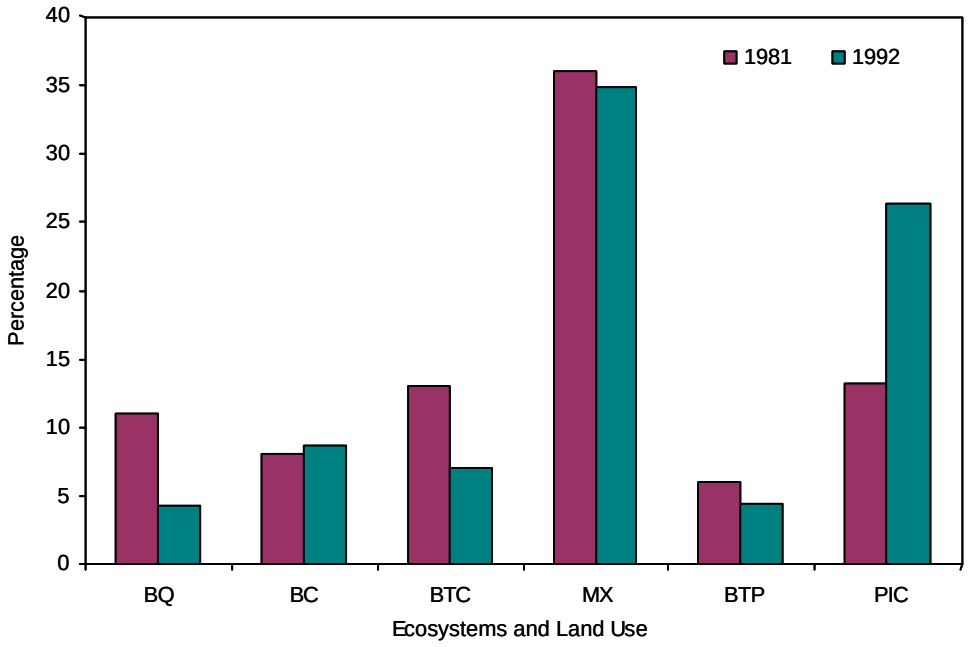
5.2. STATE

There are two principal aspects that describe the current situation of wildlife and natural reserve ecosystems in Mexico: statistics illustrating the nation's coverage of vegetation types and land use as well as the diversity of species in Mexico.

5.2.1. National Coverage by Forest Type

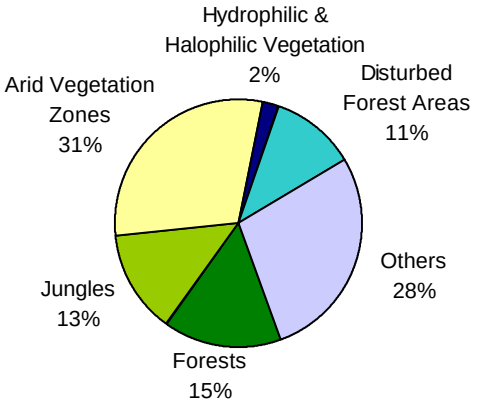
In examining the information relative to the various vegetation types, some inconsistencies were detected among the national and international sources. However, state vegetation coverage estimates made between 1981 and 1992 by Flores and Geréz (1994), containing information generated by the National Periodic Forest Inventory (1994), are considered noteworthy. The trends observed during this period denote a decrease in natural vegetation coverage and an increase in land use for agricultural and urban purposes. Additionally, the coverage percentages of the different ecosystems has decreased being replaced by animal husbandry grasslands and agriculture.

Trends in National Coverage by Forest Type (Percentage)



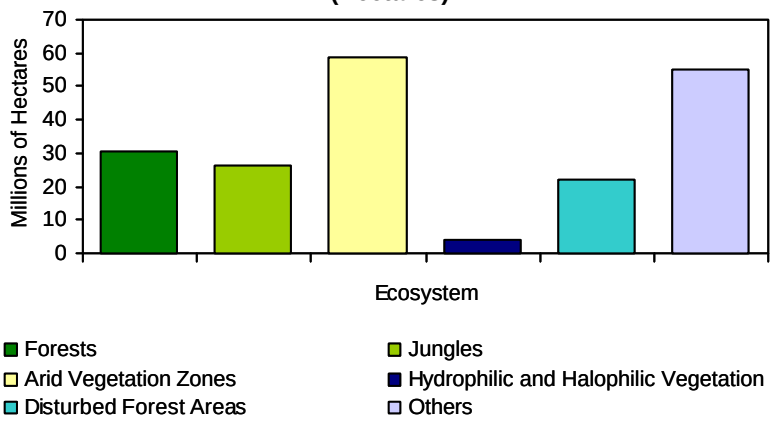
BQ = Broad Leaf Forests, BC = Coniferous Forests, BTC = Deciduous Tropical Forest,
MX = Arid Land Forrest, BTP = Evergreen Tropical Forest, PIC = Grasslands and Agriculture.
Source: Flores, O. y P. Geréz, 1994. Biodiversidad y conservación en México, Vertebrados, Vegetación y uso del suelo, Page 88.

Forest Surface Area by Ecosystem, 1994 (Percentage)*



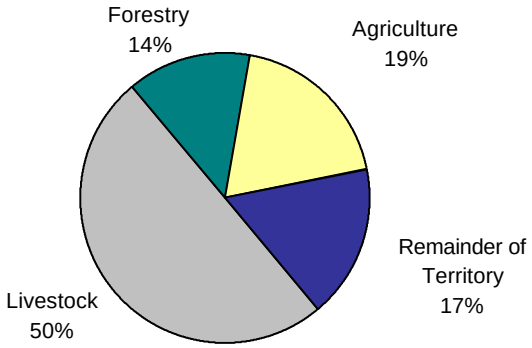
*Respective to 196, 718, 300 hectares of national territory
Source: SARH,1994. National Periodic Forest Inventory, Page 33

Forest Surface Area by Ecosystem 1994 (Hectares)



Source: SARH,1994. Inventario Nacional Forestal Periódico, Page 33.

5.2.2. Nationwide Land Use

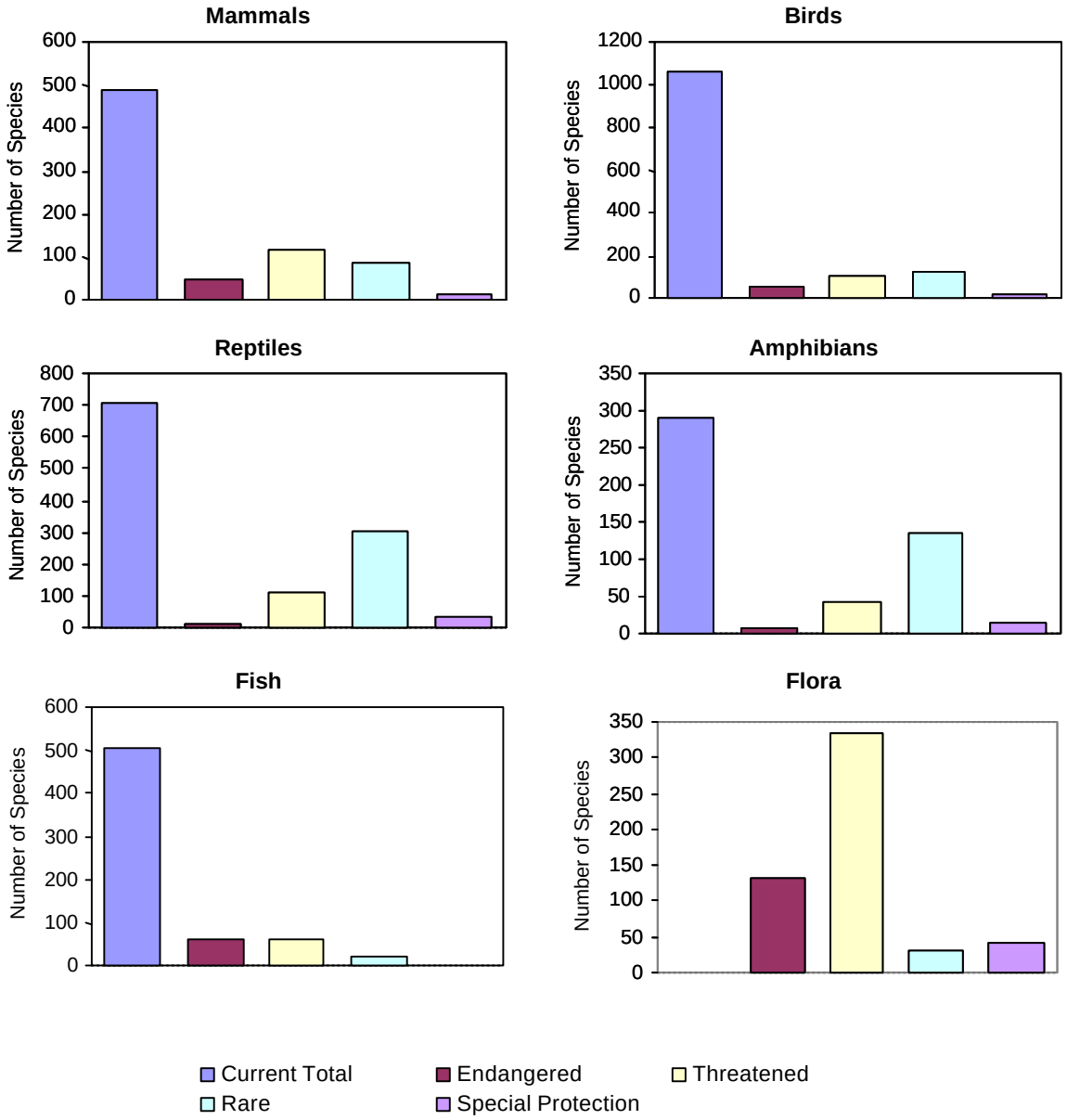


Note: The national territory extends 1,958,201 km^2
Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural, Page. 33.

5.2.3. Species Diversity

According to the available information, Mexico is one of the planet's twelve most biodiverse nations. Addressing species diversity in Mexico, attention must be made to the information available relating to national biodiversity and in particular for those threatened, rare, endangered, endemic and specially protected species.

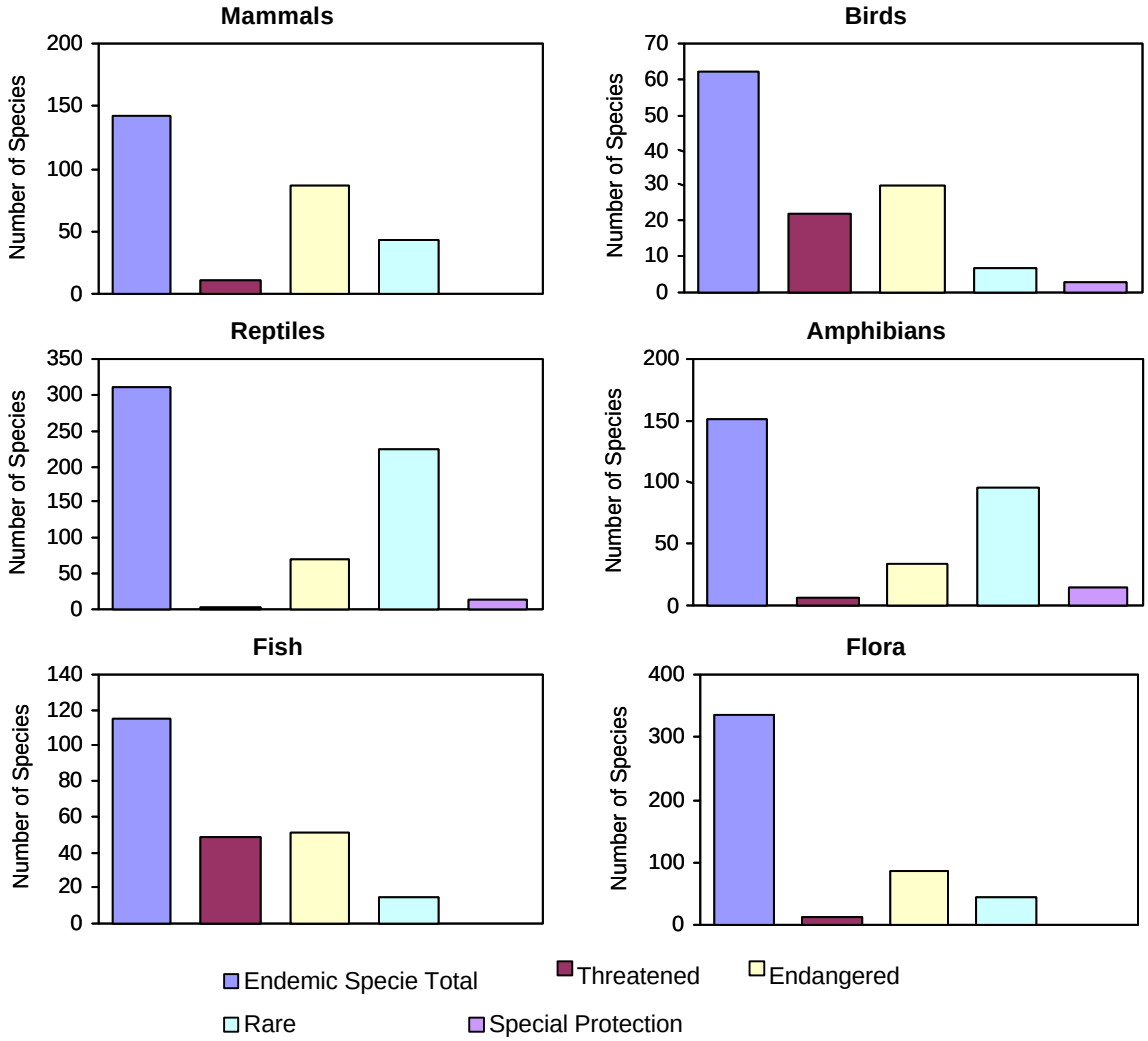
Number and Status of Species in Mexico



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural, Page 23. INE, SEDESOL, 1994. Normas Oficiales Mexicanas en Materia de Protección Ambiental, Pages 333-390. http//www.conabio.gob.mx/file///Albio3.htm

The endemic species are particularly important since they are only found in Mexico. Likewise, they are classified in a special category since they are considered a fundamental part of man's biodiverse heritage.

Number and Status of Endemic Species in Mexico



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural, Page 23
INE, SEDESOL, 1994. Normas Oficiales Mexicanas en Materia de Protección Ambiental, Pages. 333-390.
http//www.conabio.gob.mx/file///Albio3.htm

The territorial extension of Mexico represents 1.4% of the planet's total surface and has almost 10% of the total species known to mankind. In Mexico's case, this abundance includes endemic species such as 11.5% of endemic birds, 10% of mammals and 9.1% of amphibians and reptiles, representing fourth and first place respectively worldwide.

Considering Mexico's position as an OECD member, it possesses the greatest number of plant species, particularly for flowers and ferns, and has the most abundant number of freshwater fish, conifers, cicades and higher developed plants (SEMARNAP, 1997).

5.3. RESPONSE

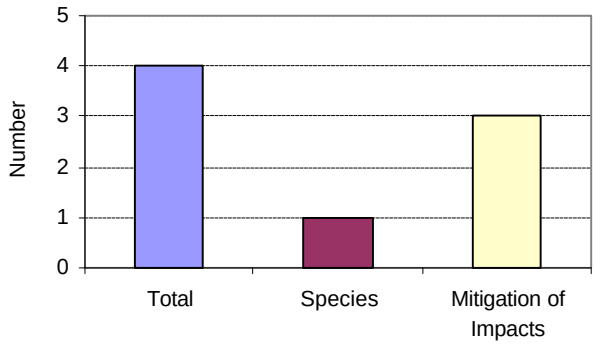
The response section is divided into three parts: regulation, natural reserves and wildlife.

Regulation

5.3.1. Legislating Natural Resource Policy

In Mexico, there are 45 different environmental standards currently in force, of which 41 refer to environmental quality and four refer to flora and fauna conservation. In addition, 14 standards apply to fishing resources and 3 standards specifically regulate the logging and timber industries. This reflects, on the one hand, the emphasis on environmental quality, while on the other, the complexity of legally protecting wildlife resources. Although efforts have been made in this direction, it is acknowledged that more must be done to define new legal mechanisms to protect wildlife in Mexico.

Number of Natural Resource Standards



Source: INE, SEDESOL, 1994. Normas Oficiales Mexicanas en Materia de Protección Ambiental, Page 332.

Natural Reserves

Natural reserves are aquatic or dry land zones where the original ecosystem has not been significantly altered by anthropogenic actions. Declared as such, normally by administrative decree, environmental authorities take specific actions to ensure the area's protection, conservation, restoration and development.

Governmental actions directed towards natural resource management are designed to reinforce and ensure the necessary conditions required to permit sustainability.

Although financial limitations exist, some resources have been assigned to a small number of areas (pilot project) in an attempt to represent the majority of Mexico's ecosystems. The selection of the natural reserves reflects national conservation priorities in an attempt to consolidate program efforts and address areas which in the past could not be funded.

Additionally, other natural reserves have received attention through the support of increased enforcement, management plans, construction of required infrastructure and supply of basic equipment, academic research projects, publicity campaigns, environmental education and the organization of regional technical councils made up of local community members, social organizations, industry and municipal governments.

5.3.2. Extension and Total Number of Reserves

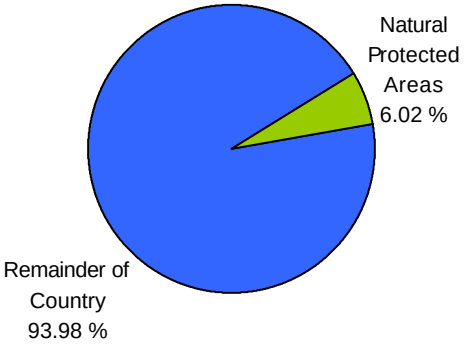
Total Number of Reserves by Category and Surface Area

Management Category*	Number	Surface Area (Hectares)
Biosphere Reserves (RB)	21	8'115,730
Others**	8	418,941
National Parks*** (PN)	63	1'385,334
Flora and Fauna Reserves (APFF)	9	1'660,502
Natural Resource Protection Reserves (APRN)	7	203,439
Natural Monuments (MN)	3	13,023
Total	**111**	**11' 796,969**

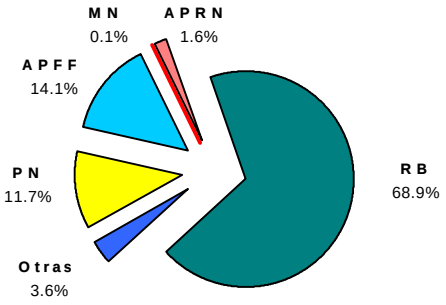
Note:
* The National Natural Reserve System (SINAP) is an instrument that permits the classification and zoning of Mexico's natural reserves as part of the nation's biodiversity. Under this program, enforcement, regulated exploitation and investigative research are key components.
According to the General Law of Ecological Equilibrium and Environmental Protection, the SINAP has six management categories, under federal jurisdiction.
** Pending recategorization.
*** Includes marine parks.
Source: INE, 1997. Unidad Coordinadora de Áreas Naturales Protegidas.

5.3.3. Percentage of Extension of National Natural Reserves

Total

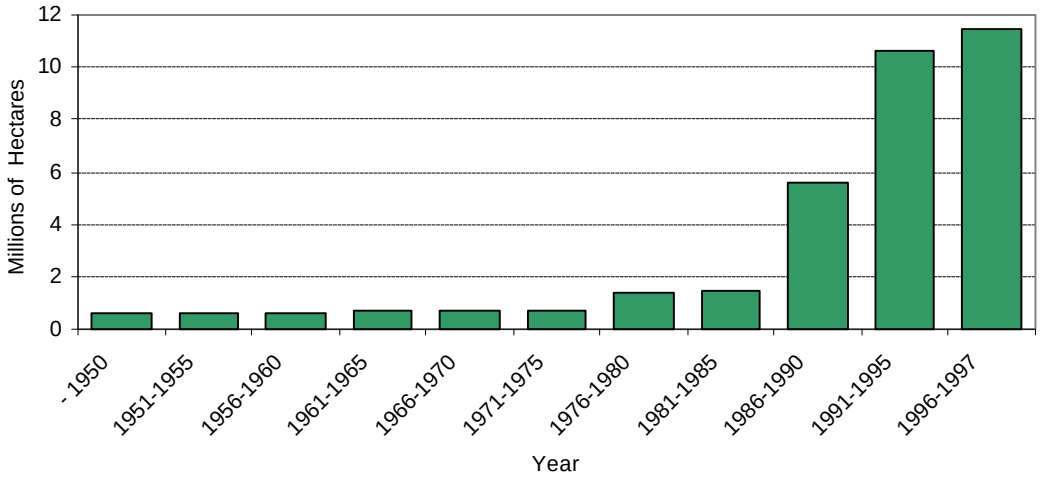


Management Categories



Total: 11,796,969 Hectares

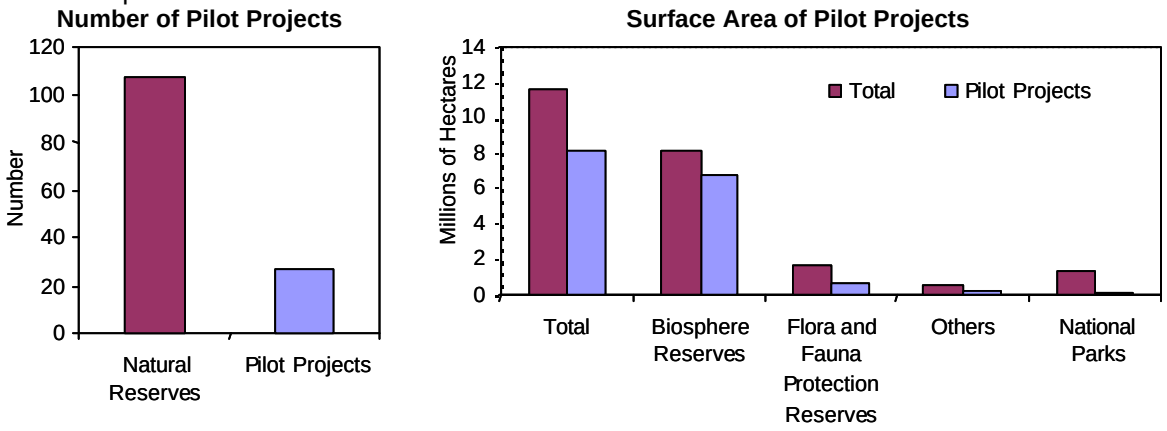
Total Accumulated Surface Area for Natural Reserves in Mexico, 1950-1997



Source: INE, SEMARNAP, 1997. Unidad Coordinadora de Áreas Naturales Protegidas.

5.3.4. Pilot Projects

The 25 natural reserve areas included in the pilot project were selected at the beginning of 1996 using ecological variables to represent each ecosystem's biological richness endemism and socio-economical variables such as the collaborative conservation efforts between non-governmental organizations and community groups as well as human encroachment. Mexico's pilot project program includes some 75% of the nation's publicly protected territory, as defined in the National Natural Reserve Program 1995-2000. Mid-term and long-term activities will expand the operating capacity of the natural reserve program in Mexico; for example, in 1997, the pilot project will grow to 27 total protected areas.

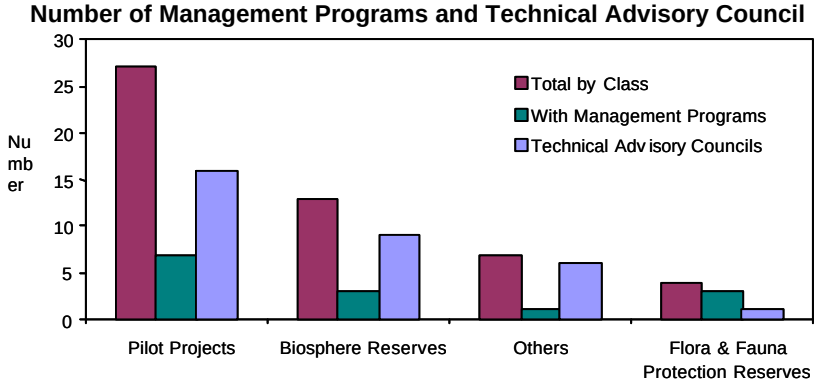


Source: INE, SEMARNAP, 1997. Unidad Coordinadora de Areas Naturales Protegidas.

5.3.5. Management Programs and Pilot Project Technical Advisory Councils

Management programs are one planning mechanism whereby various sectors can participate in the analysis and diagnosis of the areas, detecting the impacts and opportunities, and ultimately proposing short-term, mid-term and long-term strategies to increase operational efficiency and ensure conservation of natural reserves in Mexico.

Once published, the management program is widely distributed among the potential participants in order to execute the project as soon as possible. To date, 16 Technical Advisory Councils have been formed to support of this type of cooperative effort.

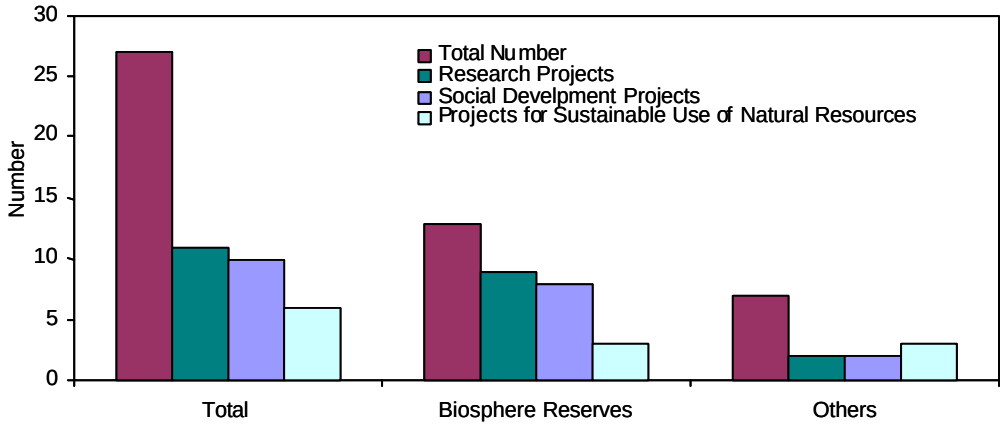


Source: INE, SEMARNAP, 1996. Unidad Coordinadora de Áreas Naturales Protegidas.

5.3.6. Pilot Project Research, Social and Sustainable Development Programs

Due a lack of information, the assignment of more research projects to natural reserves will only increase sustainable development.

Number of Research Projects in Sustainable and Social Development in Pilot Projects



Source: INE, SEMARNAP, 1996. Unidad Coordinadora de Áreas Naturales Protegidas.

Wildlife

The two principal wildlife management strategies are conservation and regulated exploitation.

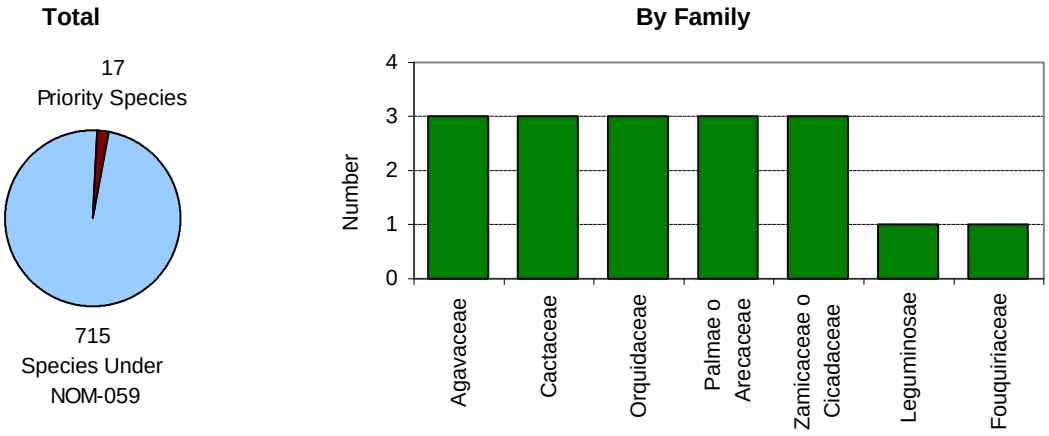
- **Conservation**

There are several reasons for selecting species as priorities in conservation and recovery efforts. Authorities can decide to target a certain specie based on the fact that it is internationally recognized as an endangered specie, a recovery and management plan is viable, or the specie's protection provides additional benefits to other species or its native habitat. Species can also be selected based upon their recognized economic or cultural value.

5.3.7. Number of Priority Flora Species under the Mexican Official Standard, NOM 059-ECOL-1994

One way to estimate the regulatory efforts to protect flora is evident in the Official Mexican Standard NOM-059-ECOL-1994. In accordance with the standard, 715 flora species are protected and 2.4% of this amount are considered priority species.

Number of Priority Flora Species

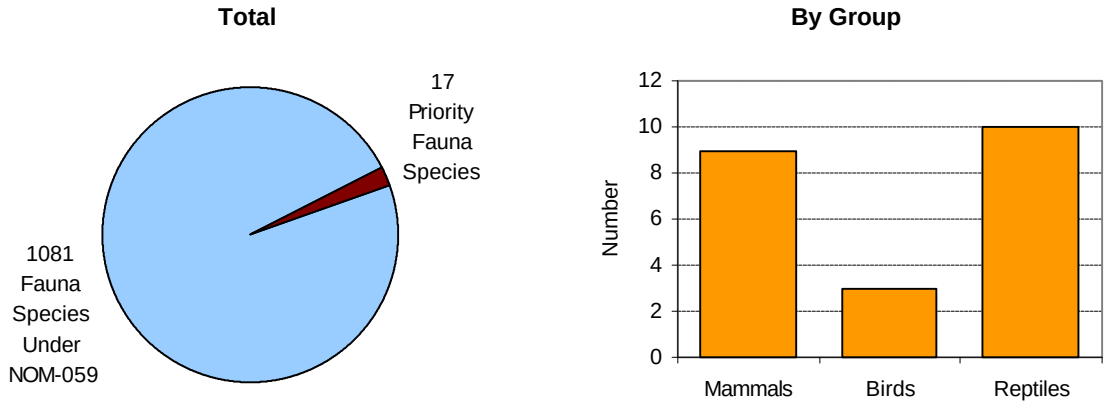


Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 110.

5.3.8. Number of Priority Fauna Species under the Mexican Official Standard, NOM 059-ECOL-1994

In accordance with the standard NOM-059-ECOL-1994, 1081 fauna species are protected and 2% of this amount are considered priority species.

Number of Priority Fauna Species



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 111.

5.3.9. Special Protection Programs

Special protection programs have been defined for the grey whale and the sea turtle.

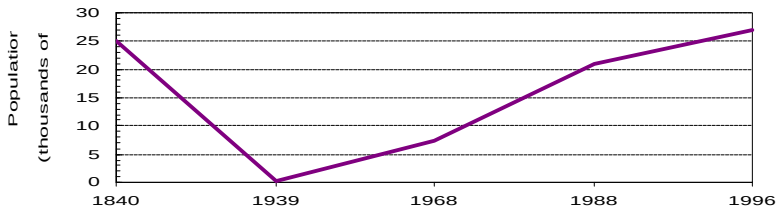
In the case of the grey whale, due to overexploitation, the Mexican government began taking legal actions to prohibit whale harvesting in national waters since the beginning of the twentieth century. Mexico's conservation of the grey whale, as part of a concerted international effort, has significantly contributed to the specie's recovery.

Chronology of Legal Actions for Grey Whale Conservation

Event	Date
Protection of the Whale in Mexico Begins.	January 20, 1933
Mexico signs the Geneva Convention for Whale Protection.	July 28, 1933
Mexico approves of the International Agreement Regulating Whale Hunting.	July 16, 1938
Mexico joins the International Whale Commission.	June 17, 1949
The Ojo de Liebre Lagoon in Baja California Sur is declared a natural reserve.	January 14 1972
The San Ignacio Lagoon in Baja California Sur is declared a natural reserve.	July 16, 1979
The Ojo de Liebre Lagoon Reserve is declared to include the Guerrero Negro and Manuela Lagoons in Baja California Sur.	March 20, 1980
The El Vizcaíno Biosphere in Baja California Sur is declared a natural reserve.	November 30, 1988
The Ojo de Liebre and San Ignacio Lagoon Reserves are internationally recognized as part of the UN's Cultural and Natural Patrimony of Humanity Program.	December 4, 1993

Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 60.

World Population of the Grey Whale

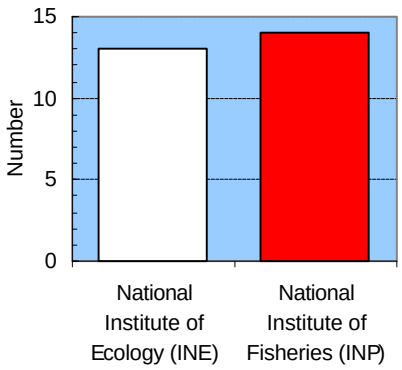


Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 60.

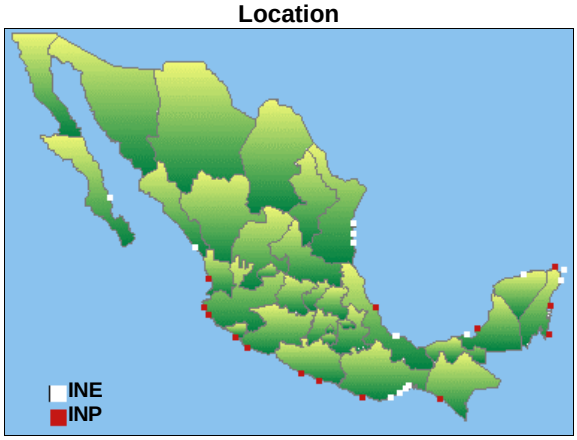
Likewise, Mexico has directed its efforts towards the marine turtle with the establishment of camps for the conservation, protection, research, inspection and oversight, environmental education and training in order to ensure the specie's survival. Particularly, research and conservation have been focused towards nest protection and relocation, egg hatching and public awareness campaigns.

SEMARNAP Turtle Camps

Number



Location



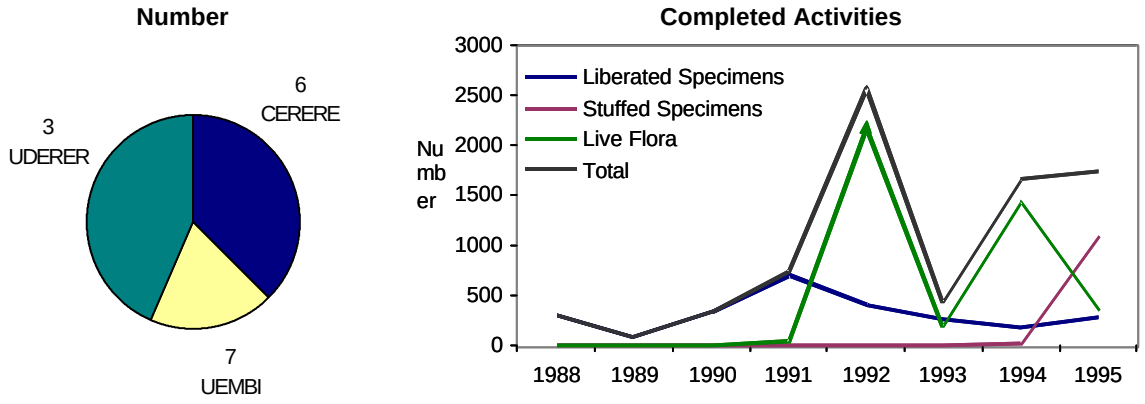
Source: INE, SEMARNAP, 1997, Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 58.

Each year, approximately 80 turtle camps are installed by non-governmental organizations, state governments, etc.

5.3.10. Number of Conservation, Rescue and Rehabilitation Centers

With the objective of rehabilitating rescued specimens and increasing inspection and oversight, Mexico has created the Wildlife Species Rescue and Rehabilitation Centers (CERERE), the Biodiversity Evaluation and Monitoring Units (UEMBI) and the Threatened Specie Rescue Units (UDERER). These institutions are currently under reorganization in order to increase their ability to efficiently aid in the conservation of Mexico's flora and fauna species.

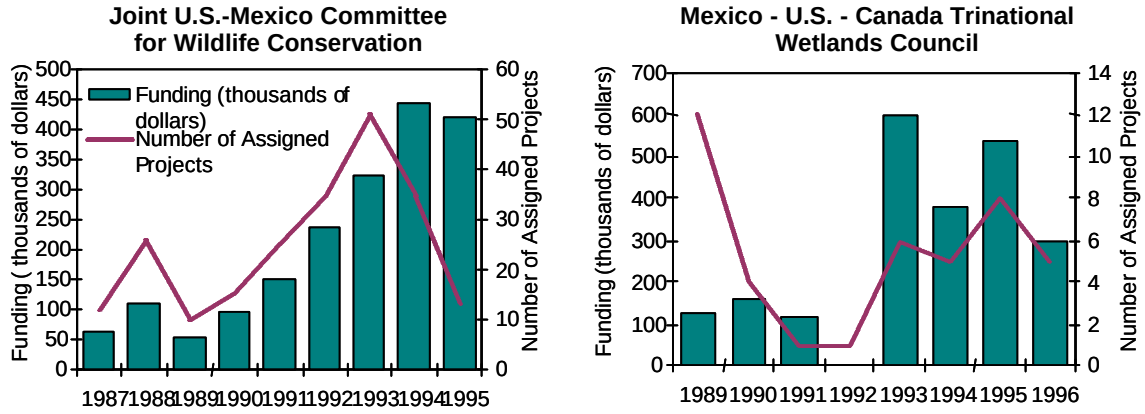
Conservation, Rescue and Rehabilitation Centers, 1996



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Pages 53 and 54.

5.3.11. Other Instruments

Additional instruments recognized in conservation and management efforts for flora and fauna species and their habitats are the international cooperation programs. One example is the Trilateral Conservation Committee between Mexico, the United States, and Canada, which includes the U.S.-Mexico Adjunct Committee and the Trilateral Wetlands Commission. Conservation efforts include projects targeting water birds, however funding has been limited.



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000,Pages 64 and 65.

- **Regulated Exploitation**

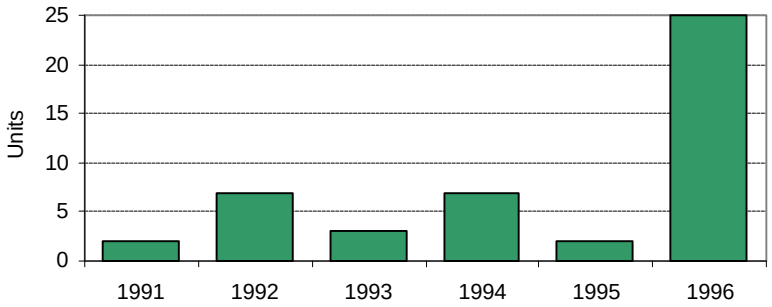
Periodic regulation allowing hunting or specie harvest has the objective of regulating exploitation. This policy, applied by the National Institute of Ecology, includes permit authorizations for the exploitation of flora and fauna during natural periods of abundance or includes the registration process associated with specie commercialization (nurseries, hatcheries, breeders, zoos and circuses).

5.3.12. Wildlife Conservation, Management and Sustainable Development Units

Wild Flora Nurseries

There are 46 registered flora nurseries, which are located in the central region of the Mexico. Income received from flora nurseries is particularly lower than fauna breeders or hatcheries, although in recent years the flora industry has grown, there is no law regulating this practice, current statistics do not represent totals.

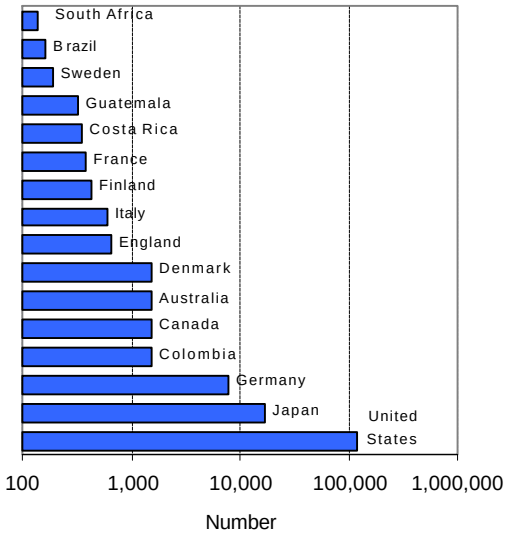
Registered Wild Flora Nurseries



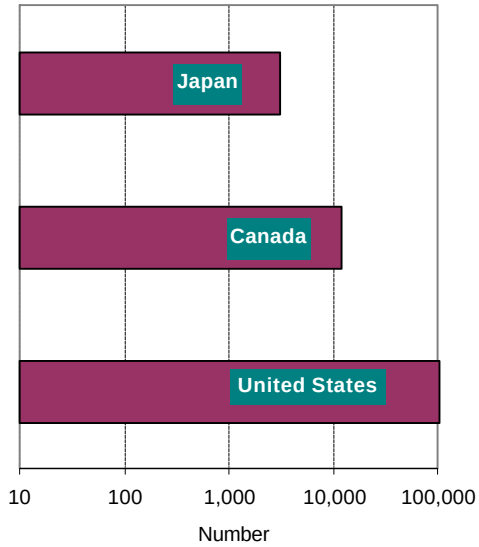
Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 34.

Exports by Nurseries

Exports of Mexican Orchids (1993-1996)



Exports of Mexican Cactuses (1994-1996)



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 89.

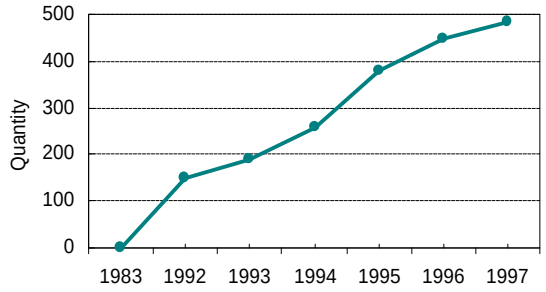
Units of Extensive and Intensive Production

Extensive and intensive production units differ in the amount of surface area being used and the type of management. In extensive production, animals and plants grow and reproduce with little human intervention or impact upon their natural environment. Principally, in the north of Mexico, 5,482,981 hectares are dedicated to extensive production of which 39.4% pertains to Sonora, 22.0% to Baja California, 12.8% to Baja California Sur, 12.5% to Coahuila, 7.0% to Nuevo León, and 4.3% to other states (INE, SEMARNAP, 1997. Dirección General de Vida Silvestre).

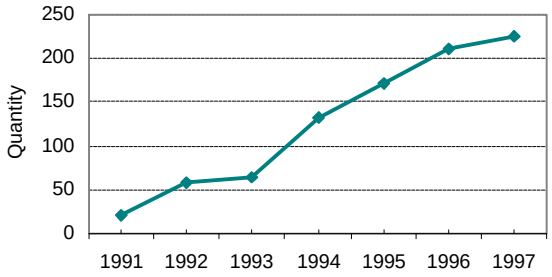
Production management plans are the responsibility of the individual property owners, representing one of the most important instruments for the habitat and species conservation efforts.

Intensive breeders, which operate in farms and corrals, for the most part work independently.In some cases they are supported by natural resource development strategies and policies.

Units of Extensive Production (Annual Accumulated Registration)



Intensive Breeders (Annual Accumulated Registration)

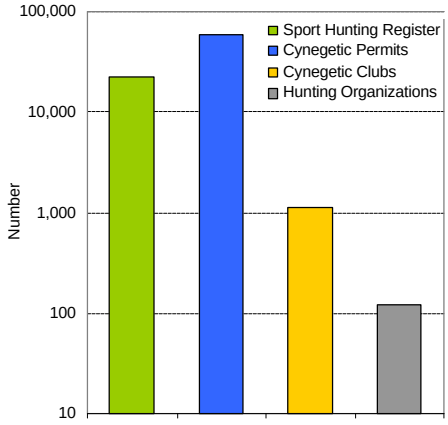


Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 34.

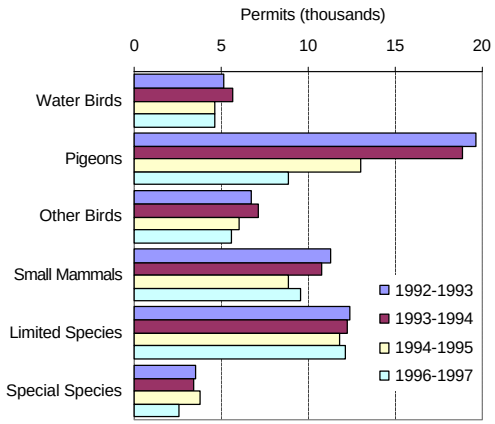
5.3.13. Hunting

Hunting and gaming clubs have aided in the conservation of fauna species in Mexico. The number of these organizations has increased as a demand for their services has also increased. International demand for these services has grown although administrative limitations and problems with the regulatory mechanisms still exist.

Hunting Permits, Clubs and Organizations (1996)



Number of Issued Hunting Permits

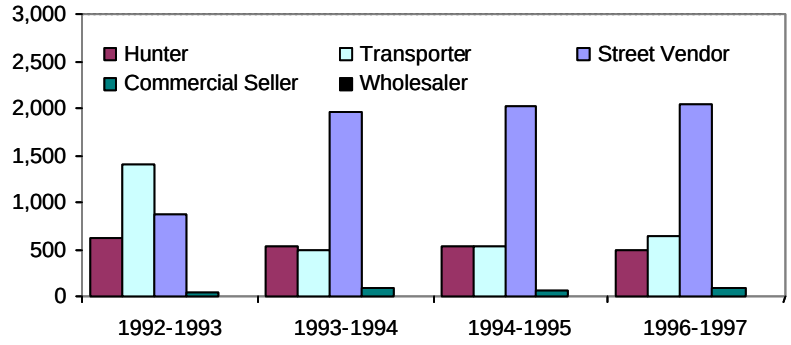


Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Pages 46 and 90.

5.3.14. Others Exploitation Methods

The capture of songbirds and other pets are permitted for approximately 72 species. On the other hand, capture of kites, hawks, harriers, eagles, owls, parrots, macaws, parakeets and parrots, as well as other threatened species are prohibited. Mexico has 563 authorized birdcatchers.

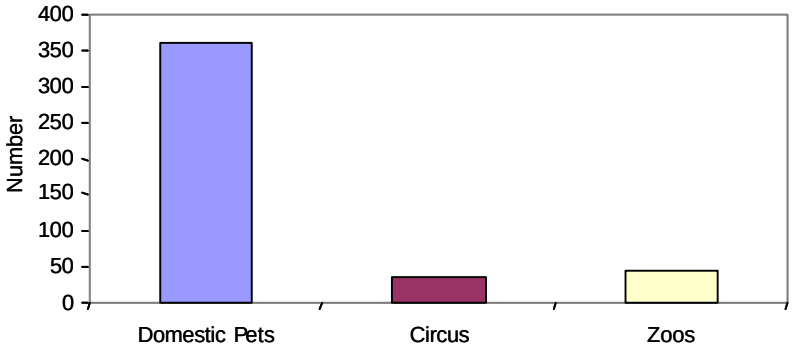
Exploitation, Capture and Commercialization of Songbirds and Birds as Domestic Pets



Source: INE, SEMARNAP, 1996. Dirección General de Vida Silvestre (5/09/97).

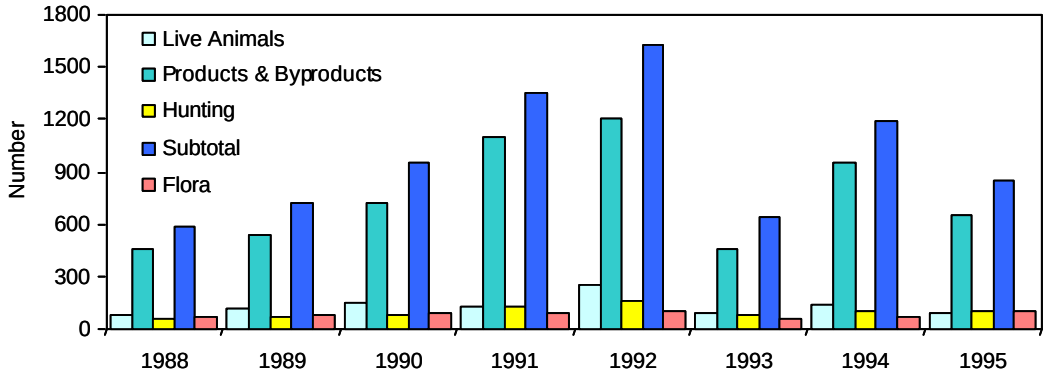
Another type of wildlife exploitation is seen in the legalization of pet ownership, of which 44 different species of birds, reptiles, mammals and insects are included.

Number of Registered Mascots, Zoos and Circuses (1996)



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Pages 39 and 46.

Import and Export Permits of Species Included Under CITES



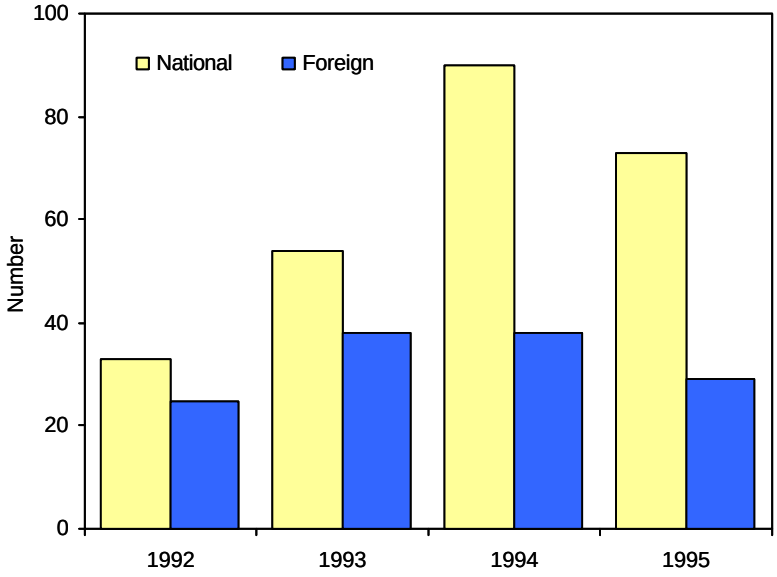
Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Page 68.

5.3.15. Scientific Research

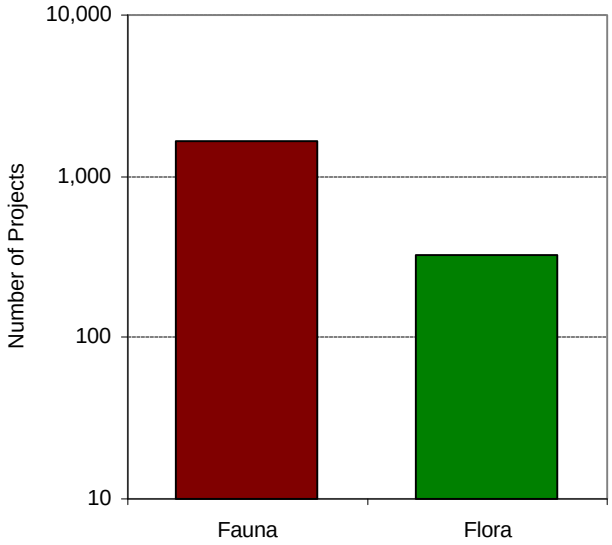
Scientific research involving the collection of flora and fauna, except for those species already regulated in the natural reserves, does not require a permit.

Research institutions can play an important role to further society's understanding of the importance of flora and fauna. However, educational institutions are not dedicating a sufficient amount of resources to research where wildlife conservation, management and exploitation techniques can be explored or utilized, and therefore it is recognized that more attention should be focused in this area.

Number of Issued Permits for Scientific Purposes in Mexico



Number of Registered Research Projects in Mexico (1992-1995)



Source: INE, SEMARNAP, 1997. Programa de Conservación de la Vida Silvestre y Diversificación Productiva en el Sector Rural 1997-2000, Pages 39 and 46.

6. STRATOSPHERIC OZONE DEPLETION

The ozone layer, which forms a thin and delicate part of the planet's stratosphere, is located some 35 kilometers above the earth's surface. The concentration of stratospheric ozone, although depending on the altitude position, accounts for a minimal fraction of the earth's total atmosphere.

The ozone layer protects life on earth from the harmful ultraviolet rays (UV-B) emitted from the sun. However, the use of some industrial substances, which generate atmospheric emissions and directly affect ozone layer (otherwise known as ozone depleting substances), can elevate the amount of these ultraviolet rays entering the earth's biosphere. Due to this situation, the international community, including Mexico, established the Montreal Protocol in 1987. The Protocol obligates the signatories to phase out certain ozone depleting substances over the next 50 years in order to maintain ozone standards registered during the last decades of the 20th century.

In the first section, pressure indicators illustrate the international consumption of ozone depleting substances, among which chlorofluorocarbons, carbon tetrachloride, methyl bromide, methylchloroform and halogens are listed.

The state indicators describe how monitoring efforts have detected a decrease in ozone content in the last decades. Total average losses of ozone have been calculated at approximately 5% since the mid-1960's globally. However, in North America, Europe and Australia, total average losses have registered as much as 10% in the winter and spring and 5% in the summer and fall.

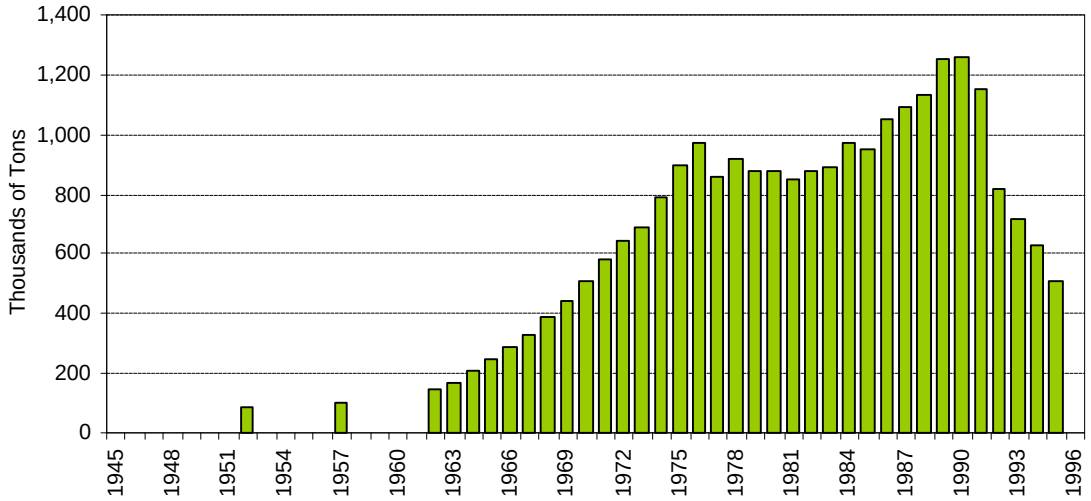
Finally, the response indicators describe the reduction efforts associated with the elimination of ozone depleting substances, including the measures being taken under the Montreal Protocol Although internationally actions have been taken, this document primarily presents Mexico's efforts in reference to its national environmental policy performance.

6.1. PRESSURE

6.1.1. International Production of Chlorofluorocarbons (CFCs)

The world's production of ozone depleting substances (CFC-11, CFC-12, CFC-112, CFC-114 and CFC-115) increased between the 1950 and 1988 and only recently began to decline as a result of the Montreal Protocol.

Global Production of Chlorofluorocarbons



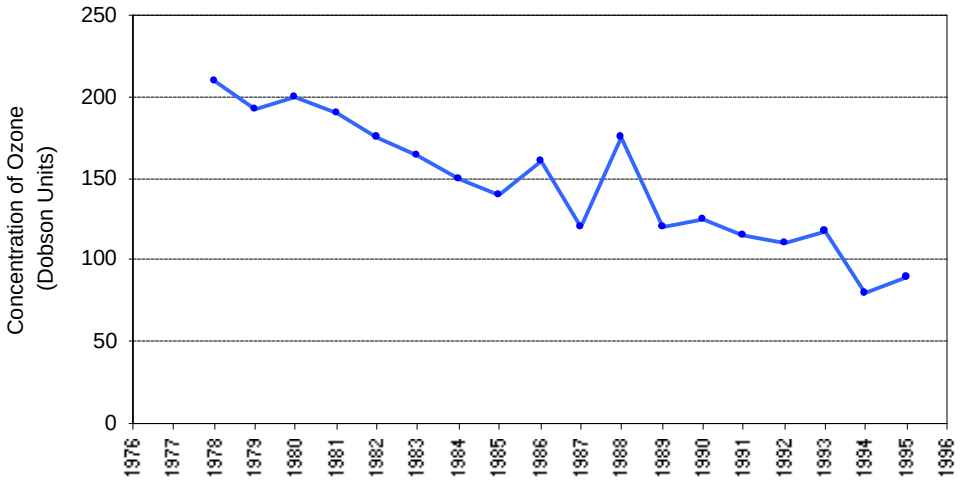
Source: PNUMA, 1995: "The Vienna Agreement: 10 Years of Progress", IMA-PNUMA Ozone Action Program Bulletin. Special Supplement, Number 3

6.2. STATE

6.2.1. Stratospheric Ozone Over the Antarctic

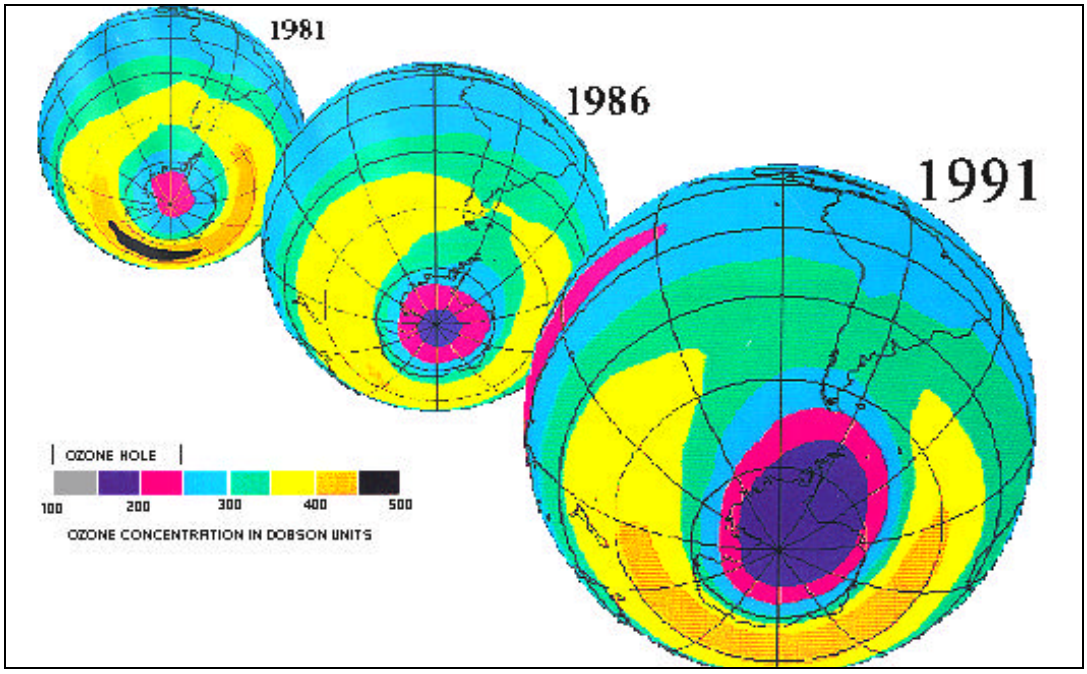
Despite the signatories of the Montreal Protocol have committed to decrease the consumption of CFC's, recent studies have shown that the earth's polar regions continue to suffer from the ozone's depletion.

Stratospheric Ozone Depletion in the Antarctic Region



Source: EPA, 1995. "Protection of the Ozone Layer" Environmental Indicators, EPA. 230-N-95-002.

The Antarctic's Land Surface and Ozone Concentration, 1981-1991



Source: 1992. Honeywell Inc.

6.3. RESPONSE

Official Calendar for Eliminating Ozone Depleting Substances According to the Montreal Protocol for Mexico

In support of the elimination of CFC´s, Mexico has gone beyond the minimum requirements of the Montreal Protocol and worked diligently for their elimination by the year 2000, ten years earlier than other developing countries. The following actions are established under the Protocol's calendar:

- Control the production of ozone depleting substances.
- Support and provide technical assistance for the substitution of non-depleting, alternative substances.
- Create a consciousness among the general population through environmental education to conserve the ozone layer.

Mexico is committed to the elimination of ozone depleting substances in accordance with the following calendar:

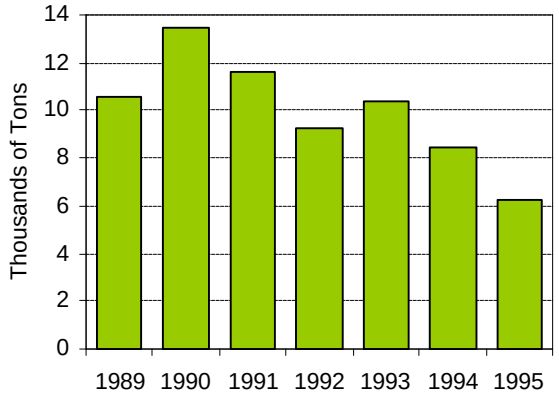
SUBSTANCE	ELIMINATION DATES
CFC-11 CFC-12 CFC-13 CFC-113 CFC-114 CFC-115 HALON-1211 HALON-1301 Tetrachlorurocarbon Methylchloroform	1993 - Freeze consumption at 1989 levels (base year) 1994 - Reduce by 20% of the total 1995 - Reduce by 40% of the total 1996 - Reduce by 60% of the total 1997 - Reduce by 70% of the total 1998 - Reduce by 80% of the total 1999 - Reduce by 85% of the total 2000 - Reduce by 90% of the total
HCFCs	Freeze consumption in 2016 at 2015 levels Eliminate by 2040
MBr - Methyl Bromide	2002 - Freeze consumption at 1996-1998 level averages (base average) 2005 - Reduce by 20% of the total 2015 - Reduce by 100% of the total

Source: INE, SEMARNAP, 1995. Coordinación de la Unidad de Protección al Ozono.

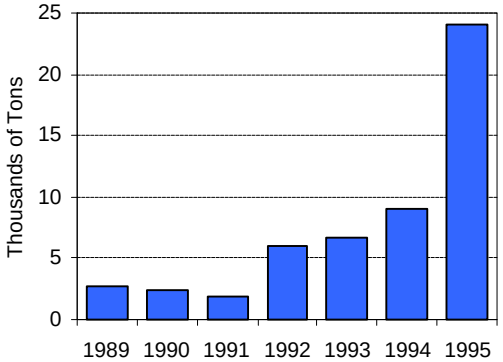
6.3.1. Reduction in the Consumption of Ozone Depleting Substances and the Increase of Consumption of Alternative Substances

The reductions in the consumption of ozone depleting substances is being undertaken as explained above. At the same time, alternative substances have received consumer support.

Total Consumption of Ozone Depleting Substances



Total Consumption of Alternative Substances

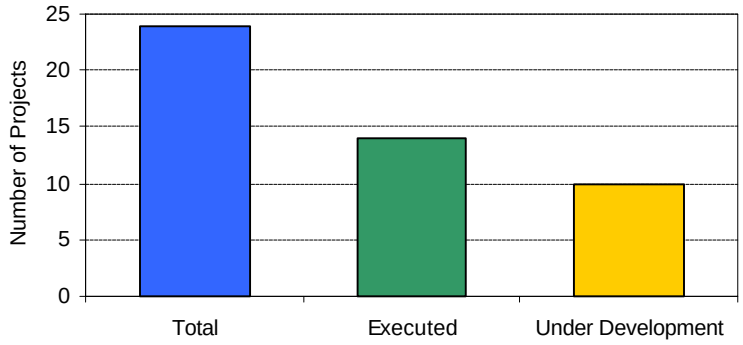


Source: INE, SEMARNAP, 1995. Coordinación de la Unidad de Protección al Ozono.

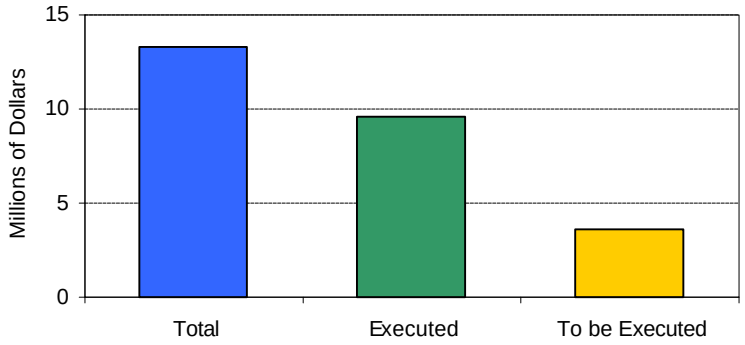
6.3.2. Financing Clean Technology

The Mexican federal government, through the designated ministries, has completed a series of actions for stratospheric ozone protection with funding from the World Bank and the United Nations Development Program (UNDP). The investments have primarily been spent on modernization projects for industry to reduce, recuperate, substitute and eliminate the consumption of CFC's nationwide.

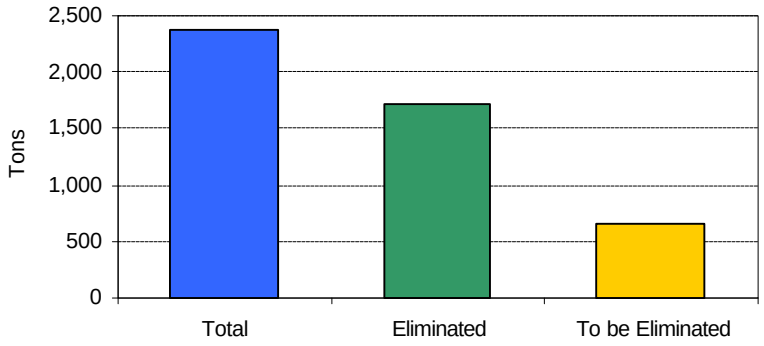
Number of Investment Projects for Ozone Protection, 1996



Amount of Investment for Ozone Protection, 1996

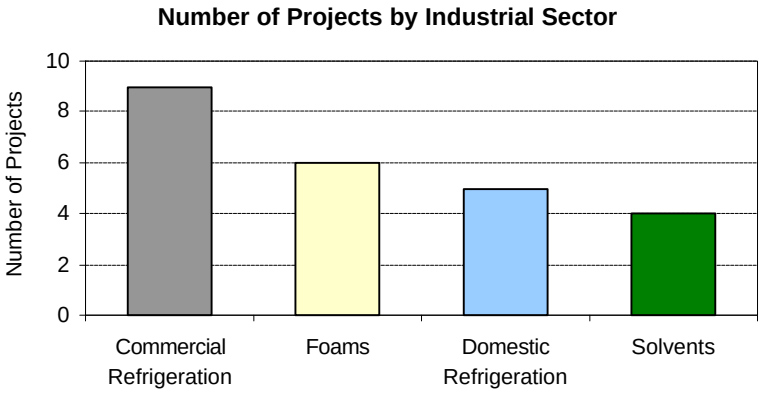


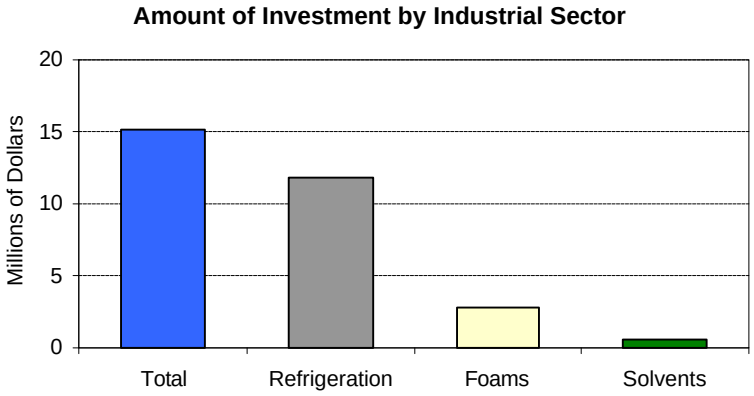
Amount of Eliminated Chlorofluorocarbons, 1996

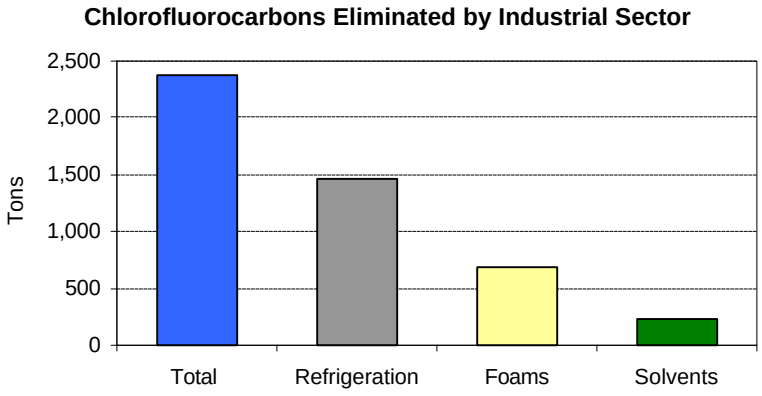


Source: INE, SEMARNAP, 1995. Coordinación de la Unidad de Protección al Ozono.

6.3.2.1. Number of Projects by Industrial Sector







Source: INE, SEMARNAP, 1995. Coordinación de la Unidad de Protección al Ozono.

7. CLIMATE CHANGE

The lowest level of the atmosphere, known as the troposphere, plays an important role in sustaining life on earth. The gases at this level are responsible, in great part, for regulating the earth's temperature, and therefore creating the maximum life conditions on the planet.

In essence, the earth's temperature increases due to the greenhouse effect, which slowly heats the planet as infrared sunlight is absorbed by the surface. Greenhouse gases, principally carbon dioxide (CO_2), water vapor, and ozone (0_3), and in addition nitrous oxide (N_20), methane (CH_4), and chloroflourocarbons (CFC), exist naturally and comprise 1% of the earth's atmosphere.

Due to an increase in the atmospheric concentrations of greenhouse gases from fossil fuel combustion, deforestation, and organic fermentation from livestock and agricultural practices and natural gas exploitation, the earth absorbs more infrared radiation and therefore the planet's temperature increases. This phenomenon is known as climate change.

In this section, the reader is presented with a group of indicators relevant to climate change beginning with pressure indicators describing the nation's emissions inventory. This marks the first step towards defining our knowledge concerning the magnitude of greenhouse gas emissions in Mexico.

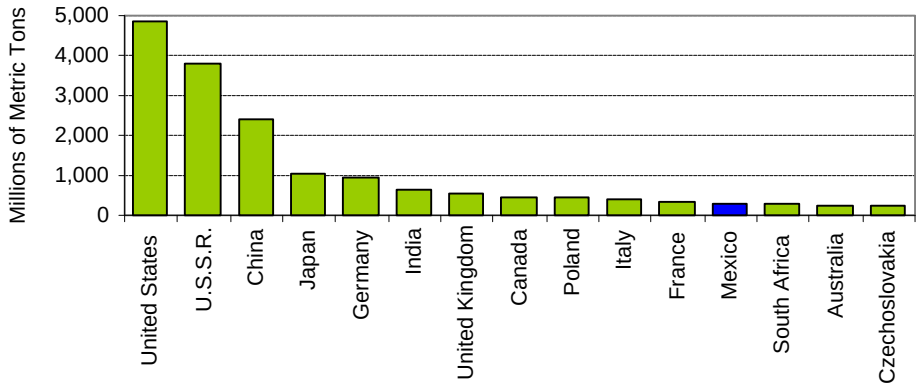
In the state indicators, as already mentioned, science has determined that as the planet's climate changes, human activities have increased the amount of atmospheric concentrations of greenhouse gases in the atmosphere. However, the rate of increase in the concentration of these gases and exactly how they are affecting the earth's ecosystem are issues still under debate.

Finally, the response indicators present Mexico's efforts to continue evaluating the problem at the national level, including the measures taken as a member of the United Nation's Framework Convention on Climate Change, future academic research and the completion of vulnerability studies concerning this phenomena.

7.1. PRESSURE

7.1.1. Inventory Report of Greenhouse Gas Emissions Worldwide

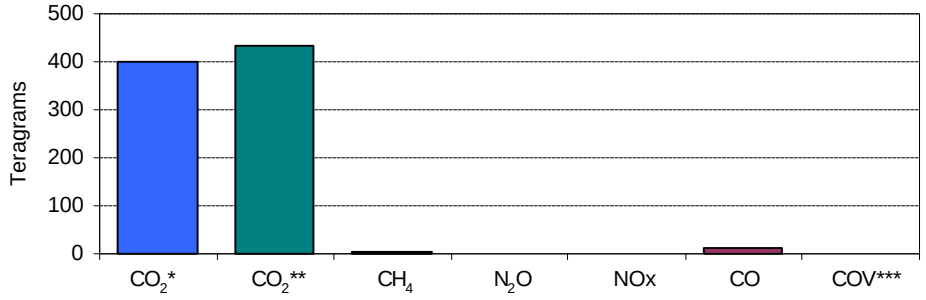
Top 15 Countries with Highest Industrial Emissions of Carbon Dioxide (1989)



Sources: World Resources Institute,1992. Atmosphere and Climate, Washington, D.C.

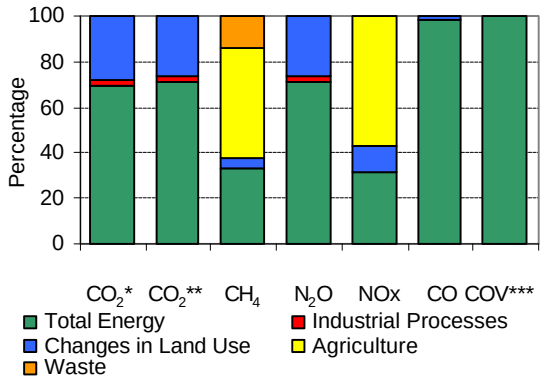
7.1.2. Inventory Report of Greenhouse Gas Emissions in Mexico

National Gas Emissions by Type

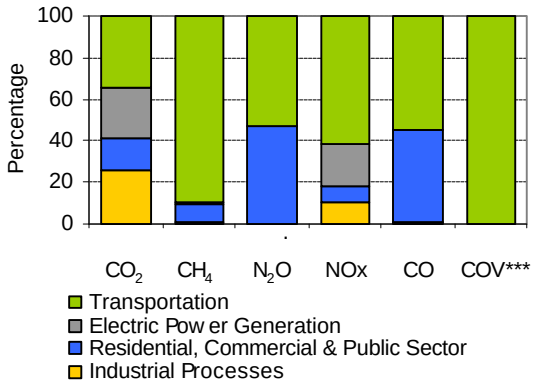


Source: SEMARNAP, INE et. al, 1995. Preliminary National Inventory of Greenhouse Gas: Mexico, Page 8.

Emissions by Type of Activity



Emissions from Energy Consumption



* Bottom-up (398.425 Tg) ** Top – down (433.721 Tg) *** (Non - Methane) Volatile Organic Compounds

Total Energy: Combustion of gasoline plus escaping and evaporating emissions.
Teragrams (Tg)=1x10^{12} g.
Gigagrams (Gg)=1x10^{9} g.
(Bottom-up), (Top-down): Methodologies for calculated CO_2 emissions.

Source: INE, SEMARNAP, PNUMA, USCSP, 1995. Preliminary National Inventory of Greenhouse Gas: Mexico, Page 8.

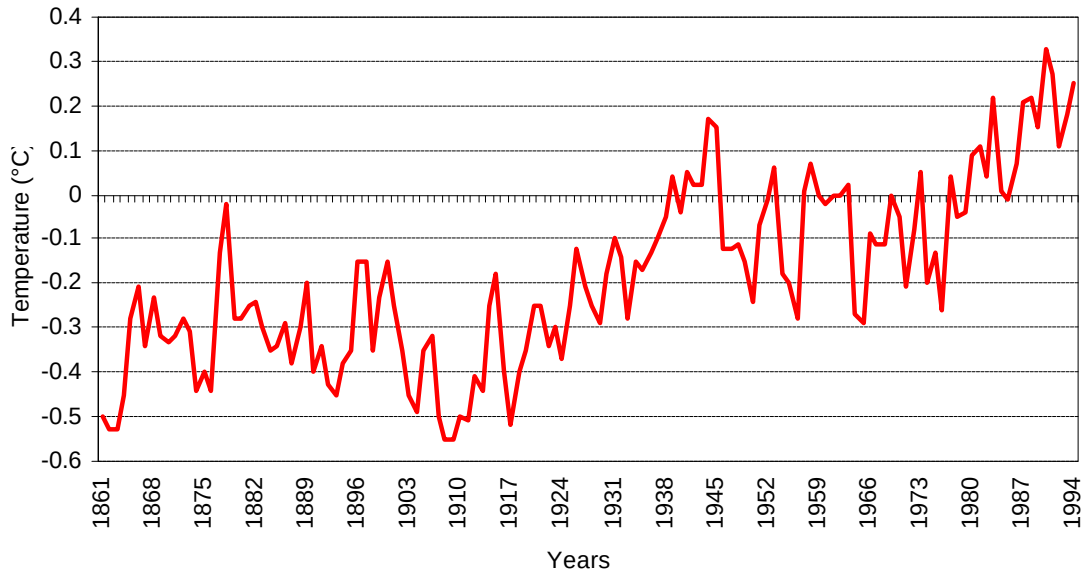
7.2. STATE

Global warming is a phenomenon that originates with the disproportional increase in carbon dioxide (CO_2) and other gases in the earth's atmosphere. This process is due to the fact that greenhouse gases trap long-range or infrared radiation after the earth reflects short-wave or solar radiation. Since this is a global problem, as each country contributes to the increase in gaseous emissions, according to their level of development and technology, the following statistics are presented in an international context.

7.2.1. Variations in Global Temperature

One of the most threatening consequences of human activities is worldwide air pollution and its affect on the planet's temperature change, a change which has increased approximately 0.3 ^{o}C (given a temperature increase range of 0.2 to 0.5 ^{o}C) since 1861 to date.

Variations in Global Temperature

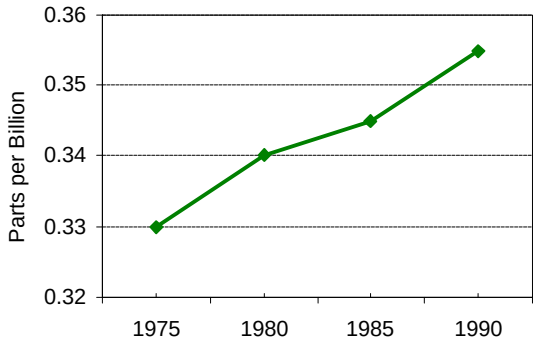


Source: World Resources Institute,1992, Atmosphere and Climate, Washington D.C.

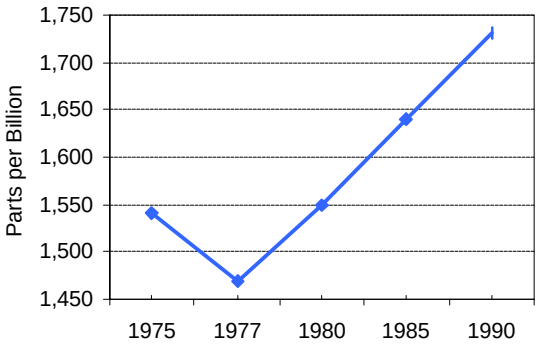
7.2.2. Global Concentrations of Greenhouse Gases

During the last 30 years, the atmospheric changes of greenhouse gases has significantly increased as a result of the anthropogenic activities involving the use and production of fossil fuels, industrial processes, agricultural activities, organic waste, among others.

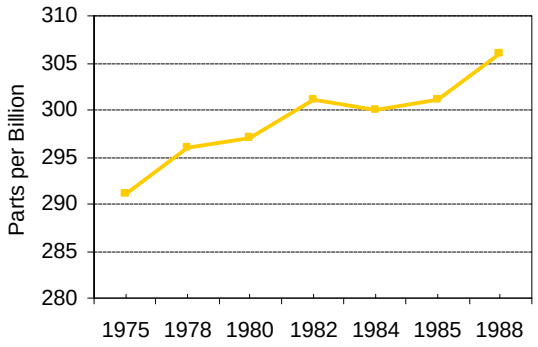
Carbon Dioxide



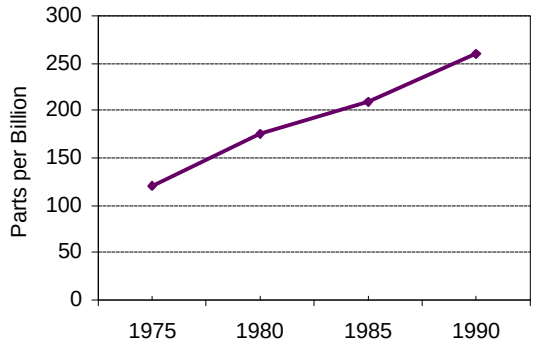
Methane



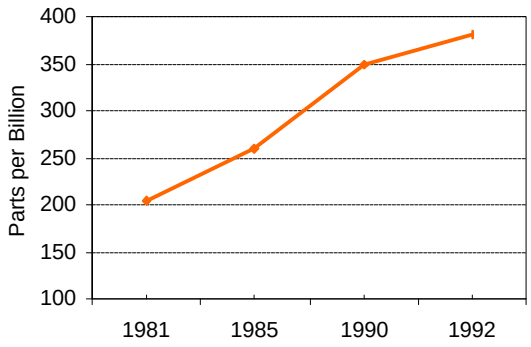
Nitrous Oxide



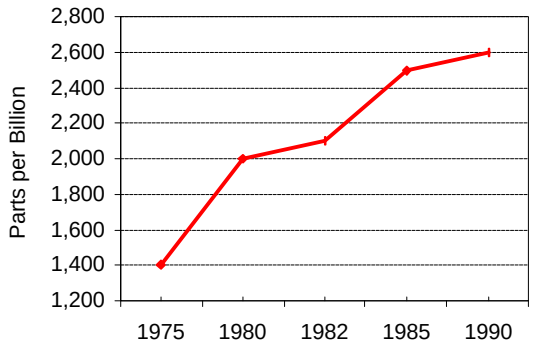
Chlorofluorocarbons (CFC-11 and CC13F)



Chlorofluorocarbons (CFC12 and CCl2F2)



Chlorine



Source: OECD, 1991. Environmental indicators, Page 35.

7.3. RESPONSE

7.3.1. Compliance of the United Nations Framework Convention on Climate Change

As an industrializing nation, Mexico's contribution to the increase in greenhouse gases is considerably less than other industrialized nations. However, Mexico signed the United Nations Framework Convention on Climate Change in 1992 and ratified the principles in 1993. Since these dates, Mexico has complied with the obligations defined under Article 4.1 of the Convention. For example, the document entitled "Country Study: Mexico" (completed by the INE/SEMARNAP and the U.S.: Country Studies Program, Support for Climate Change Studies and the National Autonomous University of Mexico), a national source emissions inventory of greenhouse gases, which was completed in September 1995, illustrates relevant pressure indicators for Mexico. At the same time, Mexico has completed other research projects concerning future emission projections and climate vulnerability studies. Some of the results are mentioned further in this document.

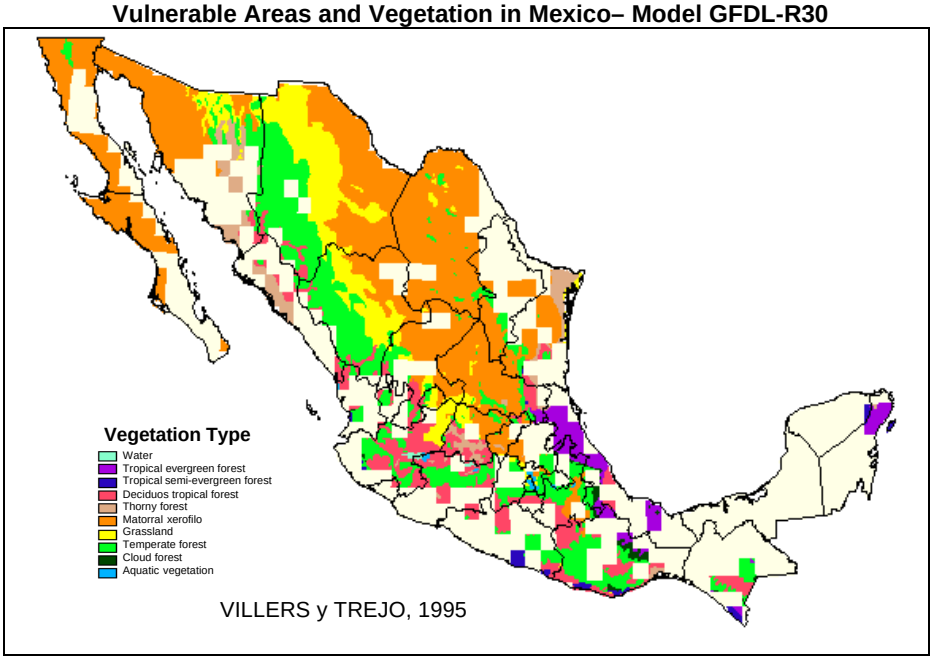
7.3.2. Global Climate Change Studies of Vulnerability in Mexico

Mexico's vulnerability to climate change was evaluated in the following formats; forest ecosystems, desertification and drought, human housing, coastal zones, energy and industrial sectors. To illustrate this phenomena, climate change models were constructed to show which regions are to be most affected by the temperature changes. The conclusions of this study reveal that Mexico will be adversely affected if the world's climate changes according to the projections.

Forest Ecosystems

The vulnerability of native forests was determined to be one of the ecosystems which will be significantly impacted due to the change in vegetation type. In particular, the temperate forest ecosystems are the most vulnerable to climate changes (vegetation coverage).

Vulnerable Areas and Vegetation in Mexico– Model GFDL-R30

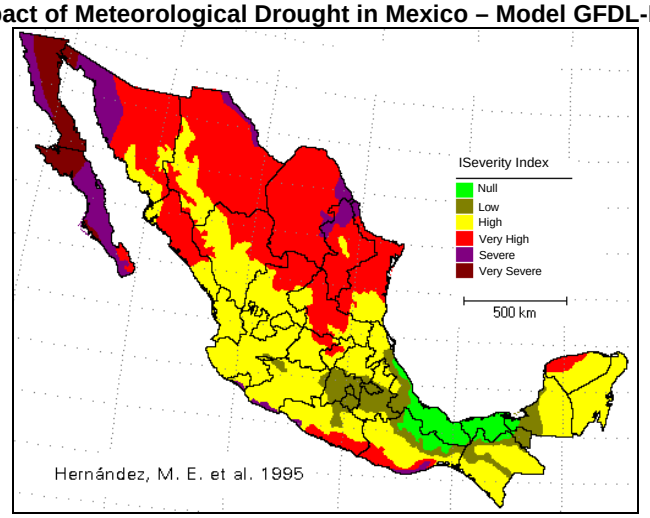


Source:INE, SEMARNAP, 1995. Estudio de Pais México, Informe Final (Unpublished).

Desertification and Meteorological Drought

The areas which present the highest index of vulnerability to desertification in the climate change models correspond to the arid, semiarid and wildly humid to dry regions as well as the economic and population centers located in the center of Mexico. In the south of Mexico, high vulnerability is associated with the logging practices from the timber industry and improperly managed soils in the agricultural and livestock sectors. In reference to meteorological drought, where a severity index was applied, the following results were obtained; more than 70% of the country present a high to very high index rate and the northern border region, the Pacific Coast and the center of Mexico will be the most affected by the change in temperatures.

Impact of Meteorological Drought in Mexico – Model GFDL-R30

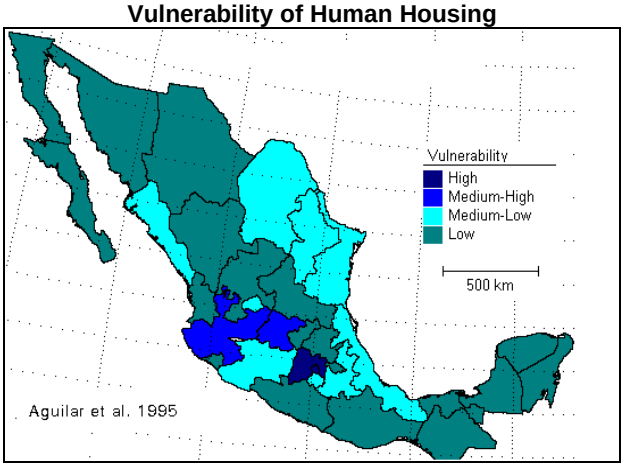


Source: INE, SEMARNAP, 1995. Estudio de Pais México, Informe Final (Unpublished).

Human Housing

Vulnerability studies related to human housing are examined in reference to climate factors (temperature change and water precipitation) and non-climate changes (population density, urban growth, morbidity and water consumption rates), which when combined can augment or decrease the effects of a potential change in Mexico's climate. The greatest vulnerability for human housing will affect regions where high environmental impacts are already present, such as Mexico's urban centers and zones already deficient in basic services and sanitary conditions.

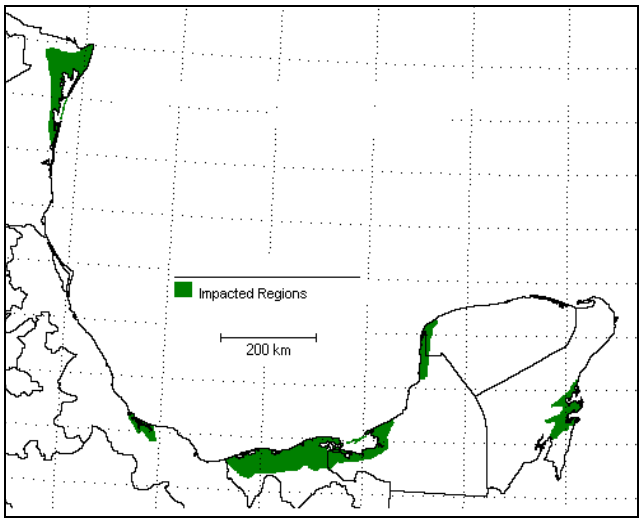
Vulnerability of Human Housing



Source: INE, SEMARNAP, 1995. Estudio de Pais México, Informe Final (Unpublished).

Coastal Zones

Vulnerability studies addressing the coastal zones examined the current physiographical conditions of the Gulf of Mexico based upon the geomorphological characteristics of the region. Based on this approach, the vulnerability study divides the region into two zones which present a potential risk to coastal economic and population centers; the tidal or intertidal zone (base scenario) directly impacted by the variations in sea levels, and a superior zone affected by a two-meter increase in relation to the medium level of high tide (future scenario).

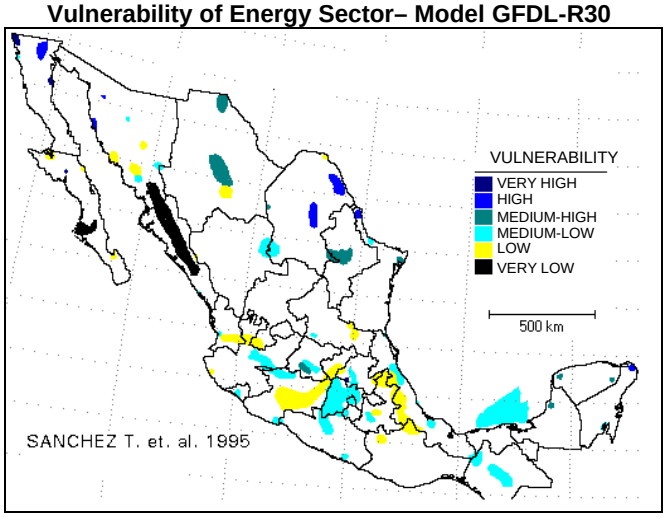


Source: INE, SEMARNAP, 1995. Estudio de Pais México, Informe Final (Unpublished).

Energy

Mexico's energy sector in the central region has a very high to high vulnerability level if temperatures continue changing. Additionally, the oil platforms located along Mexican shores could be vulnerable if sea levels were raised due to temperature increases. Temperature increase will also redistribute water resources around the nation thus creating water scarcity and increasing distribution and usage costs. Increasing costs from water scarcity will also have residual effects for the energy sector, particularly for electrical power, fossil fuel extraction and refining.

Vulnerability of Energy Sector– Model GFDL-R30

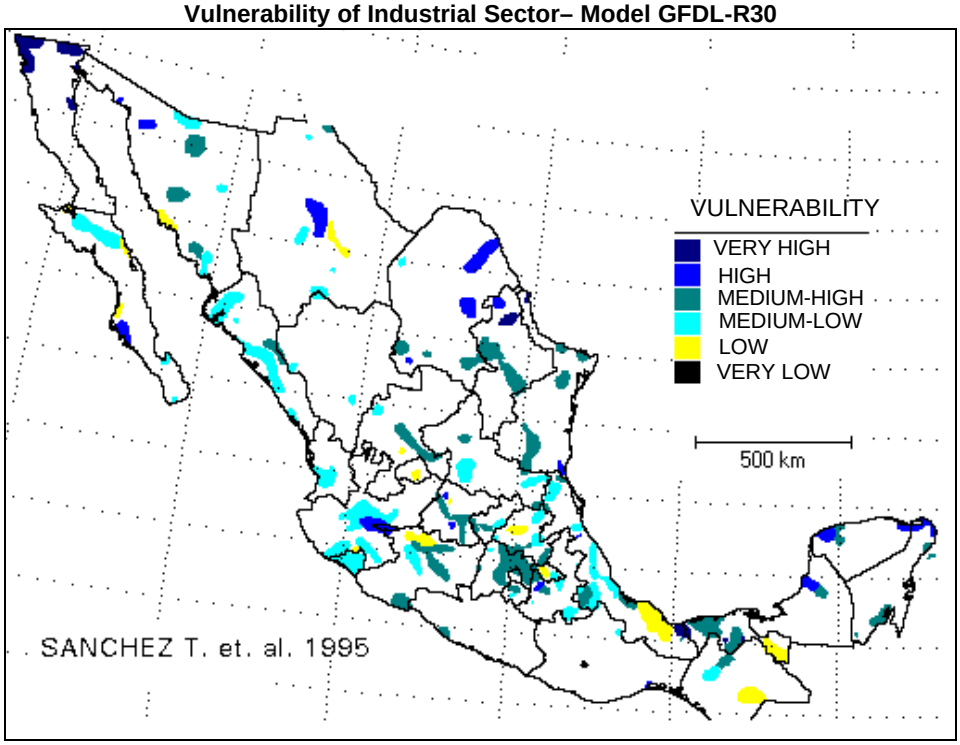


Source: INE, SEMARNAP, 1995. Estudio de Pais México, Informe Final (Unpublished).

Industry

Industrial installations and key infrastructure are the most vulnerable as the sea level rises. Temperature increase augments the vulnerability for those industries which require refrigeration in their production processes. Businesses that require prime materials which depend on the distribution of water and temperature variation such as the timber, textile, pulp and paper, food and beverage, etc, will be the most affected. Principally, this phenomena will be notorious in the central and northern sections of Mexico.

Vulnerability of Industrial Sector– Model GFDL-R30



Source: INE, SEMARNAP, 1995. Estudio de Pais México, Informe Final (Unpublished).

CONCLUSIONS

The process of information gathering and analysis needed to establish Mexico's environmental indicators is never ending. This publication is intended to give a preliminary progress report concerning the development of environmental performance indicators and demonstrate the collaborative effort of the various departments of the INE. In other words, during the project's development, all the participants had the opportunity to analyze and characterize the conditions of Mexico's "environmental information system;" a system which many agree has yet to be improved.

The project's priorities, from our perspective, must not only reflect Mexico's level of development but also present a first step in the evaluation of the nation's current environmental policy. In addition, from the outset, the project must contain specific objectives and realistic goals that can be measured with performance mechanisms. Ultimately, once performance is determined, Mexico will be able to take more precise actions in relation to long-term planning and agreements.

The magnitude of the task implies interinstitutional cooperation by the public sector and the general public's participation by means of the following specific activities:

- Support collaborative efforts among the various levels of the government, as well as between private institutions, in the integrated design and modernization of the environmental information management policies in Mexico;
- Improve the quality and comparability of the environmental indicators;
- Identify alternative sources to remedy media information gaps;
- Develop indicators to evaluate environmental performance and public policy implementation;
- Issue periodic publications on environmental indicators and establish revision mechanisms among the various participating sectors.

Mexico is not far from achieving its planned objectives. As shown in the first chapter, positive results have been achieved by those countries and international organizations that have completed their environmental reports based on the indicator model. Mexico too hopes that the development of its environmental indicators, which it has only recently begun, will also bring the same type of results.

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