



# OECD Environmental Performance Reviews

## MEXICO



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# OECD Environmental Performance Reviews

## MEXICO



ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

## ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article I of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

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*Publié en français sous le titre :*  
Examens environnementaux de l'OCDE  
**MEXIQUE**

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## FOREWORD

The principal aim of the OECD's Environmental Performance Reviews programme is to help *member countries improve their individual and collective performances in environmental management* with the following primary goals:

- to help *individual governments* assess progress;
- to promote a continuous policy *dialogue among member countries*, through a peer review process; and
- to stimulate *greater accountability* from member countries' governments towards their public opinion, within developed countries and beyond.

Environmental performance is assessed with regard to the degree of achievement of *domestic objectives and international commitments*. Such objectives and commitments may be broad aims, specific qualitative goals, precise quantitative targets or a commitment to a set of measures to be taken. Assessment of environmental performance is also placed within the context of historical environmental records, the present state of the environment, the physical endowment of the country in natural resources, its economic conditions and demographic trends.

These systematic and independent reviews have been conducted for all member countries as part of the first cycle of reviews. The OECD is now engaged in the second cycle of reviews directed at *promoting sustainable development*, with emphasis on implementation of domestic and international environmental policy, as well as on the integration of economic, social and environmental decision-making.

The present report reviews Mexico's environmental performance. The OECD extends its most sincere thanks to all those who helped in the course of this review, to the representatives of member countries to the Working Party on Environmental Performance, and especially to the examining countries (Japan, Korea, Spain and Sweden) and their experts. The OECD is particularly indebted to the Government of Mexico for its co-operation in expediting the provision of information and the organisation of the experts' mission to Mexico, and in facilitating contacts with many individuals both inside and outside administrative and governmental structures of the country. The present review benefited from grant support from Japan, Norway and Switzerland.

The OECD Working Party on Environmental Performance conducted the review of Mexico at its meeting on 30 June-2 July 2003 and approved its conclusions and recommendations. This report is published under the authority of the Secretary-General of the OECD.

Lorents G. Lorentsen  
Director, Environment Directorate

## TABLE OF CONTENTS

<b>1. CONCLUSIONS AND RECOMMENDATIONS .....</b>	<b>15</b>
1. Environmental Management .....	16
Implementing environmental policies and developing the environmental infrastructure .....	16
Air.....	18
Water .....	20
Waste .....	22
Nature and biodiversity .....	23
2. Towards Sustainable Development.....	25
Integration of environmental concerns in economic decisions .....	25
Integration of environmental and social concerns.....	26
Sectoral integration: agriculture and rural development .....	28
3. International Commitments.....	30

### Part I

## ENVIRONMENTAL MANAGEMENT

<b>2. AIR MANAGEMENT .....</b>	<b>33</b>
Recommendations.....	34
Conclusions .....	34
1. Policy Objectives.....	36
2. National Air Management Framework.....	38
3. Air Management in Large Metropolitan Areas .....	40
3.1 Progress and challenges.....	40
3.2 Air management in the megacity of Mexico .....	46
4. Integration of Air Management in Transport Policies.....	49
5. Integration of Air Management in Energy and Industrial Policies .....	53
<b>3. WATER MANAGEMENT .....</b>	<b>55</b>
Recommendations.....	56
Conclusions .....	56
1. Policy Objectives: Water as a Government Priority .....	57
1.1 Water policy objectives in the 1990s .....	57
1.2 Current water policy objectives .....	59

2. Providing Water Services to a Growing Population.....	62
2.1 Water supply .....	62
2.2 Sanitation services .....	67
2.3 Waste water treatment.....	67
3. Irrigation and Groundwater Abstraction .....	69
3.1 Irrigation .....	69
3.2 Depletion of groundwater aquifers .....	70
4. Economic and Financial Aspects of Water Management.....	71
4.1 Expenditure on and financing of water infrastructure .....	71
4.2 Environmental taxes .....	73
4.3 Water pricing .....	74
4.4 Water trading .....	75
5. Water Governance .....	75
5.1 Enforcement of regulations .....	75
5.2 Performance of water utilities.....	76
5.3 Creating a “culture of water” and promoting stakeholder participation	78
5.4 Decentralisation of water management .....	78
<b>4. WASTE MANAGEMENT .....</b>	<b>81</b>
Recommendations.....	82
Conclusions .....	82
1. Objectives and Institutional Framework.....	83
2. Waste Generation Trends .....	84
3. Municipal Waste Management.....	86
3.1 Collection and disposal trends.....	86
3.2 Recovery and recycling trends.....	88
3.3 Policy measures .....	88
3.4 Financing of municipal waste management .....	90
4. Hazardous Waste Management .....	91
4.1 Recycling, treatment and disposal trends .....	91
4.2 Policy measures .....	92
<b>5. NATURE AND BIODIVERSITY MANAGEMENT .....</b>	<b>97</b>
Recommendations.....	98
Conclusions .....	98
1. Policy Objectives.....	99
2. Legal and Institutional Framework .....	104
3. Species and Ecosystem Conservation .....	104
4. Developing a Network of Protected Areas.....	107



5. Sustainable Management of Biodiversity.....	110
5.1 Terrestrial species .....	110
5.2 Aquatic and marine species .....	111
6. Financing Nature and Biodiversity Conservation .....	113
7. Sustainable Forest Management.....	114
7.1 Deforestation .....	114
7.2 Policy responses .....	115

## Part II

**SUSTAINABLE DEVELOPMENT**

<b>6. ENVIRONMENTAL-ECONOMIC INTERFACE .....</b>	<b>119</b>
Recommendations.....	120
Conclusions .....	121
Integrating environmental concerns in economic decisions .....	121
Implementing environmental policies and developing the environmental infrastructure .....	122
1. Sustainable Development .....	123
1.1 Planning and programming .....	123
1.2 Institutional integration.....	127
1.3 Market-based integration.....	130
1.4 Sectoral integration.....	135
2. Environmental Management .....	144
2.1 Legal and regulatory framework.....	144
2.2 Enforcing compliance with environmental law .....	146
2.3 Environmental charges, user fees and other economic instruments ...	148
2.4 Environmental expenditure and financing .....	150
<b>7. ENVIRONMENTAL-SOCIAL INTERFACE.....</b>	<b>153</b>
Recommendations.....	154
Conclusions .....	154
1. Environmental and Health Progress .....	155
1.1 Children's health.....	155
1.2 Objectives for further progress .....	159
2. Poverty and Access to Basic Water Services .....	160
3. Income Generation through Environmental Protection.....	164
3.1 Income generation through environmental programmes.....	164
3.2 Environmentally related employment.....	165
4. Environmental Democracy: Information, Participation and Education .....	166
4.1 Environmental information.....	166
4.2 Access to environmental information .....	167
4.3 Public participation.....	167
4.4 Environmental education .....	167

## 8. **SECTORAL INTEGRATION: AGRICULTURE AND RURAL DEVELOPMENT**

8. <b>SECTORAL INTEGRATION: AGRICULTURE AND RURAL DEVELOPMENT</b> .....	169
Recommendations.....	170
Conclusions .....	170
1. Agricultural and Rural Development Policy Objectives .....	172
2. Environmental Impact of Agriculture .....	175
2.1 Agrochemicals: fertiliser and pesticide use .....	175
2.2 Water use: large-scale irrigation, water pricing reform .....	177
2.3 Land reform, deforestation and biodiversity loss .....	182
3. Environmental Impact of Agricultural and Rural Development Policy .....	184
3.1 Agricultural policy and the environment .....	184
3.2 Rural development policy and the environment .....	188

### Part III

## **INTERNATIONAL COMMITMENTS**

9. <b>INTERNATIONAL CO-OPERATION</b> .....	191
Recommendations.....	192
Conclusions .....	192
1. Overall Performance.....	193
2. Multilateral Environmental Co-operation .....	195
2.1 Climate change .....	195
2.2 Ozone depleting substances.....	200
2.3 Pollution control agreements .....	200
2.4 Marine resources and coastal areas .....	201
2.5 World Summit on Sustainable Development (WSSD) .....	205
3. Bilateral and Regional Environmental Co-operation .....	206
3.1 Environmental co-operation between Mexico and the United States .....	206
3.2 NACEC .....	210
3.3 Other bilateral and regional environmental co-operation .....	213
3.4 Aid .....	215

## **REFERENCES**

I.A Selected environmental data.....	218
I.B Selected economic data .....	220
I.C Selected social data .....	222
II.A Selected multilateral agreements (worldwide) .....	224
II.B Selected multilateral agreements (regional) .....	228
III. Abbreviations .....	230
IV. Physical context.....	234
V. Selected environmental events (1992-2002) .....	237
VI. Selected environmental Web sites.....	241

## LIST OF FIGURES, TABLES AND BOXES

### Figures

Map of Mexico .....	14
2.1 Air pollutant emissions.....	41
2.2 Trends in the transport sector .....	50
2.3 Road fuel prices and taxes.....	52
2.4 Road fuel prices in Mexico and the United States .....	53
3.1 Access to water services.....	66
3.2 CNA revenue from various charges.....	72
3.3 Public investment and financing sources for water supply, sewerage and sewage treatment.....	72
3.4 Financial and physical efficiency of water utilities .....	77
4.1 Municipal waste generation.....	85
4.2 Municipal waste composition.....	85
4.3 Hazardous waste management infrastructure.....	94
5.1 Protected areas.....	109
6.1 Economic structure and trends .....	125
6.2 Energy structure and intensity .....	142
7.1 Social indicators .....	158
7.2 Trend in GDP per capita and extreme poverty .....	160
8.1 Agricultural inputs.....	176
8.2 Freshwater use.....	178
8.3 Agriculture.....	186

### Tables

2.1 Legal ambient air quality standards.....	37
2.2 Official Mexican standards for air pollutant emissions.....	38
2.3 Air quality in major metropolitan areas .....	45
2.4 Air quality objectives and achievements .....	45
2.5 Measures to curb emissions of traditional air pollutants in the ZMVM .....	47
2.6 Cost-benefit analysis of air pollution prevention measures in the ZMVM ....	51
3.1 Targets of the National Water Plan.....	59
3.2 Surface water quality in Mexico.....	61
3.3 Water outlook .....	64

3.4	Performance in provision of water services .....	65
3.5	Industrial waste water generation .....	69
3.6	Public investment in water supply, sewerage services and waste water treatment .....	73
4.1	National waste management policy objectives and targets .....	84
4.2	Municipal waste collection and disposal .....	87
4.3	Municipal waste disposal .....	87
4.4	Hazardous waste recycling capacity .....	94
5.1	Quantitative conservation and biodiversity targets .....	101
5.2	Global priority eco-regions in Mexico .....	106
5.3	Species of wild flora and fauna at risk .....	106
5.4	Number and size of Federal natural protected areas .....	108
5.5	Trends in number and size of UMA .....	111
5.6	Vegetation types .....	115
6.1	Selected environmentally related taxes on transport and energy .....	131
6.2	Revenue from environmentally related energy and transport taxes .....	132
6.3	Selected environmental charges and other economic instruments .....	133
6.4	Economic trends and environmental pressures .....	137
6.5	Energy prices in selected OECD countries .....	138
6.6	Selected environmental legislation .....	145
6.7	Monitoring and enforcement by PROFEPA .....	147
6.8	Federal budgetary expenditure on environment and natural resources .....	151
7.1	Marginalisation and health impacts, southern states .....	159
7.2	Selected social indicators: lowest and highest state rankings .....	162
7.3	Water supply in rural areas: Mexico and selected states .....	163
8.1	Composition of Mexican agricultural support .....	175
8.2	Public investment in infrastructure for water use in the agriculture sector ...	180
8.3	Main agricultural policy programmes .....	180
8.4	Rural development policy measures .....	189
9.1	Follow-up on 1998 OECD Recommendations .....	196
9.2	Emissions of greenhouse gases .....	198
9.3	CO <sub>2</sub> emissions from fuel combustion .....	198
9.4	Ozone depleting substances .....	201
I.A	Selected environmental data .....	218
I.B	Selected economic data .....	220
I.C	Selected social data .....	222
II.A	Selected multilateral agreements (worldwide) .....	224
II.B	Selected multilateral agreements (regional) .....	228

## Boxes

2.1	Monitoring air quality .....	40
2.2	Emissions of air pollutants .....	42
2.3	Analysis of air pollution effects on health.....	44
3.1	The quality of Mexico's waters .....	60
3.2	Protection against flooding .....	61
3.3	Water shortage in the Rio Bravo/Rio Grande basin .....	63
3.4	Lake Chapala .....	79
4.1	From informal to modern recycling of municipal waste .....	89
4.2	Transfrontier movements of hazardous waste .....	93
4.3	Identification and remediation of contaminated sites.....	96
5.1	International commitments.....	102
5.2	A megadiverse country.....	105
6.1	The economic context .....	124
6.2	Decoupling environmental pressures from economic growth.....	136
6.3	Selected features of the Mexican energy sector .....	140
6.4	Diversification of the transport sector: railway development .....	143
7.1	Social context: poverty and demographic sustainable development challenges..	156
7.2	Indigenous communities, natural resources and intellectual property rights .....	161
7.3	Local initiative: "peso-for-peso" school-based recycling programme .....	168
8.1	Structural and policy features of Mexican agriculture .....	173
8.2	Irrigation water management in Mexico .....	181
8.3	Land tenure reform: ejido, private and communal property.....	183
9.1	Protection of fauna: whales, dolphins, turtles .....	203
9.2	The northern border .....	207
9.3	Trade and the environment.....	211

## Signs

The following signs are used in Figures and Tables:

- ..: not available
- : nil or negligible
- .: decimal point

## Country Aggregates

OECD Europe: All European member countries of the OECD, i.e. countries of the European Union plus the Czech Republic, Hungary, Iceland, Norway, Poland, the Slovak Republic, Switzerland and Turkey.

OECD: The countries of OECD Europe plus Australia, Canada, Japan, the Republic of Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.  
The sign \* indicates that not all countries are included.

## Currency

Monetary unit: peso (MXN)  
In 2002, MXN 9.062 = USD 1.

## Cut-off Date

This report is based on information and data available up to June 2003.

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# 1

## CONCLUSIONS AND RECOMMENDATIONS\*

Despite the 1994-95 peso crisis and a sharp economic slowdown in 2001, Mexico's GDP grew by 41% overall between 1990 and 2001 while its *population increased by 22%* (the highest rate among OECD countries) to reach over 100 million today. The Mexican economy is the eighth largest in the OECD and the largest in Latin America, though GDP per capita is among the lowest in the OECD area. These national data mask the existence of *dual consumption and production patterns* and the persistence of regional disparities. Income inequality in Mexico is among the greatest in the OECD area. *Poverty* remains widespread, affecting 53 million people in urban and rural areas, including in particular the indigenous population. Particularly since 1994 (conclusion of the North American Free Trade Agreement and accession to the OECD), Mexico has pursued a policy aimed at *opening up its economy* and integrating it with world markets. Mexico is Latin America's most important exporting country by far; it has extensive oil and natural gas reserves and a wealth of other mineral resources, while its industrial sector is competitive in many fields. With 1.3% of world land area, Mexico hosts about 12% of known terrestrial biota and is one of the world's 12 *megadiverse countries*.

Strong *decoupling* of environmental pressure from GDP, as seen in a number of OECD countries, has not yet been achieved in Mexico. Indeed, recovery from the currency crisis and overall subsequent rapid economic growth have occurred together with increased pressures on the environment, including through pollution and natural resource use, despite the establishment of a solid environmental legal and institutional framework. Further, Mexico has adopted an ambitious approach to environmental governance, increasingly mainstreaming sustainable development as a guiding principle of sectoral policy-making processes

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\* Conclusions and Recommendations reviewed and approved by the Working Party on Environmental Performance at its June 2003 meeting.

and as a shared responsibility of different sectors and institutions. Today, *priority environmental issues* include: water and forest management, which have become issues of national security; integrated management of natural resources; environmental management and environmental planning at the watershed level; decentralisation of environmental management and decision-making; increased public participation and the right of access to environmental information; ensuring that users of natural resources pay for the environmental cost of resource use; and, strengthening of environmental legislation, inspection and compliance rates. Several of these issues reflect pressures on the environment deriving from Mexico's development choices and demography, as some 1.5 million new citizens per year increase the challenges of providing basic environmental services.

To meet these challenges, it will be necessary for Mexico to: i) thoroughly implement its environmental policies, improving cost-effectiveness and financing to extend environmental infrastructure; ii) further integrate environmental concerns into economic and social decisions; and iii) meet its international environmental commitments. This report examines progress made by Mexico *since the previous OECD Environmental Performance Review* in 1998, and the extent to which the country's *domestic objectives and international commitments* are being met. It also reviews progress in the context of the *OECD Environmental Strategy*.<sup>\*</sup> Some 61 recommendations are made that could help strengthen Mexico's environmental progress in the context of sustainable development.

## 1. Environmental Management

### *Implementing environmental policies and developing the environmental infrastructure*

*Environmental legislation* progressed during the review period. The General Law on Ecological Balance and Environmental Protection (covering air, sea and fresh water quality, hazardous waste, soil, protected areas, environmental impact assessment and noise) was updated in 1996 to introduce *integrated pollution control* for air, water and waste (introducing a Single Environmental License) and, in 2001, to establish the right of *public access to environmental information* and to strengthen public participation. New general laws were recently enacted

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\* The objectives of the "OECD Environmental Strategy for the First Decade of the 21st Century" are covered in the following sections of these Conclusions and Recommendations: maintaining the integrity of ecosystems (Section 1), decoupling of environmental pressures from economic growth (Sections 2.1 and 2.3), integration of social and environmental concerns (Section 2.2) and global environmental interdependence (Section 3).

on wildlife protection (2000) and on waste management (2003). In addition, all states have created their own environmental legal regimes. An increasing number of environmental offences are considered in the criminal code, and penal sanctions have been taken (e.g. for arson in forests). *Emission standards* are now linked to environmental quality objectives for recipient bodies. *Voluntary industry audits* have led to the granting of clean industry certificates. *User charges for Federal marine reserves* have recently been introduced and will be extended to terrestrial protected natural areas. Efforts are being made to develop public-private partnerships in the water sector.

However, though Mexico has recognised the severe environmental degradation confronting it, time as well as sustained and continuous efforts will be required to implement and fund its environmental policies. Devolution of environmental policy implementation has not been accompanied by adequate capacity building at state

It is *recommended* to:

- improve *enforcement of environmental legislation*, especially for nature and forest protection, by enhancing the human and financial capacity of PROFEPA and fostering partnerships with police authorities; review water related enforcement and compliance and include waste water discharge in integrated pollution control licences;
- extend the application of the *user and polluter pays principles* through better pricing of water and waste services, with due regard to social constraints;
- review the scope for introducing *new economic instruments* such as product charges on hazardous waste streams, air emission charges, payments for environmental services and water pollution charges;
- expand *environmental infrastructure*; in particular, increase related spending (e.g. from public, private and international sources), improve efficiency in the provision of environmental services, and develop public-private partnerships in the water and waste sectors;
- accompany decentralisation of environmental management to states and municipalities through commensurate *devolution of powers to tax and charge for environmental services* and determined efforts to build local administrative and technical capacity;
- formalise *institutional integration* mechanisms relating to sustainable development; further integrate environmental concerns into economic, fiscal and sectoral policies (e.g. transport, energy, agriculture, tourism).

and municipal levels. This *implementation gap* reflects, in particular, the complex and sometimes unclear distribution of environmental competency across levels of government and limited local authority to raise revenues from taxes or charges. The scope of *environmental enforcement* has been broadened to address unsustainable use of natural resources (e.g. illegal forest cutting) but without the necessary parallel increases in staff and budget of the Federal Attorney for Environmental Protection (PROFEPA). Irrigation Districts continue to be inspected separately by the National Water Commission (which both inspects and enforces its own irrigation schemes), while individual irrigation schemes (50% of irrigation water) are virtually uninspected. There is wide scope to extend the use of *economic instruments*, particularly in air and waste management. User charges for water and waste water services are set below cost recovery levels. Farmers are exempt from water abstraction charges. *Pollution abatement and control expenditure* has remained low by OECD standards. In fact, there are very large needs with respect to environmental infrastructure (e.g. water supply, waste water collection and treatment, waste infrastructure) which reflect cumulated underinvestment in such infrastructure and rapid population increase in urban areas. Given Mexico's environmental objectives, there is a *financing gap*: insufficient Federal spending on environmental protection, limited application of the user and polluter pays principles, the limited revenue-raising ability of states and municipalities and low reliance on external financing all explain Mexico's difficulties.

### Air

Air pollution has significantly declined overall in urban areas during the last ten years, including in the megacity of Mexico. CO, SO<sub>2</sub> and lead concentrations have decreased in many Mexican cities. There is evidence of a reduction of acute respiratory diseases in children under five. Mexico has switched from fuel oil to natural gas for part of its electricity production; the share of *natural gas* in total primary energy supply increased to 21% while oil's share fell to 62%. Seven large metropolitan areas have adopted local *air quality management programmes* that address pollution by the industry, service and transport sectors as well as environmental recovery. *Fuel quality improvements* have been the cornerstone of these programmes. Reducing the lead and sulphur content of motor vehicle fuels contributed to the reduction of some emissions from mobile sources. A regional surcharge was applied to petrol in order to finance environmental improvement measures in the Valley of Mexico Metropolitan Area (ZMVM) and to internalise environmental externalities. Further, several Official Mexican *Standards* have been issued concerning emissions from mobile and fixed sources, and more stringent *limit values* have been introduced for *vehicle emissions* of CO, NO<sub>x</sub>

and hydrocarbons. Vehicles with catalytic converters replaced after five years of operation, clean companies, and facilities using natural gas have been exempted from air quality emergency plans due to a recent regulation. The number of firms voluntarily carrying out eco-audits has consistently increased. Significant progress has been made with implementation of the OECD recommendation on the Pollutant Release and Transfer Register.

However, *exposure to air pollution remains a severe threat to public health*. Extremely high pollution episodes have become rare, but the number of days on which air quality standards are exceeded has remained unchanged. *Suspended particles and photochemical ozone* are of particular concern. Ambient air quality standards for PM<sub>10</sub> are exceeded up to 30% of the year in all metropolitan areas. The goal of reducing national NO<sub>x</sub> emissions by 40% by 2000 was not achieved.

It is *recommended* to:

- continue to strengthen *implementation and enforcement* of the regulatory system;
- extend air emissions regulation to additional *industrial branches* and update existing regulations for SMEs; improve compliance rates, particularly for the most polluting firms;
- better enforce *vehicle inspection*, make it mandatory in the most polluted cities and extend it to buses and lorries; speed up *renewal of the vehicle fleet*; further develop and implement *traffic management* in urban areas, giving appropriate priority to public transport;
- strengthen integration of air quality concerns in the industry, transport and energy sectors through use of *economic instruments* as well as elimination of subsidies with harmful environmental effects;
- continue efforts to improve *fuel quality*; in particular, reduce the sulphur content of diesel and petrol, internalise externalities in fuel prices; proceed with appropriate investment to reduce emissions and to prevent accidents in the energy sector (e.g. in refineries, power plants);
- give higher priority to pollutants with significant impacts on *human health*; in particular extend air quality monitoring to include PM<sub>2.5</sub> and VOCs;
- further develop the air management capacity of *states and municipalities*; extend *air emission estimates* to the whole country, including to all cities with over 500 000 inhabitants and to energy and industrial facilities; strengthen criteria in air quality emergency plans and extend such plans to the most polluted cities.

An integrated, long-term approach is required to reduce ozone concentrations to safe levels in the ZMVM. Relatively high levels of emissions from the transport, industry and energy sectors remain a challenge. *Transport* is growing rapidly: the number and use of private vehicles, as well as freight transport, are increasing partly as a result of NAFTA. This “volume effect” has offset the benefits of improved fuels, vehicle standards and traffic management measures. Implementation and enforcement of vehicle inspection programmes is to be strengthened for both cars and commercial vehicles (e.g. buses and lorries). Conversion of high-use vehicles (such as taxis) to compressed natural gas might be usefully revisited. Regulation of *industrial emissions* from specific branches requires updating (e.g. for SMEs) and several branches are still unregulated. Three-quarters of firms inspected in 1998-2002 were not in compliance with air emission standards. Concerning the *energy sector*, the national oil company (PEMEX) has already made important investments and half its facilities are working towards obtaining clean industry certificates; however, it still needs to invest massively to control air pollution (e.g. in its refineries) and to prevent accidents at production facilities. The energy sector reform has not been engaged. The potential for using economic instruments and reducing economic distortions with negative environmental consequences (e.g. due to subsidies) remains to be further explored in the transport industry and energy sectors.

### Water

Mexico made substantial progress towards the targets it set itself in the 1995-2000 National Water Plan. Targets for providing access to *water supply, sanitation services and waste water treatment* were largely met in urban areas, though performance fell somewhat short of targets in rural areas. Over 95% of drinking water supplied is now disinfected, with a consequent dramatic decrease in the number of cases of gastro-intestinal disease and the disappearance of cholera. There has been progress towards *decentralisation* of water management: several National Water Commission programmes are now administered at state level; state water laws have been passed in many but not yet all states, and state water commissions have been created. About 25 *river basin councils* are now operating. Administration of *irrigation districts* has been transferred to user associations, which have management and financial responsibility for operating and maintaining their irrigation systems. Water abstraction rights and permits for waste water discharge have been recorded in a Public Register available on Internet. Mexico has greatly improved its water information systems; large amounts of water data and documentation are available. Stakeholder participation in water management is actively promoted.

Use of water resources nonetheless remains *unsustainable*. *Investment in water infrastructure*, already low by OECD standards, fell in real terms during the 1990s. It currently stands at about *half of the investment that would be required* to achieve a sustainable scenario by 2025. Little over one-quarter of urban waste water is treated. Few waste water utilities met the 2000 deadline for effluent limits (set in a 1996 standard); the rest were subject to large fines. Some treatment stations are not operating due to lack of funds. Industrial discharges are largely untreated. The operational standard at treatment stations is often well below design specifications. Water utilities find it difficult to make customers pay their water bills, with the result that their income is too low to maintain good service. *Enforcement* also suffers from inadequate resourcing, and standards are not well respected. *Water losses* from irrigation and drinking water supply systems, despite recent improvements, remain high. The degree of *over-exploitation of groundwater* resources is increasing. Ecological aspects of water quality have so far been given too little consideration.

It is *recommended* to:

- increase current water-related *investments* and management efforts, in order to meet Mexico's 2025 long-term objectives and the 2015 Johannesburg targets for water supply and sanitation, with due regard to the rural population;
- pursue current proposals to increase *compliance* by local utilities and industry with the effluent limits and deadlines of 1996 standard;
- encourage drinking water and waste water facilities to obtain ISO accreditation to improve the *operational performance* of treatment plants;
- continue efforts to improve the *water efficiency of agricultural irrigation*, particularly groundwater-fed irrigation; take measures to halt overexploitation of groundwater aquifers;
- further develop demand management measures that encourage *sustainable water use* and further progress in the transition towards pricing of water services, whilst giving attention to the special needs of the poor;
- strengthen and further develop an *integrated watershed approach* to both improve water and forest resources management and provide environment-related services more efficiently;
- reinforce current policies for *awareness raising* on water quality and for fostering stakeholder participation in water basin management;
- give greater weight in water management to the protection of *aquatic ecosystems* (e.g. rivers, lakes, estuaries, deltas, wetlands).

## Waste

Significant efforts have been made to improve *hazardous waste management* in Mexico. Treatment and disposal capacity is increasing steadily and rapidly, with proper waste management capacity reaching 50% of hazardous waste generation and 100% of biological and infectious waste generation. A system to monitor hazardous waste generation, treatment and disposal has been established and its coverage is expanding. The inter-ministerial framework for managing use of toxic chemicals has been active, and efforts to promote substitution of non-hazardous for hazardous substances have been strengthened. Work to identify *contaminated sites* has begun, with these sites being prioritised according to the urgency for remediation. Remediation has been initiated at two sites.

In contrast, *municipal waste management* is at an early stage. Framework legislation has recently been approved but it remains to be implemented. Proper disposal capacity is so inadequate that over half of municipal waste is sent to uncontrolled and illegal landfills. Local governments do not have the capacity

It is *recommended* to:

- *enforce waste regulations* and reduce *illegal disposal* of hazardous and municipal waste, at national and local government levels;
- continue to enhance *hazardous waste management*, and to improve monitoring of hazardous waste generation, by working towards the completion target for the national registry (100% coverage by 2006);
- implement the newly adopted framework legislation for *municipal waste management*; increase the waste management capacity of municipal authorities and operating enterprises;
- develop a national strategy and local programmes to reduce urban and hazardous waste generation;
- increase *investment in infrastructure* (e.g. new sanitary landfills, closure of illegal landfills) for municipal waste management and extend services to medium and small cities;
- improve and modernise *recycling and reuse of municipal waste*, introducing producer responsibility for selected waste streams and taking social factors into account (e.g. the role of the informal sector); increase *composting of organic waste*;
- speed up identification of *contaminated sites*; develop and implement a national remediation strategy.



for proper waste management. Most households do not pay for waste collection. While a deposit-refund scheme was recently proposed for plastic bottles, there is still little use of economic instruments. Though part of municipal waste is recycled in the informal sector, recycling rates in Mexico are among the lowest in any OECD country. Little has been done to address waste streams of concern (e.g. tyres, used oil, plastic packaging).

### *Nature and biodiversity*

As a megadiverse country, Mexico hosts approximately 12% of the world's total biodiversity. It is a world centre of origin and domestication of food germ plasm. Mexico now has a *complete legal and institutional framework* with which to tackle challenges relating to conservation and sustainable use of biodiversity. It has adopted a model National Biodiversity Strategy and is taking steps to define and implement a National Biodiversity Action Plan. Biodiversity and natural resource policies since the 1990s have aimed at changing production activities with adverse environmental impacts and using biological resources in a sustainable way. *Designated protected areas* increased substantially during the review period. This was accompanied by the establishment of the National Commission for Protected Natural Areas and the National System of Protected Natural Areas, adoption of a number of management plans, and increased funding from public, private and international sources. The National Forestry Commission was created in 2001 to implement the National Forest Strategy, whose objectives are to reduce rural poverty, increase the share of forestry in GDP and reduce deforestation by 75% over the period 2001-25. This led to a 15-fold increase of Mexico's budget for forest management and to enactment in 2003 of a new law for sustainable forest management. Concerning species, some progress was made with conservation and recovery projects for several priority species and the System of Units for the Conservation, Management and Sustainable Use of Wildlife, which covers over one-third of the national territory. The introduction of *incentives for conservation* and sustainable use of biodiversity (e.g. charges at marine national parks, proposed payments for environmental services to forest communities implementing biodiversity conservation initiatives) is a positive step.

However, *important problems requiring solutions can still be identified*. Mexico's biological wealth is *seriously threatened* and is undervalued as a primary factor in socio-economic development. Biodiversity loss and issues have been associated with the pressures created by inadequate earlier development policies: conversion of natural habitats to unsustainable agricultural schemes, deforestation in temperate and tropical forests, overgrazing of arid zone vegetation,

It is *recommended* to:

- integrate *biodiversity* concerns into the planning, execution and evaluation of public policies (e.g. agriculture, forestry, tourism, rural development), in line with the National Biodiversity Strategy and National Biodiversity Action Plan;
- significantly increase *financial resources* (from public, private and international sources) for biodiversity conservation at national, state and local levels, including through user charges;
- further develop the National System of *Protected Natural Areas*: extending its geographical and ecological coverage; providing resources to develop and implement management plans; promoting the establishment of biological corridors; and stimulating participation by private initiatives, as well as indigenous and local communities, in their conservation;
- foster recovery of *endangered species* populations, protecting their natural habitats and reducing illegal trafficking in wild species;
- support conservation and management of terrestrial and aquatic ecosystems *outside protected natural areas*; expand *ecological land planning*;
- combat *deforestation*, particularly for tropical woods and forests: strengthening reforestation programmes; promoting sustainable forest management; encouraging forest certification; and redirecting agricultural subsidies in forest areas to finance public ecological assets;
- consolidate *information systems* on Mexico's biological diversity and introduce *monitoring and evaluation* of biodiversity related policies and actions;
- Promote new laws to regulate the access to and sustainable use of *genetic resources*, consistent with international trade and multilateral environmental agreements.

illegal trade in threatened species, conservation conflicts in protected areas, lack of integrated coastal zone management programmes, risks of genetic contamination. The *deforestation* rate is still extremely high (among the highest in the world). Despite progress in managing protected areas, these areas account for under 10% of the territory and some types of ecosystems are under-represented; human, material and financial resources are still insufficient, leaving a sizeable number of protected areas without management plans. In the last few years the number of endangered *animal and plant species* has increased. There is a lack of specific legislation regulating access to and sustainable use of genetic resources.

## 2. Towards Sustainable Development

### *Integration of environmental concerns in economic decisions*

Attaining sustainable development has become increasingly an explicit aim of the strategic National Development Plan (issued by the Office of the President and covering six year periods, based on a 25-year outlook). This plan provides the framework for the programming of much Federal public expenditure by sectors. *Environmental programming* is co-ordinated with other sectoral programming. The National Environmental and Natural Resources Programme is issued every six years. The Programme to Promote Sustainable Development in the Federal Government seeks to include sustainable development targets and action plans in sectoral planning. “Presidential” targets have been set for all ministries, including performance requirements in terms of environmental outcomes and public administration. Two national crusades have been launched, to raise public awareness of tropical deforestation and water resources and of waste management. Since 2001, the Ministry of Environment and Natural Resources (SEMARNAT), which oversees air, water and waste management as well as nature conservation and forestry, has participated in inter-ministerial economic, social and law and order meetings. There is *institutional integration* of environmental concerns within tourism policies (e.g. national eco-tourism programme, Agenda 21 for the tourism sector) and within energy policies (resulting in lower energy intensity and weak decoupling of total final energy consumption from economic growth, fuel switching from oil to natural gas, improvement of road fuel quality). Prices of *road fuel* have steadily increased. A petrol surcharge was levied in Mexico City’s metropolitan area to raise revenue for environmental activities; it has been discontinued.

However, Mexico has not achieved strong *decoupling* of environmental pressure from economic growth as has been done in some other OECD countries. This reflects its development choices as well as rapid population growth. Major sources of direct *environmental pressure* include road traffic, industrial and agricultural production, and energy production and consumption. Road freight traffic increased by 78% between 1990 and 2001, while industrial production, agricultural outputs and primary energy supply rose by 43%, 33% and 24%, respectively. *Market-based integration* has remained very limited. There have been many proposals to improve energy pricing and transport taxation, but few have been put into practice. Excise duty on fuels, designed to protect public revenue and consumer prices from fluctuations in world oil prices, and taxes on vehicles could be further differentiated according to environmental externalities. No

It is *recommended* to:

- fully take into account environmental concerns should *fiscal reform* be completed; there is a strong need for an increase in revenues to invest in environmental infrastructure;
- improve the environmental effectiveness of *energy and transport taxes*, differentiated according to air pollutant emissions and fuel efficiency; consider wider use of green taxes (petrol surcharge) to internalise environmental externalities and raise revenues;
- remove *environmentally harmful subsidies* (e.g. electricity and water) whilst giving due consideration to social concerns (e.g. replacement by direct income support for poor farmers and households so as not to distort price signals);
- improve *institutional integration within agriculture policies*, including through creating an environmental unit within the Ministry of Agriculture, Rural Development, Fisheries and Food;
- prepare a strategic environmental assessment of *transport policy*, including measures to reduce urban traffic congestion and develop rail and sea freight traffic, based on cost-benefit analysis;
- finalise the *strategy on energy and the environment*, with nationwide objectives and targets and expected completion dates, including for PEMEX and the Federal Electricity Commission's facilities.

strategic environmental assessment is carried out in the case of *transport sector policies*. Limited efforts have been made to influence modal split, resulting in a 78% increase in road freight traffic over the decade. There is very little institutional and market-based integration within the *agricultural sector*. On the contrary, support is provided for the development of intensive irrigated production, and the various agricultural and rural development programmes are designed and implemented with little regard to environmental protection. Progress in developing *renewable energy sources* has been slow, and further investments are needed to expand natural gas production and distribution to meet targets.

### *Integration of environmental and social concerns*

In the last five to ten years, Mexico has made significant progress in reducing the health impacts of pollution. In particular, a *drop in child mortality rates* (e.g. from acute gastro-intestinal and respiratory diseases) is related to water disinfection and air quality improvements. An *active policy towards income and employment generation* through environmental/natural resources management

programmes is achieving positive and sizeable results. The quantity and variety of environmental information available from national authorities (e.g. data, indicators, environmental accounting, state of the environment reports, Pollutant Release and Transfer Registers) has progressed to an advanced stage, though (as in many other countries) statistics from different agencies are not always consistent and some gaps remain. Mexico recently introduced a new law on *transparency of government activities and public access to information*; this emphasis is reflected in the whole array of its environmental laws and regulations. SEMARNAT and the Ministry of Social Development are committed to work together to certify each other's programmes, with a view to meeting both environmental and social objectives. *Environmental education* in both the formal and non-formal educational systems is commendable, as are attempts to reach the least literate part of the population. Indigenous people have been given extended rights, which should enable them to benefit more from the biodiversity they help conserve.

However, efforts on all these fronts (e.g. health, income generation, education, rights of indigenous communities), as well as improvement of access to environmental services, need to be consolidated and extended. Poverty and regional inequalities hamper further progress. *Access to basic services* such as safe water, basic sanitation and electricity remain inadequate, particularly in less-developed regions and poorer communities (including urban slums). Respiratory illnesses due to urban air pollution, as well as indoor air pollution in rural

It is *recommended* to:

- further improve health and quality of life, particularly in areas with high marginalisation levels, by reducing the share of people who do not have *access to basic services* (e.g. safe water, basic sanitation, electricity);
- continue to promote initiatives that contribute to *income and/or job generation* together with environmental improvements (e.g. reforestation, eco-tourism, sustainable forestry), particularly in rural and less developed regions;
- further strengthen *environmental education and awareness*, especially among young people;
- continue the development and *use of indicators* to measure environmental progress and related institutional effectiveness;
- ensure practical implementation of the *right of access to environmental information*.

communities where wood-burning stoves are used, still need to be addressed. While a register of hazardous activities has been established, handling of hazardous chemicals and pesticides (especially by migrant farm workers) still entails significant occupational health risks. There is a correlation between poverty and deforestation, as clearing forested land for subsistence farming is often the only way marginalised farmers can secure a livelihood. In many instances such progress will require not only well targeted programmes and more efficient environmental management, but also increased financing.

### *Sectoral integration: agriculture and rural development*

*Fertiliser and pesticide* use in Mexico is low by OECD standards. Over the last ten years, while farmland area has increased, per hectare use of nitrogenous fertilisers has fallen; this is partly because direct subsidisation of agricultural inputs has been eliminated and payments based on input use have decreased considerably. There have also been efforts to improve pesticide regulations and harmonise registration procedures with those in other OECD countries. Many harmful pesticides, including chlordane and DDT (two persistent organic pollutants), have been withdrawn from the market. *Soil and water conservation infrastructure* is being rehabilitated in rainfed areas to retain rainwater and curb surface water runoff and soil erosion. The ambitious 1992 *water pricing reform* has resulted in water user associations currently covering 80% of operational and maintenance costs in irrigation districts, compared with 20% in the early 1990s. The 1992 *land tenure reform* gave many Mexican farmers titles to property, thereby providing incentives to increase productivity in agricultural and forestry activities and to consolidate small plots into viable farms. The major agricultural policy reform process aims at improving the *market orientation of agricultural production*. The overall level of agricultural support in Mexico is low by OECD standards (Producer Support Estimate of 22%). The share of incentives aimed at intensifying agricultural production is falling significantly, while that of support more decoupled from agricultural production is increasing. Payments have been introduced to prevent use of fires as a farming practice. *Eco-certification* of forest management and of shade-grown coffee plantations is being developed. Further policy reforms give greater emphasis to creation of *new income sources in rural areas*. A new Law on Sustainable Rural Development was enacted in 2001. Rural development measures have been regrouped in a comprehensive national programme (the Concurrent Special Programme). More staff and a larger budget in the Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA) are being devoted to rural development policy.

However, commercial farmers tend to *overuse water and chemicals* on high-potential irrigated land. Agricultural water use has increased over the last 10 years; intensity of water use was already high, to the extent that water has become a significant constraint on sustainable development in many agriculture areas. Every year new areas are brought under irrigation, largely due to public investment in water infrastructure and government transfers to support on-farm irrigation, including recently increased subsidies for groundwater pumping. Consumption of methyl bromide (bromomethane), an ozone layer depleting fungicide, has dramatically increased. Traditional and subsistence farming also contributes to environmental degradation, as it tends to encroach on forests and fragile land to sustain agricultural production. *Deforestation* continues at alarming rates in tropical forests, mainly due to forest conversion to farmland or grassland. On-going agricultural policy reforms could provide new incentives for development of profitable forestry, provided the otherwise unremunerated but environmentally beneficial public services associated with forests are compensated. In fact, the link between agricultural policy and forest management has remained weak.

It is *recommended* to:

- create *synergies among agriculture, rural development, environment and natural resource management*, particularly by reinforcing institutional integration between SAGARPA and SEMARNAT and their respective agencies at the Federal and state levels and by developing a national agri-environmental strategy with quantified objectives;
- pursue efforts towards *water pricing reform in agriculture*, particularly by progressively eliminating environmentally harmful irrigation subsidies;
- contribute to the *development of profitable forestry* in the context of agricultural policy reform; in particular, further reduce incentives to intensify agricultural production and compensate populations engaged in forest management for otherwise unremunerated though environmentally beneficial public services, possibly through PROCAMPO;
- promote consolidation of forest units on ejido land into viable larger-scale forest units in the context of *land tenure reform*, and introduce more flexibility to allow contracting out of forest management;
- explore use of *economic incentives* to increase the revenues of rural populations; in particular, evaluate the potential for further promoting eco-tourism in protected areas;
- assess the environmental effects of *PROCAMPO* support payments, as well as the anticipated environmental effects of NAFTA.

Though decoupled from production, the Programme of Direct Payments to the Countryside (PROCAMPO), introduced in 1994, has not led to significant changes in agricultural production. The option of green PROCAMPO payments for environmental purposes has scarcely been used, partly reflecting limited institutional integration between SAGARPA and SEMARNAT. The *environmental effects of PROCAMPO*, including changes in pressures on marginal farmland, have not yet been evaluated. Neither have the anticipated *environmental effects of NAFTA* (from 2003, free trade applies to all agricultural commodities except maize, beans, sugar and powdered milk). *Rural development policy* has supported poor populations, but with little attention to land use patterns. In some cases land reform has led to fragmentation of forestland or its conversion to farmland. A limited amount of ejido land has actually been sold; no attempts have been made to contract out management of large-scale forests on ejido land. Few rural development activities have combined environmental and poverty alleviation objectives. Use of economic instruments to increase local people's revenues should be further explored, as well as the potential for carbon sequestration and eco-tourism.

### 3. International Commitments

Mexico has greatly improved the manner in which its international environmental agenda is being addressed. To a great extent it has acted in line with other OECD countries, though it has not always been obliged to do so. It has assumed *responsibilities beyond its legal obligations* under the Climate Change Convention and the Montreal Protocol. Mexico ratified the Kyoto Protocol in 2000. CO<sub>2</sub> inventories have been carried out and effective measures have been taken to reduce GHG emissions. CO<sub>2</sub> emissions have been decoupled from GDP growth. Consumption of ozone-depleting substances has been much reduced, in advance of mandatory requirements. Mexico has important responsibilities relating to *its rich biodiversity*, but resources with which to protect the environment and conserve natural resources are limited. It has made considerable *progress towards protection of whales, sea turtles and dolphins* and has created the world's largest whale sanctuary. It promotes co-operation with like-minded countries that are also rich in biodiversity, with a view to creating an equitable system of natural resource use. *Bilateral environmental co-operation* has been strengthened, and *regional environmental co-operation* with other Latin American countries has increased. Mexico has provided technical assistance to support sustainable development in a number of Latin American countries. Tripartite environmental co-operation within North America is increasing and has led to concrete results; improvements were made recently in waste water treatment near the northern border.



However, Mexico is experiencing difficulties *implementing its legal regime*, as well as adequately *funding* projects, in order to meet its international commitments. Law and order in the environmental protection area could be improved, especially in an open economy like that of Mexico. *Air pollution* in the twin cities along the northern border has worsened, largely due to increasing international lorry traffic. Cross-border difficulties have arisen over *water use* in northern Mexico. Current plans concerning access to drinking water and basic sanitation are not consistent with undertakings under the UN Millennium Declaration or the objectives agreed at the Johannesburg Summit. Additional financial resources should be made available to ensure consistency. Regarding climate change, economic instruments are still not used as incentives for behavioural change or to finance subsidies encouraging use of cleaner energy. Activities to protect the *marine environment* and coastal ecosystems from land-based activities and pollution sources, and from pollution from ships, could be given greater attention and be better co-ordinated.

It is *recommended* to:

- continue to emphasise the use of *indicators and quantified targets* in developing result-oriented international environmental strategies;
- address the negative environmental impacts of growing *international trade and investment* in northern Mexico;
- strengthen both the institutions to enhance bilateral co-operation and the mechanisms that encourage international commitments, consistent with *environmental management decentralisation*;
- develop *like-minded countries* positions on international issues, such as biodiversity conservation, response to climate change, and international law, and assume leadership as appropriate;
- develop a national strategy to reduce the rate of growth of *GHG emissions*, with specific objectives and precise measures to be taken over the next few years, including under the proposed Clean Development Mechanism;
- seek the development of *integrated management of international water basins*, with special emphasis on efficient use of water;
- improve institutional mechanisms to provide better protection of the environment in *marine waters*, coastal waters and coastal zones, and increase involvement by SEMARNAT in this regard;
- continue to develop institutions and measures to combat marine *pollution from ships* and to respond rapidly to *oil emergencies*.

# 2

## AIR MANAGEMENT\*

### Features

- Air management in the megacity of Mexico
- Integration of air quality concerns in transport policies
- Integration of air quality concerns in energy policies
- Analysis of air pollution effects on health

\* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “maintaining the integrity of ecosystems” of the 2001 OECD Environmental Strategy.

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- continue to strengthen *implementation and enforcement* of the regulatory system;
- extend air emissions regulation to additional *industrial branches* and update existing regulations for SMEs; improve compliance rates, particularly for the most polluting firms;
- better enforce *vehicle inspection*, make it mandatory in the most polluted cities and extend it to buses and lorries; speed up *renewal of the vehicle fleet*; further develop and implement *traffic management* in urban areas, giving appropriate priority to public transport;
- strengthen integration of air quality concerns in the industry, transport and energy sectors through use of *economic instruments* as well as elimination of subsidies with harmful environmental effects;
- continue efforts to improve *fuel quality*; in particular, reduce the sulphur content of diesel and petrol, internalise externalities in fuel prices; proceed with appropriate investment to reduce emissions and to prevent accidents in the energy sector (e.g. in refineries, power plants);
- give higher priority to pollutants with significant impacts on *human health*; in particular extend air quality monitoring to include PM<sub>2.5</sub> and VOCs;
- further develop the air management capacity of *states and municipalities*; extend *air emission estimates* to the whole country, including to all cities with over 500 000 inhabitants and to energy and industrial facilities; strengthen criteria in air quality emergency plans and extend such plans to the most polluted cities.

## Conclusions

Air pollution has significantly declined overall in urban areas during the last ten years, including in the megacity of Mexico. CO, SO<sub>2</sub> and lead concentrations have decreased in many Mexican cities. There is evidence of a reduction of acute respiratory diseases in children under five. Mexico has switched from fuel oil to natural gas for part of its electricity production; the share of *natural gas* in total primary energy supply increased to 21% while oil's share fell to 62%. Seven large metropolitan areas have adopted local *air quality management programmes* that address pollution by the industry, service and transport sectors as well as environmental recovery. *Fuel quality improvements* have been the cornerstone of these programmes. Reducing the lead and sulphur content of motor vehicle fuels contributed to the reduction of some emissions from mobile sources. A regional surcharge was applied to petrol in order to finance

environmental improvement measures in the Valley of Mexico Metropolitan Area (ZMVM) and to internalise environmental externalities. Further, several Official Mexican *Standards* have been issued concerning emissions from mobile and fixed sources, and more stringent *limit values* have been introduced for *vehicle emissions* of CO, NO<sub>x</sub> and hydrocarbons. Vehicles with catalytic converters replaced after five years of operation, clean companies, and facilities using natural gas have been exempted from air quality emergency plans due to a recent regulation. The number of firms voluntarily carrying out eco-audits has consistently increased. Significant progress has been made with implementation of the OECD recommendation on the Pollutant Release and Transfer Register.

However, *exposure to air pollution remains a severe threat to public health*. Extremely high pollution episodes have become rare, but the number of days on which air quality standards are exceeded has remained unchanged. *Suspended particles and photochemical ozone* are of particular concern. Ambient air quality standards for PM<sub>10</sub> are exceeded up to 30% of the year in all metropolitan areas. The goal of reducing national NO<sub>x</sub> emissions by 40% by 2000 was not achieved. An integrated, long-term approach is required to reduce ozone concentrations to safe levels in the ZMVM. Relatively high levels of emissions from the transport, industry and energy sectors remain a challenge. *Transport* is growing rapidly: the number and use of private vehicles, as well as freight transport, are increasing partly as a result of NAFTA. This “volume effect” has offset the benefits of improved fuels, vehicle standards and traffic management measures. Implementation and enforcement of vehicle inspection programmes is to be strengthened for both cars and commercial vehicles (e.g. buses and lorries). Conversion of high-use vehicles (such as taxis) to compressed natural gas might be usefully revisited. Regulation of *industrial emissions* from specific branches requires updating (e.g. for SMEs) and several branches are still unregulated. Three-quarters of firms inspected in 1998-2002 were not in compliance with air emission standards. Concerning the *energy sector*, the national oil company (PEMEX) has already made important investments and half its facilities are working towards obtaining clean industry certificates; however, it still needs to invest massively to control air pollution (e.g. in its refineries) and to prevent accidents at production facilities. The energy sector reform has not been engaged. The potential for using economic instruments and reducing economic distortions with negative environmental consequences (e.g. due to subsidies) remains to be further explored in the transport industry and energy sectors.



## 1. Policy Objectives

*Air quality targets* have been established for major metropolitan areas using the *Air Quality Metropolitan Index* (IMECA) initially developed in the Valley of Mexico Metropolitan Area (ZMVM). The ambient air quality standard for each pollutant is set at IMECA 100; levels over 100 are considered a health concern. The following intermediate key targets were set in the *1995-2000 Environmental Programme* (first two items) and the 2001-06 National Programme on Environment and Natural Resources (third and fourth items):

- decrease the *IMECA daily maximum values* mean in the Valley of Mexico Metropolitan Area from 170 points to 140 to 150 points, and reduce by 75% the number of days on which IMECA 250 is exceeded;
- reduce *air pollutant emissions* by 50% (hydrocarbons), 40% (NO<sub>x</sub>) and 45% (PM<sub>10</sub> from human activities);
- in the Valley of Mexico Metropolitan Area, decrease the IMECA daily maximum values mean for *ozone* to less than 130 points, and reduce by 10% the number of days on which standards are exceeded;
- ambient air quality standards for *CO and SO<sub>2</sub>* not to be exceeded in the cities of Ciudad Juárez, Guadalajara, Mexicali, Monterrey, Puebla and Tijuana or in Mexico City.

Seven Official Mexican Standards were issued in 1993 to regulate ambient air quality. These NOMs were for CO, NO<sub>2</sub>, SO<sub>2</sub>, lead, ozone, PM<sub>10</sub> and total suspended particles (Table 2.1). Other NOMs have been issued to address emissions from both fixed and mobile sources (Table 2.2).

Air management performance can further be assessed against the recommendations of the *1998 OECD Environmental Performance Review* of Mexico:

- continue to strengthen implementation and enforcement of the regulatory system;
- pursue efforts to supplement the regulatory regime with self-reporting, audits and voluntary agreements with specific industrial subsectors (particularly the electricity generation, oil, petrochemical and chemical industries); give special attention to the many “micro” industries in urban areas;
- pursue efforts to prevent and control pollution from mobile sources through national and local programmes; tighten emission limits for new petrol and diesel vehicles;
- further pursue the introduction and application of economic instruments;

- improve the technical capability of states and municipalities to plan and implement air quality programmes under their jurisdiction, and ensure that the implementation of environmental standards is harmonised across the country;
- identify cost-effective implementation strategies for all states; in major urban and industrial centres, develop integrated air quality improvement plans with clearly defined goals and targets;
- develop a national database of air emissions, including toxic emissions; co-ordinate existing local monitoring systems and develop a national air quality monitoring programme capable of producing timely and policy-relevant information; pay special attention to risk and exposure assessment and epidemiological aspects of air pollution in metropolitan areas;

Table 2.1 **Legal ambient air quality standards**  
( $\mu\text{g}/\text{m}^3$ )

Pollutant	Parameter	Limit value	Maximum number of exceedances per year	Official Mexican Standard
Ozone	1-hr mean value	216	1	NOM-020-SSA1-1993, as amended in 2002
	8-hr mean value	157	5	
CO	8-hr mean value	12 595	1	NOM-021-SSA1-1993
SO <sub>2</sub>	Daily mean value	341	1	NOM-022-SSA1-1993
	Annual mean value	79	0	
NO <sub>2</sub>	1-hr mean value	395	1	NOM-023-SSA1-1993
Total suspended particles	Daily mean value	260 <sup>a</sup>	1	NOM-024-SSA1-1993
	Annual mean value	75	0	
PM <sub>10</sub>	Daily mean value	150 <sup>b</sup>	1	NOM-025-SSA1-1993
	Annual mean value	50	0	
Lead	3-month mean value	1.5	0	NOM-026-SSA1-1993
PM <sub>2.5</sub> <sup>c</sup>	Daily mean value	65	1	NOM-025-SSA1-1993, proposed amendment
	Annual mean value	15	0	

a) It is proposed to lower the standard to 210  $\mu\text{g}/\text{m}^3$  (daily mean value).

b) It is proposed to lower the standard to 120  $\mu\text{g}/\text{m}^3$  (daily mean value).

c) Proposed standard, not yet implemented.

Source: INE.

Table 2.2 Official Mexican standards for air pollutant emissions

	Industry	Vehicles
1993	Sulphuric acid producing plants (SO <sub>x</sub> ), sulphuric acid haze Dodecylbenzene sulphonic acid producing plants (SO <sub>x</sub> ) Cement industry (particles, fugitive emissions) Industrial process (particles) Heavy oil consumption by fixed sources prohibited in ZMVM	Diesel vehicles in plant (HC, CO, NO <sub>x</sub> , particles, opacity) Motorcycles (HC, CO, opacity) LPG and natural gas vehicles in use
1994	Combustion process in industrial sources, including powered plants (SO <sub>x</sub> , NO <sub>x</sub> , particles, opacity) Fuel quality <sup>a</sup>	Fuel quality <sup>a</sup>
1995	Oil refineries (VOCs) Service stations in ZMVM (vapour recovery) Glass (NO <sub>x</sub> , particles)	New vehicles in plant over 3 857 tonnes gross weight Inspection of diesel vehicles (opacity)
1996	Cellulose (sulphur compounds, particles)	Diesel vehicles in use (opacity)
1997	Automobile industry (VOCs) Paint (VOCs)	
1999		Petrol vehicles in use New petrol and gas vehicles in plant (unburnt and evaporative HC, CO, NO <sub>x</sub> )

a) The same NOM applies to fixed and mobile sources.

Source: SEMARNAT.

- raise public awareness of air pollution issues and implement recently legislated provisions for public access to information, for example by putting the new Pollutant Release and Transfer Register and the System of Indicators of Environmental Law Compliance into effect as quickly as possible.

## 2. National Air Management Framework

The Ministry of Environment and Natural Resources (SEMARNAT) is responsible for issuing air *emission permits* for certain categories of *fixed sources* (i.e. facilities producing chemicals, oil and petrochemicals, paint and dye, cars and lorries, paper, metals, glass, electric power, asbestos and cement, as well as hazardous waste treatment plants). SEMARNAT and the Ministries of the Economy and of

Energy regulate the content and characteristics of motor, industrial, commercial and domestic *gaseous and liquid fuels*. Within SEMARNAT, the National Institute of Ecology (INE) has primary responsibility for setting technical ambient standards and emission limits for fixed and mobile sources, as well as *vehicle emission standards*. The Ministry of Health, which also has a role in standard setting, reviews standards from around the world and evaluates health studies from Mexico and other countries.

Articles 110 through 116 of the General Law on Ecological Balance and Environmental Protection (LGEEPA) provide the legal basis for air quality management. The law's general principle is that air pollutants which might cause ecological imbalance or danger to the environment may not be emitted. Amendment of LGEEPA in 1996 changed and more clearly delineated *Federal, state and municipal powers* with respect to air pollution. SEMARNAT continues to issue air quality standards by region, area or zone, and to ensure that air pollution programmes developed by state and municipal governments are consistent with Federal standards. Under the amended LGEEPA, states and municipalities have greater responsibility for air quality management (e.g. in developing economic instruments that encourage taking air management goals into account). In regard to the 1998 OECD recommendation to improve the air management capability of states and municipalities, air quality monitoring networks have been updated and strengthened in the 15 largest metropolitan areas and emission inventories developed in the seven largest (Box 2.1). A Joint Consultation Committee has been established in Ciudad Juárez; an Air Quality Alliance in Tijuana involves local authorities, the private sector, academics and NGOs.

The Federal Attorney for Environmental Protection (PROFEPA) verifies *compliance* with Federal legislation. In regard to the 1998 OECD recommendation to strengthen implementation and enforcement of the regulatory system, *inspection of industry* has become more selective (concentrating on highly polluting firms) but also more in-depth (three-day instead of one-day inspections). Of the 34 000 plants that exist in Mexico, PROFEPA focuses inspections on the 7 000 that are most polluting or at high risk of a major accident. Three-quarters of these plants still do not comply with air emission standards; this may result in fines and penalties, which amounted to MXN 200 billion between 1998 and 2002. In the case of major violations (1.3% of firms), administrative procedures have been initiated that could lead to partial or total closure.

To avoid fines, firms can opt to enter into voluntary auditing schemes. The number of *eco-audits* carried out annually has continuously increased since this scheme was introduced in 1992. There were 136 per year in the period 1992-97, 170 in 1998, 221 in 1999 and 472 in 2000. Firms that volunteer to perform an eco-audit may be granted a Clean Industry Certificate, provided all environmental performance requirements are met (188 such certificates were granted in 2002).



*Emergency plans* are activated when certain air quality threshold levels are exceeded. An IMECA of 240 for ozone (250 before 1998) or 175 for PM<sub>10</sub> triggers a city's phase-one emergency plan (e.g. requesting, on a voluntary basis, that people not drive, that 20% of petrol stations close, and that certain factories also close). An IMECA of 300 (350 before 1998) triggers the phase-two emergency plan (e.g. closing of all public schools, government offices, banks, museums, parks and recreational facilities, and further reduction of industrial activities). In the Valley of Mexico Metropolitan Area between 1993 and 2000, there were 32 phase-one emergencies (31 involving ozone and one involving PM<sub>10</sub>) extending over 92 days. Since 2000 only one phase-one emergency has occurred (involving PM<sub>10</sub>).

### Box 2.1 Monitoring air quality

The 2001-06 National Programme on Environment and Natural Resources stresses the need for *local governments* to monitor air quality and air pollutant emissions periodically. The purpose of monitoring is to *inform the public and facilitate decision-making*, particularly through helping prepare air quality management programmes for major metropolitan areas.

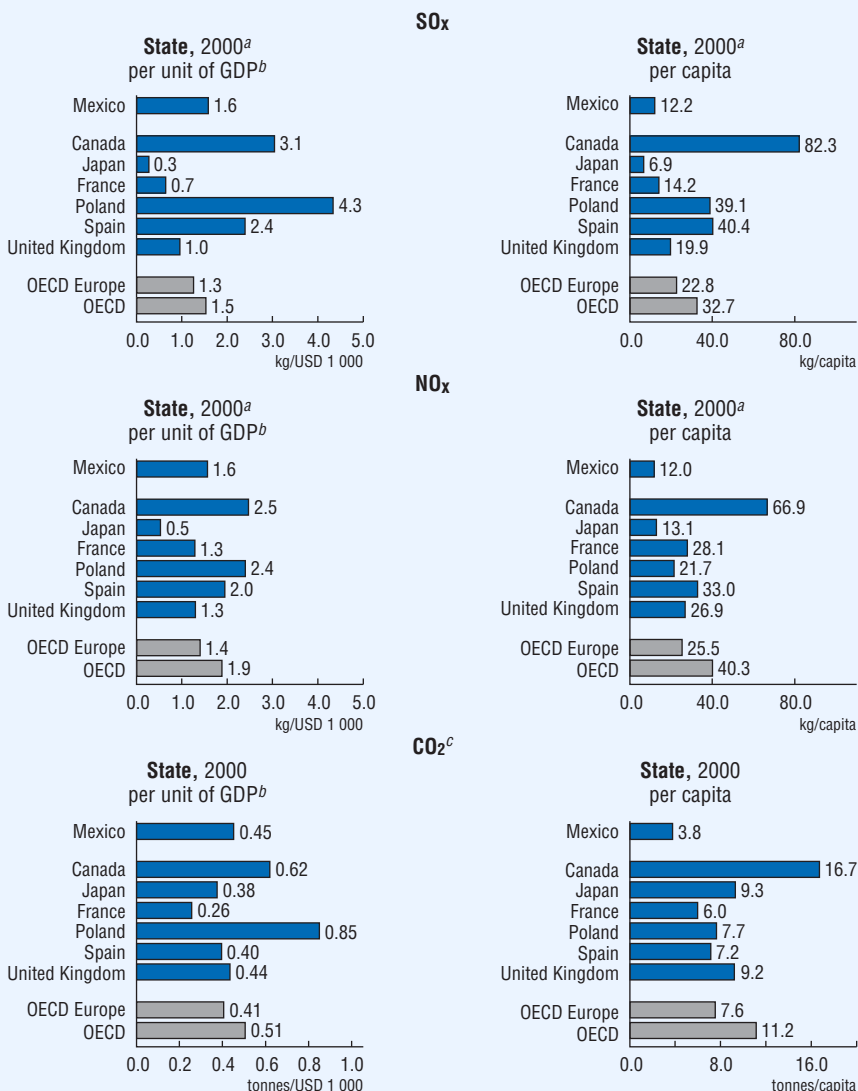
Progress has been made regarding the 1998 OECD recommendation to develop a national air quality monitoring programme. A *National Information System on Air Quality* (SINAICA) was established in the second half of the 1990s. The Federal government transferred USD 2.5 billion to 26 states to assist installation of monitoring systems in metropolitan areas. Currently 23 cities have permanent monitoring systems, including major cities (Mexico City, Guadalajara, Monterrey, Toluca) and cities along the northern border (Ciudad Juárez, Tijuana, Mexicali). Air quality improvement programmes (PROAIRE) are in place in the seven largest. Once SINAICA is fully operational in 2004, it will give the general public real time access to air quality information according to city, pollutant and concentration.

## 3. Air Management in Large Metropolitan Areas

### 3.1 Progress and challenges

The far-reaching policies implemented in Mexico to combat air pollution have produced significant results, e.g. with respect to children's health (Chapter 7). However, relatively high emissions from industry, energy production and transport remain a challenge (Figure 2.1 and Box 2.2). This is especially true in major urban areas, where related *severe threats to public health* persist (Box 2.3). Over the last ten years

Figure 2.1 Air pollutant emissions



a) Or latest available year.

b) GDP at 1995 prices and purchasing power parities.

c) Emissions from energy use only; excludes international marine and aviation bunkers.

Source: OECD; IEA.

### Box 2.2 Emissions of air pollutants

A methodology has been developed for preparing *emission inventories*. National inventories should allow sectoral emissions to be identified (e.g. from industry, energy, transport, housing, agriculture). In regard to the 1998 OECD recommendation to develop a national air emissions database, between 1995 and 2000 individual inventories were elaborated for Ciudad Juárez, Guadalajara, Mexico City, Mexicali, Monterrey, Tijuana and Toluca. SEMARNAT is updating the emission inventory for the Valley of Mexico Metropolitan Area (ZMVM), jointly with Mexico City and state of Mexico authorities.

A 1995-98 inventory of *emissions in seven major metropolitan areas* (Valley of Mexico, Guadalajara, Monterrey, Valley of Toluca, Ciudad Juárez, Mexicali and Tijuana) showed that transport was the major cause of urban pollution, particularly CO, NO<sub>x</sub> and HC emissions. The transport sector emits almost 90% of traditional air pollutants in Ciudad Juárez, 85% in the ZMVM, 75% in Guadalajara, 70% in Mexicali and Toluca, and 50% in Monterrey. Private vehicles are the main source of these emissions. In 1995-98, 3.1 million tonnes of traditional air pollutants per year was emitted in the ZMVM, 2 million in Monterrey, 1.4 million in Guadalajara, 600 000 in Ciudad Juárez, 500 000 in Toluca and 400 000 in Mexicali. These inventories are being updated with special attention to PM<sub>10</sub> and PM<sub>2.5</sub> emissions from vehicles, industry, commercial establishments and soil sources (e.g. unpaved streets, deforested land, areas without vegetation).

According to available estimates, in the last ten years national NO<sub>x</sub> emissions and (to a lesser extent) national SO<sub>x</sub> emissions have tended to increase. *SO<sub>x</sub> and NO<sub>x</sub> emissions* per unit of GDP are close to the OECD average, though significantly lower when expressed per capita.

The Industry Verification Programme, a self-monitoring and self-reporting programme begun in 1992, requires all industries in the ZMVM to measure air pollution emissions once a year and report the results. *Annual Operating Record (COA) reporting by the main industrial branches* (asbestos, automotive, cellulose and paper, cement and lime, chemical, electric power generation, glass, hazardous waste treatment, metallurgical, paint and dye, petroleum and petrochemical) has recently become mandatory. COA includes information on pollutant transfer (treatment, recycling, reuse, final disposal or incineration), pollution prevention measures and projections of future pollution. The number of COA increased from 1 252 in 1998 to 1 775 in 2000. In 2000 the chemical industry submitted 36% of all COA and the metallurgical industry 21%.

Most COA (65%) include information that can be put into the national *Pollutant Release and Transfer Register (PRTR)*. The PRTR contains data on substances or pollutants released to the environment (or transferred to a treatment or disposal system) which could harm human health or ecosystems. In regard to the 1998 OECD recommendation to improve public access to information, Mexico's first country-wide PRTR was published in 1998. It included national information on sources of

**Box 2.2. Emissions of air pollutants (cont.)**

GHGs, ozone depleting substances and on urban basin air quality. Protocols have been signed between the Federal government and state governments to improve reporting and include State sources of air pollutant emissions.

Energy-related *CO<sub>2</sub> emissions* have been increasing for many years. They continued to grow (by 23%) in the 1990s; the main sources were road transport and oil-fired power stations (Chapter 9). *CO<sub>2</sub> emissions* per unit of GDP are slightly below the OECD average; per capita, they are well below this average. Urban air quality improvement programmes do not explicitly aim at reducing greenhouse gas emissions, though the 2001-10 ZMVM programme requests that the link between local air pollutant emissions and global climate change be studied. Double dividends can be achieved (for GHG and traditional pollutant emissions) in a number of ways, particularly through energy efficiency initiatives.

*SO<sub>2</sub> concentrations* have decreased in the Valley of Mexico (–67%), Guadalajara (–53%) and Monterrey (–8%). Between 1993 and 2000, *NO<sub>2</sub> concentrations* also decreased in the Valley of Mexico (–29%) and Monterrey (–21%) but increased significantly in Guadalajara (+68%). Today the main ambient air quality problems in urban areas concern *photochemical ozone and suspended particles*, largely the result of fossil fuel combustion (from industry and transport) and of soil erosion (Table 2.3). *PM<sub>10</sub> concentrations* decreased between 1995 and 2000 in the Valley of Mexico (–14%) and Guadalajara (–23%) but increased in Monterrey (+15%).

In regard to the 1998 EPR recommendation to develop integrated air quality improvement plans, programmes have been initiated to improve urban air quality with the aim of protecting human health by setting quantitative air quality targets and controlling emission sources. Seven large metropolitan areas have adopted *local air management programmes*: the Valley of Mexico in 1995, Guadalajara, Monterrey and Toluca in 1997, Ciudad Juárez in 1998, Mexicali and Tijuana-Rosarito in 2000. Each programme has its own goals (Table 2.4). The situation in the Valley of Mexico is somewhat different from that in other metropolitan areas, but all these air management programmes address pollution originating in the industry, service and transport sectors, as well as environmental recovery. Measures concerning the industry and service sectors typically include stricter emission limits, self-regulation, emergency plans, air emission control equipment, regulation of fuel quality, economic incentives to acquire new equipment, and inspection and enforcement. Transport measures include

### Box 2.3 Analysis of air pollution effects on health

The health impacts of population exposure to air pollutants began to be studied a number of years ago. In 1998 the Ministry of Health created the *National Centre of Environmental Health* (CENSA) to perform epidemiological studies (e.g. ozone and PM<sub>10</sub> pollution in the ZMVM). CENSA and the National Environmental Research and Training Centre (CENICA), established by INE in 1997, have undertaken joint research activities.

In Mexico City studies have shown a close correlation between *urban air pollution and pulmonary diseases*, ageing processes in the lungs and respiratory infections. Concern in large cities focuses on ozone, suspended particles and certain VOCs (e.g. benzene). *Ozone* standards in the ZMVM are exceeded 80% of the year. Days on which ozone concentrations are higher than twice the current standard (IMECA 200) decreased from 26% of the year in 1995 to 3% in 2001.

In large metropolitan areas a large percentage of the population is frequently exposed to *PM<sub>10</sub> concentrations* exceeding 150 µg/m<sup>3</sup> (current standard). This contributes to respiratory disease as well as increased mortality. Several recent studies have established a correlation between 3% increased mortality and every 10 µg/m<sup>3</sup> PM<sub>2.5</sub> increase above the standard, with deaths mainly due to cardiopulmonary disease and lung cancer. Other studies have shown a correlation between a 0.6 to 1.3% increase in mortality in the over-65 population and a 10 µg/m<sup>3</sup> increase in PM<sub>10</sub> concentrations. In the metropolitan area of Guadalajara, days on which PM<sub>10</sub> standards were exceeded decreased from 30% of the year in 1999 to 19% in 2002.

Besides being ozone precursors, *volatile organic compounds* (VOCs) are directly toxic to humans. There is still no continuous or widespread monitoring of VOC concentrations in Mexico; no air quality standard (NOM) has been set. Whatever the difficulty of establishing VOC standards, concentrations of some of these toxic substances (e.g. acetaldehyde, benzene, 1,3 butadiene, formaldehyde, and by-products of diesel combustion) and the extent to which they could have negative health impacts should be monitored periodically. This would allow improvements in risk management.

restricting use of polluting cars, stricter emission limits, improving vehicle inspections, regulating fuel quality, renewing the vehicle fleet and improving public transport. Environmental recovery measures involve green areas, road paving, and urban and rural reforestation.

**Table 2.3 Air quality in major metropolitan areas, 1999-2002<sup>a</sup>**  
(% of days on which IMECA 100 exceeded)

Metropolitan area	Ozone	PM <sub>10</sub>	NO <sub>2</sub>	SO <sub>2</sub>	CO
Valley of Mexico	83.5	9.1	2.9	1.8	0.3
Guadalajara	16.1	24.3	5.3	0.5	2.0
Monterrey	3.1	22.1	0	0	0.3
Toluca Valley	7.3	8.7	0.2	0	0
Ciudad Juárez	1.8	23.4	..	..	0.8
Tijuana-Rosarito <sup>b</sup>	0.3	5.6	0.3	0	0
Mexicali <sup>b</sup>	7.8	34.8	0.5	0	18.8

a) Simple 4-year average.

b) Simple 3-year average 1997-99.

Source: INE.

**Table 2.4 Air quality objectives and achievements**

Metropolitan area	PROAIRE period	Unit	Beginning of PROAIRE period	1999	2000 target	2005 target <sup>b</sup>
Valley of Mexico	1995-2000	IMECA <sup>a</sup>	170	147	150	140
Guadalajara	1997-2001	IMECA <sup>a</sup>	125	93	100	75
Monterrey	1997-2000	IMECA <sup>a</sup>	70	83	50	0
Toluca Valley	1997-2000	Days above norm	60	77	54	30
Ciudad Juárez	1998-2002	Days above norm	42	27	21	0
Mexicali	2000-05	Days above norm	108	..	108	54
Tijuana-Rosarito	2000-05	Days above norm	7	..	7	2

a) Annual average of the Air Quality Metropolitan Index (IMECA) for five traditional air pollutants (ozone, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO).

b) Assuming extension in time of Air Quality Improvement Programme (PROAIRE).

Source: INE.

### 3.2 Air management in the megacity of Mexico

Unfavourable *topographic and meteorological conditions* aggravate air pollution in the Valley of Mexico Metropolitan Area (ZMVM). The Valley of Mexico is surrounded by mountains as high as 3 000 to 5 000 metres, which reduces average wind speeds and interferes with the dispersal of pollutants, particularly suspended particulate matter. It is also very exposed to ultraviolet radiation due to its altitude (2 440 metres on average) and low latitude (19° north). Inversions favouring photo-chemical reactions are frequently observed.

The *first programme* (PICCA) addressing air pollution in the ZMVM was launched in 1990. It aimed at improving fuel quality, promoting public transport, reducing emissions from vehicles and the industry and service sectors, and encouraging reforestation. The *second programme* (PROAIRE 1995-2000) had four main goals: cleaner industry (emission reduction in the industry and service sectors); cleaner vehicles (per-kilometre emission reduction); new urban zoning and cleaner transportation (traffic regulation); and environmental recovery (combating soil erosion). Other initiatives have included the Valley of Mexico Environmental Trust Fund, which promotes air quality improvement activities and is financed by fuel taxes; the Automatic Environmental Monitoring Network; the Environmental Emergency Programmes; the “day without a car” programme; a reforestation programme; and environmental education (Table 2.5).

These efforts have had a number of *positive effects*. Overall air pollution declined significantly in the 1990s. However, CO and SO<sub>2</sub> levels still exceed air quality standards. Mexico City has experienced *high levels of particulate and ozone air pollution* for many years. In 1995-99 the ZMVM was exposed to annual average concentrations of PM<sub>10</sub> above the standard of 50 µg/m<sup>3</sup>; two million people were exposed to annual averages above 75 µg/m<sup>3</sup>. Concerning ozone, the daily maximum one-hour standard was exceeded on at least 277 days per year. Occurrence of extremely high ozone concentrations has been decreasing in Mexico City; IMECA 200 was exceeded on 88 days in 1995, compared with 19 days in 2000 and only 12 days in 2001. Between 1995 and 2001, about 80% of measurements in Mexico City still exceeded the ozone standard (IMECA 100). The number of days per year on which ozone standards were met ranged from 50 to 129 in 1995-2001 (against 26 to 53 days in 1990-94).

The *third programme* to improve air quality (PROAIRE 2002-10), was designed and implemented by the recently created Metropolitan Environmental Commission that regroups the Federal government, the Federal District (Mexico City) and Mexico state government. PROAIRE 2002-10 includes short and medium-term goals to improve air quality and identifies specific responsibilities for the industry and transport sectors. The main measures are the Single Environmental License (LAU), the annual operating

**Table 2.5 Measures to curb emissions of traditional air pollutants in the ZMVM, by pollutant<sup>a</sup>**

	Lead	SO <sub>2</sub>	NO <sub>2</sub> and ozone	PM <sub>10</sub>	CO
1990 or end 1980s	Start reducing TEP <sup>a</sup> in petrol (nova, nova plus) from 3.5 ml to 0.5-1.0 ml/gallon	Industry and thermal power plants start using natural gas	"A day without a car" programme; new vehicle inspection programme; petrol with 5% MTBE; relocation outside ZMVM of highly polluting firms		
1991	to 0.3-0.54 ml/gallon	Start reducing sulphur from 2% to 1% (light fuel oil) and from 3.8% to 3% (heavy fuel oil) <sup>b</sup>	New vehicles equipped with two-way catalytic converters (NO <sub>x</sub> , HC)		
1992	to 0.2-0.3 ml/gallon (regular unleaded or magna sin)	Thermal power plants use 100% natural gas	Reducing HC in petrol (nova and magna sin); programme to control industrial emissions (NO <sub>x</sub> , HC)	PROFEPA eco-audit programme	Programme to use LPG
1993		Start distributing low-sulphur road diesel (0.05% instead of 0.5%)	New vehicles equipped with three-way catalytic converters (NO <sub>x</sub> , HC, CO); extension of distribution of magna sin petrol	Start distributing low-sulphur road diesel (0.05% instead of 0.5%)	
1994	to 0.1-0.2 ml/gallon in winter		Standards (NOMs) for industrial emissions and fuel quality	Standards (NOMs) for industrial emissions and fuel quality	
1995	Start distributing petrol with 0.01 gTEP/gallon (nova plus magna)	Light fuel oil replaced by industrial diesel	Control of vapour losses in 4 PEMEX petrol storage terminals	Light fuel oil replaced by industrial diesel	
1996	Start distributing unleaded high octane petrol (premium)				
1997	End distribution of leaded petrol (nova)	Sulphur in industrial diesel from 1% to 0.05%	Start distributing petrol magna reformulada; new vehicle inspection programme		



Table 2.5 **Measures to curb emissions of traditional air pollutants in the ZMVM, by pollutant<sup>a</sup> (cont.)**

	Lead	SO <sub>2</sub>	NO <sub>2</sub> and ozone	PM <sub>10</sub>	CO
1998		Sulphur in heavy fuel oil from 3% to less than 1%		Public participation programme (paving of dirt roads, reforestation)	CNG pilot programme for vehicles
1999			PIREC programme <sup>c</sup> to reduce NO <sub>x</sub> emissions; Metro line B starts operating	Programme to mitigate PM <sub>10</sub> emissions	PIREC programme to renew three-way catalytic converters

a) TEP: lead tetraethyl; 1 gallon is 3.7854 litres.

b) Heavy fuel oil is called combustóleo; light fuel oil is called gasóleo.

c) PIREC: Integral Programme to Reduce Polluting Emissions.

Source: PROAIRE 2002-10.

record (COA), the integrated system for industrial regulation and environmental management (SIRG), consolidation of the pollutant release and transfer register (PRTR), as well as improvements in urban traffic and highway infrastructure. It is expected that by 2010 these measures will reduce emissions of PM<sub>10</sub> by 78%, SO<sub>2</sub> by 77%, CO by 67%, NO<sub>x</sub> by 41% and hydrocarbons (HC) by 79% compared with 2002.

Implementation of these air quality improvement programmes has benefited from both *public and private funding*. Public funding in the ZMVM has largely come from Mexico City, the state of Mexico and SEMARNAT. It has also included investments by PEMEX in the production of high-quality fuels, and by the electricity sector in environmental rehabilitation and replacement of thermal power plants. Investments in public transport (USD 10.5 billion between 1996 and 2000) have involved fuel improvement, extension of public transport systems (including the metro) and urban restructuring. In recent years the surcharge on magna and premium petrol has generated revenues of USD 2.8 billion per year, part of which has been allocated to an environmental trust fund to improve public transport. Private investments have focused on reconversion in the industry and service sectors, as well as new automotive technologies and public transport. In the Monterrey Metropolitan Area, air management expenditure has been financed by an environmental fund regrouping financial resources for all pollution prevention and control activities.

#### 4. Integration of Air Management in Transport Policies

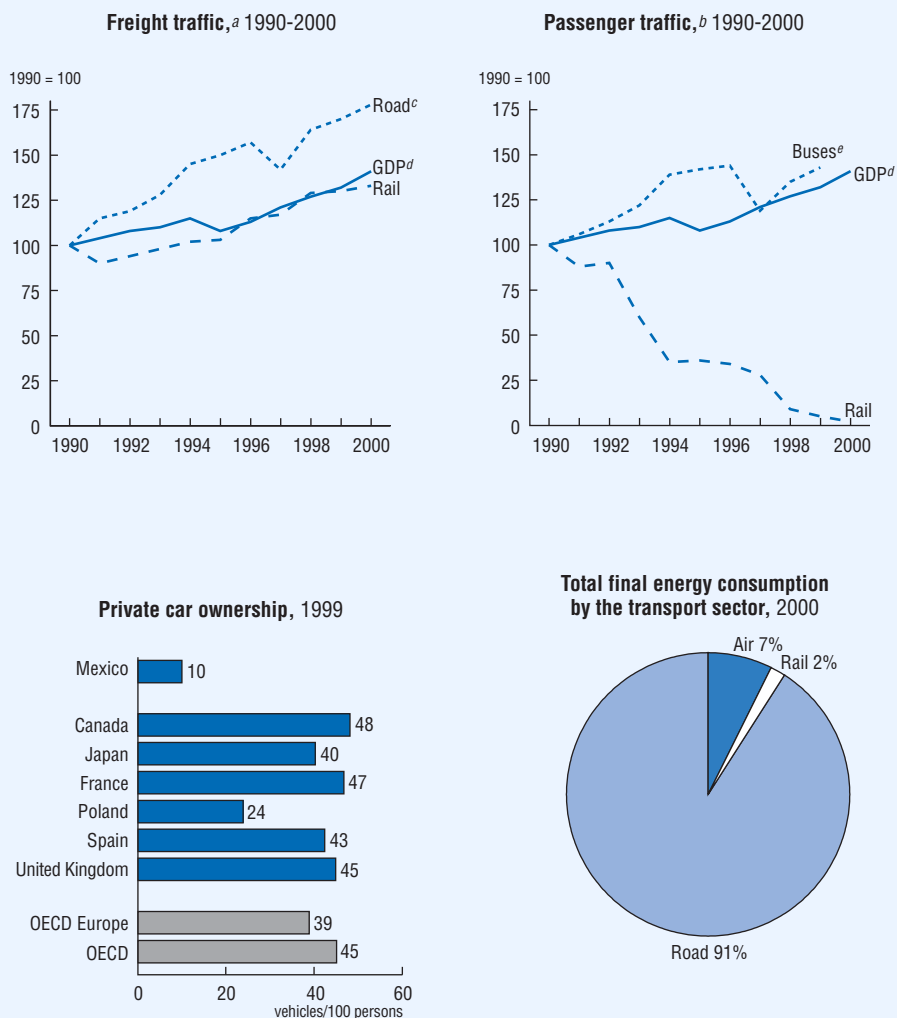
*Road transport* continues to dominate surface transport in Mexico, an increasing trend in the 1990s (Figure 2.2). Over 95% of passengers and 80% of freight are currently carried by road. Inter-urban traffic mainly consists of private cars, trucks and buses, but air also represents a significant share. In the case of passenger transport, rail is not competitive with other modes though this situation could change with the privatisation of FERRONALES (Chapter 6). Growth in car sales (now over 1 million/year) is expected to continue. In the context of North American economic integration, proposals have been made to remove or reduce registration taxes on new vehicles by 2004 to bring them closer to those of the US and Canada. It has been estimated that this could reduce new car purchase prices significantly, perhaps by up to 30%.

Mexico has eight sets of *vehicle emission limits* for different fuel types and models (including values for cars not yet equipped with catalytic converters), as well as more stringent limits for the ZMVM. In regard to the 1998 OECD recommendation to tighten emission limits for new vehicles, in 1999 the National Institute of Ecology (INE) introduced more stringent limit values for CO, NO<sub>x</sub> and HC emissions. Current regulations are largely based on US standards. Mexico introduced these regulations with some delay compared with the US, but delays are being greatly reduced, reflecting *economic integration in northern Mexico*. For example, in 1994 the regulation on new vehicle emissions was modified in Mexico to regulations in effect in the US since 1981. The 1999 Mexican regulation establishes TIER I standards in effect in the US since 1994. Under current plans, TIER II standards will be introduced in Mexico in 2006, compared with 2004 in the US.

Programmes have been initiated by SEMARNAT, the energy ministry, PEMEX and vehicle assembly plants to improve *inspections* of new vehicle emissions. There is a need to develop in-use vehicle emission inspection infrastructure to verify compliance of heavy trucks and passenger vehicles with emission criteria. Such emission testing should become mandatory for buses and trucks with Federal license plates. While catalytic converters have been mandatory in new cars since 1994, in 1999 the Mexico City government issued a regulation that exempted all vehicles with catalytic converters less than five years old or replaced after five years from use restrictions. That regulation created a market for catalytic converters; 170 000 are expected to be replaced per year.

Concerning *public transport*, in Mexico City the *dominant mode of passenger transport* has clearly shifted from large diesel-fuelled buses (40 to 50 seats) to small petrol-fuelled models (five to 10 seats). Small buses (“micros”) now account for 60% of passenger-kilometres (the share of large buses two decades ago); the remaining 40% includes the subway (metro) (17%), taxis (11%), large buses (11%) and trolley buses

Figure 2.2 Trends in the transport sector



a) Index of relative change since 1990 based on values expressed in tonne-kilometres.

b) Index of relative change since 1990 based on values expressed in passenger-kilometres.

c) Intercity truck activity on Mexico's Federal highway system.

d) GDP expressed in 1995 prices and purchasing power parities.

e) Intercity buses, Mexico's Federal highway system.

Source: ECMT; AAMA; IRF; OECD.

(1%). The subway's share has decreased since 1980 (from 25 to 17%), while that of taxis has increased (from 6 to 11%). Mexico City authorities recently decided to stop issuing new taxi licences (there are currently 110 000). Cost-benefit analysis indicates that the best option for the next five years is to convert taxis and small buses to *compressed natural gas* (raising external safety issues) and to get rid of passenger vehicles over 20 years old (Table 2.6). A natural gas conversion programme introduced in 1989 to reduce air emissions from vehicles by 30% has met with limited success. Initial goals called for conversion of 80 000 taxis, 2 000 buses and 16 000 official cars and trucks to CNG. Despite backing by the city government and World Bank funding, only two CNG service stations are operating in Mexico City and fewer than 5 000 vehicles have been converted. However, retrofitting for CNG is expected to increase significantly in the near future as Mexico City expands its natural gas distribution network.

Concerning *fuels*, in 1998 leaded petrol was completely phased out and the sulphur content of road diesel fuel (currently 350 ppm) is to be reduced to 50 ppm. The inter-ministerial group on fuel policy (involving the Ministries of the Economy, Finance and Public Credit and Energy, as well as PEMEX) periodically adjusts fuel prices. *Road fuel prices* have increased in the last ten years, but are still lower than those in Europe (Figure 2.3). When calculated at current exchange rates, they are now higher than prices in the US (Figure 2.4). In regard to the 1998 OECD recommendation to further introduce and apply economic instruments, a regional surcharge has been applied to fuels to finance environmental improvement measures in the ZMVM and, to some extent, internalise environmental externalities (Chapter 6).

Table 2.6 **Cost-benefit analysis of air pollution prevention measures in the ZMVM**

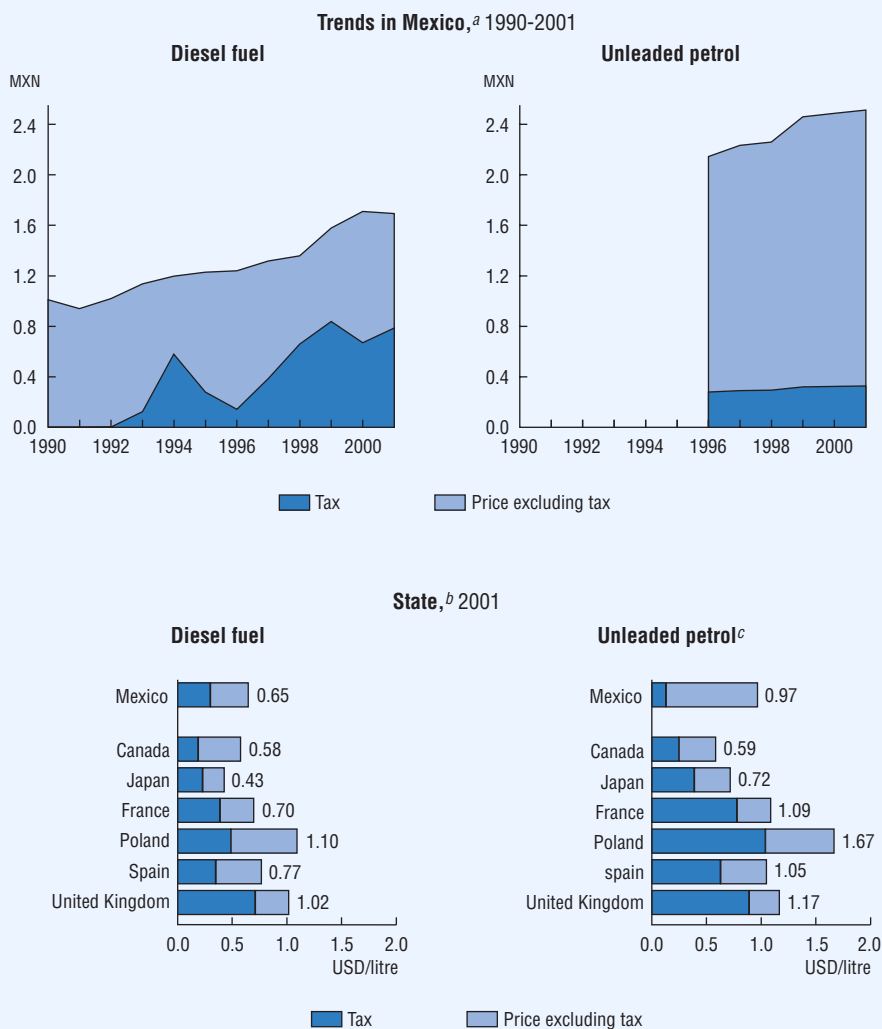
Measure	emission reduction %		Cost (MXN billion 1999)	Time horizon (years)
	NO <sub>x</sub>	HC		
Renew taxi fleet	4	6	6 <sup>a</sup>	6
Renew diesel bus fleet	2	3	5	5
Eliminate cars over 20 years old	8	8	3 <sup>b</sup>	4
Convert small buses to natural gas	9	8	4	5
Convert taxis to natural gas	9	9	2.5	5

a) Assuming cost of MXN 100 000 per taxi.

b) Assuming cost of MXN 15 000 per car.

Source: INE.

Figure 2.3 Road fuel prices and taxes

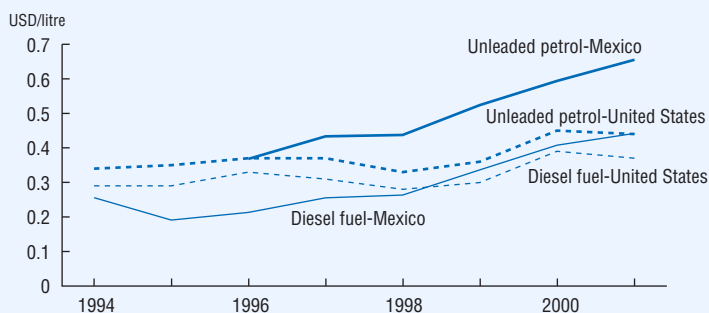


a) At constant 1995 prices.

b) In USD at current prices and purchasing power parities.

c) Unleaded premium (RON 95); Canada, Japan: unleaded regular.

Source: IEA-OECD.

Figure 2.4 Road fuel prices<sup>2</sup> in Mexico and the United States

a) In USD at current prices and exchange rates.

Source: IEA-OECD.

## 5. Integration of Air Management in Energy and Industrial Policies

The *energy intensity* (toe per unit GDP) of Mexico's economy is slightly below the OECD average. About 93% of primary energy supply comes from fossil fuels, with the share of natural gas growing (to 21%) and that of oil falling (to 62%); renewable energy sources account for over 5%. Mexico's energy sector has not undergone major reforms (e.g. extending competition, as in many other OECD countries) and large investments may be required in the future (Chapter 6).

Regulation of *industrial emissions* is targeted at specific industrial branches. Key criteria are volume of emissions, type of industrial processes and quantity of fuel consumed. The regulations cover SO<sub>x</sub>, NO<sub>x</sub>, particle and hydrocarbon emissions. Regulation of specific branches is not complete; several branches are not yet regulated. Among the sources of SO<sub>x</sub> emissions, thermal power plants have been identified as a serious problem.

*Improving fuel quality* has been the cornerstone of Mexico's air quality improvement programmes. Over the last decade, higher fuel quality and use of cleaner technologies have significantly contributed to air quality improvement in Mexico's major cities. PEMEX began constructing desulphurisation facilities which are soon expected to achieve a recovery rate of 98.5%; this performance will represent an improvement of 80% over the 1994 level. In 1986 PEMEX introduced a process to improve fuel quality in Mexico. In 1998 the sulphur content of industrial diesel fuels was reduced to 0.05%. Notwithstanding these achievements, Mexico will need to make major

investments to further expand desulphurisation capacity in order to produce low-sulphur petrol and diesel. This is all the more necessary in order to take full advantage of low-emission vehicular technologies that will be introduced in the near future.

*Fuel switching to natural gas* is on-going. Mexico is making major investments in natural gas transport and distribution country-wide. Especially in Mexico City, PEMEX has supported the government's fuel switching efforts in the industrial sector. Natural gas accounted for 58.5% of total fuel used for industrial purposes in 1998; its share is expected to be around 68% by 2007.

Concerning *PEMEX facilities*, the Integrated Management System for Industrial Safety and Environmental Protection programme was launched in 1998 with the objective of making PEMEX an environmentally friendly company. A first step was to inscribe each PEMEX facility in the *voluntary environmental audit* programme. Audits of each facility have produced individual assessments and generated a list of corrective actions to be implemented at each site. Almost half the facilities have produced action lists and are working towards obtaining clean industry certificates. Some aim to achieve ISO 14001 certification. SO<sub>x</sub> emissions account for 70% of air pollution from *PEMEX facilities* and VOC emissions for 30%. SO<sub>x</sub> emissions come from flares on offshore platforms (33%), boilers using fuel oils (25%) and gas processing centres (23%). Over 90% of VOCs are produced by evaporation of hydrocarbons at storage facilities; corrective measures have included installing internal floating roofs and improving service stations for tanker trucks, including installation of vapour recovery equipment. Over USD 270 million has been invested in air pollution abatement from a budget of USD 420 million for 1999-2002. PEMEX has already made important investments in the last few years to improve its air pollution record. It should continue investing to meet its goal of obtaining clean industry certificates for at least half its facilities.

The *Federal Electricity Commission* (CFE) generates over 90% of Mexico's electric power. It has made important investments to improve its environmental performance. Most were aimed at switching from fuel oil to natural gas. However, some power plants are located in areas with critical air quality problems. This will require CFE to use fuel oil with lower sulphur content and to continue investing in cleaner technologies, particularly at facilities that cannot be converted to natural gas.

Air quality *emergency plans* cover industries in Mexico City and Guadalajara. The Mexico City plan involves 450 firms that must reduce their operations by 30 to 40% during phase-one and up to 50% during phase-two emergencies. Clean companies are exempt from emergency plans, creating an incentive to invest in cleaner technologies. To be exempted from emergency plans, companies have to be in compliance with air emission regulations, especially for SO<sub>x</sub>. Facilities using natural gas as fuel may be exempted if they can demonstrate that they are in compliance with PM<sub>10</sub> emission regulations.

# 3

## WATER MANAGEMENT\*

### Features

- Policy objectives: water as a government priority
- Providing water services to a growing population
- Economic and financial aspects
- Water governance
- Water shortage in the Rio Bravo/Rio Grande basin
- Lake Chapala

\* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. In addition, it reviews progress with respect to the objective “maintaining the integrity of ecosystems” of the 2001 OECD Environmental Strategy.



## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- increase current water-related *investments* and management efforts, in order to meet Mexico's 2025 long-term objectives and the 2015 Johannesburg targets for water supply and sanitation, with due regard to the rural population;
- pursue current proposals to increase *compliance* by local utilities and industry with the effluent limits and deadlines of 1996 standard;
- encourage drinking water and waste water facilities to obtain ISO accreditation to improve the *operational performance* of treatment plants;
- continue efforts to improve the *water efficiency of agricultural irrigation*, particularly groundwater-fed irrigation; take measures to halt overexploitation of groundwater aquifers;
- further develop demand management measures that encourage *sustainable water use* and further progress in the transition towards pricing of water services, whilst giving attention to the special needs of the poor;
- strengthen and further develop an *integrated watershed approach* to both improve water and forest resources management and provide environment-related services more efficiently;
- reinforce current policies for *awareness raising* on water quality and for fostering stakeholder participation in water basin management;
- give greater weight in water management to the protection of *aquatic ecosystems* (e.g. rivers, lakes, estuaries, deltas, wetlands).

## Conclusions

Mexico made substantial progress towards the targets it set itself in the 1995-2000 National Water Plan. Targets for providing access to *water supply, sanitation services and waste water treatment* were largely met in urban areas, though performance fell somewhat short of targets in rural areas. Over 95% of drinking water supplied is now disinfected, with a consequent dramatic decrease in the number of cases of gastro-intestinal disease and the disappearance of cholera. There has been progress towards *decentralisation* of water management: several National Water Commission programmes are now administered at state level; state water laws have been passed in many but not yet all states, and state water commissions have been created. About 25 *river basin councils* are now operating. Administration of *irrigation districts* has been transferred to user associations, which have management and financial responsibility for operating and maintaining their irrigation systems. Water

abstraction rights and permits for waste water discharge have been recorded in a Public Register available on Internet. Mexico has greatly improved its water information systems; large amounts of water data and documentation are available. Stakeholder participation in water management is actively promoted.

Use of water resources nonetheless remains *unsustainable*. *Investment in water infrastructure*, already low by OECD standards, fell in real terms during the 1990s. It currently stands at about *half of the investment that would be required* to achieve a sustainable scenario by 2025. Little over one-quarter of urban waste water is treated. Few waste water utilities met the 2000 deadline for effluent limits (set in a 1996 standard); the rest were subject to large fines. Some treatment stations are not operating due to lack of funds. Industrial discharges are largely untreated. The operational standard at treatment stations is often well below design specifications. Water utilities find it difficult to make customers pay their water bills, with the result that their income is too low to maintain good service. *Enforcement* also suffers from inadequate resourcing, and standards are not well respected. *Water losses* from irrigation and drinking water supply systems, despite recent improvements, remain high. The degree of *over-exploitation of groundwater* resources is increasing. Ecological aspects of water quality have so far been given too little consideration.



## 1. Policy Objectives: Water as a Government Priority

### 1.1 Water policy objectives in the 1990s

The medium-term objectives of the *National Water Plan (PNH 1995-2000)* were to:

- reduce limitations on water availability affecting disadvantaged social groups;
- promote integrated river basin management, starting with basins where pollution causes the greatest health, economic and environmental damage;
- safeguard the right to use national waters and the right to the benefits therefrom;
- move towards sustainable development through a pricing regime that takes economic and environmental factors into account;
- increase public participation in water use and management;
- progressively devolve water management towards local authorities and users to achieve more efficient use of the resource;
- promote more efficient water use for irrigation, industrial and domestic purposes to safeguard the resource's future availability and quality.

More *specific quantitative objectives* to be achieved by 2000 included:

- in rural areas, increase the number of people connected to drinking water systems from 13.8 to 18.8 million and the number connected to sanitation facilities from 5.5 to 15.1 million;
- in urban areas, increase the number of people connected to drinking water from 62.8 to 68.8 million and the number connected to sewerage networks from 56.0 to 60.6 million;
- maintain adequate disinfection of at least 95% of the water supplied by drinking water systems and increase these systems' installed capacity from 2.21 to 2.37 cubic kilometres per year;
- increase urban waste water treatment from 0.536 to 2.586 cubic kilometres per year by rehabilitating existing systems and building new ones, with priority given to the 15 priority basins;
- bring an additional 1 040 km<sup>2</sup> of land under irrigation and rehabilitate 8 000 km<sup>2</sup> of existing irrigation systems.

Different types of objectives are established in the official *Mexican standard NOM-001-ECOL-1996*, which came into force in 1997. This standard sets limits on concentrations of contaminants in waste water effluent (though they are not as stringent as those applying in most OECD countries) discharged to various types of water bodies (e.g. those used for irrigation, recreation, protection of aquatic life). It also contains a timetable stipulating dates by which discharges are to comply, depending on their size.

Water management performance can further be assessed based on the recommendations of the *1998 OECD Environmental Performance Review* of Mexico to:

- further pursue measures to reduce health risks from contaminated water, particularly in rural areas; extend the existing Agua Limpia programme;
- strengthen enforcement of water regulations, concessions and permits, as well as collection of water abstraction and pollution fees;
- complete management reforms in the areas of irrigation, municipal water services and devolution of functions to the states;
- strongly pursue measures to improve efficiency of water use for irrigation and other purposes;
- examine priorities for public investment in water infrastructure and continue setting up public-private partnerships for financing, building and managing municipal water services;

- establish clear performance criteria and accountability mechanisms for all water utilities;
- establish all proposed basin councils and enable them to become strong water resource management agencies (e.g. provide mechanisms making it possible for them to generate their own financing).

This chapter will show that despite good progress made to date, considerable further efforts are needed with respect to all the above OECD recommendations.

## 1.2 Current water policy objectives

*Water is one of the two main themes of the Presidential targets* that function as signposts for the present administration (Chapter 6). The water-related Presidential targets are largely the same as the targets of the current National Water Plan (PNH 2001-06) (Table 3.1).

*PNH 2001-06*, adopted following extensive public consultation, establishes a considerable number of medium-term strategies and programmes under six general objectives:

- efficient use of water in agriculture;
- expanded coverage and better quality of water supply, sewerage and waste water treatment services (Box 3.1);

Table 3.1 **Targets of the National Water Plan, 2001-06<sup>a</sup>**

Targets	2001	2002	2006
Inhabitants connected to drinking water supply (%)	88	88	89
Inhabitants connected to sewerage (%)	76	77	78
Ratio of volume of waste water treated (%)	23	28	41 <sup>b</sup>
Inhabitants in rural areas with drinking water supply (%)	68	69	71
Ratio of efficiently irrigated area/total irrigated area (%)	14	15	23
Number of basin councils in operation	1	6	25
Number of groundwater committees in operation	4	13	41
Verification of compliance with water and pollution permits (%)	7	26	100
Amount collected from levies, fees and taxes (MXN million 2001)	6 150	6 337	7 094
Number of people protected from floods (thousand inhabitants)	150	607	1 697

a) PNH 2001-06.

b) Revised PNH target (original target was 65%).

Source: PNH 2001-06.

### Box 3.1 The quality of Mexico's waters

Mexico has formulated a *practical water quality index* (ICA) to describe the quality of its surface waters. The ICA can range from 0 (toxic) to 100 (pristine); it incorporates up to 18 variables (e.g. biochemical oxygen demand, dissolved oxygen, coliform, nutrients and suspended solids). An extensive national monitoring network with 535 measuring stations has been established. Frequency of measurements varies with the importance of each station. Not all 18 parameters are measured every time at all stations.

Results published by the CNA show that *78% of measuring stations registered an ICA of 50 or better* in 2001. The proportion of water bodies with an ICA below 50 increased from 17% in 1998 to 23% in 2001 (Table 3.2). While three years is too short a period on which to base a reliable assessment of trends in water quality (which is also affected by natural phenomena such as drought in the 1990s), the growing number of water bodies with low water quality may reflect the fact that the sewerage connection rate has increased more rapidly than the rate of sewage treatment.

Pollution pressure on Mexico's surface waters is *highly concentrated* in a small number of rivers. About 90% of the BOD<sub>5</sub> load is found in 20 basins; over one-half is concentrated in just four basins (Alto Balsas, Blanco, Lerma and San Juan). Of the over 22 billion cubic metres of waste water discharged to surface waters, agriculture accounts for 56% by volume (mainly as diffuse sources), urban waste water 34% and industry about 10%.

*Little attention has so far been paid to ecological aspects of water quality.* Aquatic biodiversity has not yet been well described (with the possible exception of the biodiversity of fish), but the National Biodiversity Commission (CONABIO) is creating an inventory. The main water law makes only a general reference to "ecological balance". The CNA, which until now has employed few ecologists, has begun trying to link its regional water programmes with other elements of the National Environmental and Natural Resources Plan 2001-06, whose objectives include conservation of Mexico's biodiversity. The CNA has also developed a method for calculating the minimum flows required to safeguard aquatic species in rivers, though this method has not been applied yet. It may be time for the CNA to consider ecology more explicitly in its mission, functions and objectives (as hydraulic engineering organisations in several other OECD countries have already done) and to give greater weight to water quality's ecological aspects.

- integrated and sustainable management of basins and aquifers;
- technical, administrative and financial development of the water sector;
- increased participation in water management by users and civil society and encouragement of wise use of water;
- reducing the risks of and damage caused by floods and droughts (Box 3.2).

### Box 3.2 Protection against flooding

One of the six general objectives of the current PNH concerns *reducing the risks of and damage caused by floods* and droughts; the material damage they cause has been estimated at about MXN 4.5 billion per year on average. Concerning flooding, the authorities have reinforced emergency response capabilities by establishing regional emergency management centres that co-ordinate rescue efforts and other emergency actions. A national natural disasters fund provides emergency assistance when needed. Flood warning capability has been improved. The CNA is building flood protection works, but it is difficult to control development in floodplains in such way as to reduce the population's vulnerability to flooding. Some of the larger cities are attempting to use spatial planning to discourage construction in floodprone areas. The existence of informal settlements (i.e. squatters) makes such measures even more difficult to implement in Mexico than in some other OECD countries.

Table 3.2 Surface water quality in Mexico, 1998-2001

ICA <sup>a</sup> range	Water quality	Use	% of water bodies <sup>b</sup>	
			1998	2001
100-85	Excellent	All uses	4	6
84-0	Acceptable	Drinkable with conventional treatment	21	20
69-50	Lightly contaminated	Drinkable with advanced treatment	58	51
49-30	Contaminated	Unsuitable for most direct uses	13	16
29-0	Highly contaminated	Unsuitable for most direct uses	2	6
Off scale	Presence of toxics	Unsuitable for most direct uses	2	1

a) ICA = Mexican water quality index, incorporating 18 water quality parameters such as pH, BOD<sub>5</sub>, suspended solids.

b) Measured in 535 surface water bodies throughout Mexico.

Source: PNH 2001-06.

PNH 2001-06 sets a number of *quantitative targets* (Table 3.1). Together they point to a slowing of the pace with respect to extending the coverage of water supply and sewerage services, and to catching up in terms of the still much lower coverage of sewage treatment. The current PNH also places greater emphasis on management issues such as compliance, collection of fees and charges, and better operating efficiency of utilities and Irrigation Districts.

Mexico has ratified several *international agreements* relating to water (Chapter 9 and Box 3.3). It is committed to the 2002 *Johannesburg Plan of Implementation*, whose water-related targets are to:

- halve, by 2015, the proportion of people in the world without access to safe drinking water (reaffirmation of the United Nations Millennium Development Goal); and
- halve, by 2015, the proportion of those who do not have access to basic sanitation.

The present rate of progress can be evaluated against the *long-term perspective* for the year 2025. PNH 2001-06 presents two possible “scenarios” describing the water infrastructure needed in 2025 (Table 3.3). The “business-as-usual” scenario is an extrapolation of current policies, conditions and trends. It does not anticipate an increase in the share of the population with access to water supply and sanitation services (growth in the number of people with such access is implied). The other scenario makes certain assumptions concerning economic growth and structure and specifies conditions required for sustainability. Only the second scenario is consistent with the Johannesburg targets.

## 2. Providing Water Services to a Growing Population

Mexican *water utilities* are predominantly municipal services or municipally owned and operated companies. In recent years private companies (e.g. in Aguascalientes, Cancún, the Federal District, Navojoa, Puebla and Saltillo) have also become involved. The government is encouraging wider private sector participation, through which management and technical expertise as well as financial resources would be contributed.

*Good progress* has been made towards meeting the PNH 1995-2000 infrastructure targets. Even if these targets were not wholly met by the end of 2000, the delay in most cases has been around one or two years (Table 3.4). However, the current rate of progress is not sufficient to meet the sustainability goals for 2025 (Table 3.3).

### 2.1 Water supply

The PNH 1995-2000 objective of providing 86.8 million people with water supply services was *nearly met*. In 2002 access was provided to 88.3 million inhabitants. Performance exceeds targets in urban areas but *falls short in rural areas* (Table 3.4). While 95% of people covered have a tap in their dwelling, for some a public stand-pipe or hydrant is the only means of accessing water supply. Mexico’s water supply connection rate is a little above the average for the Latin America/Caribbean region in both urban and rural areas, but below the average in North America.

### Box 3.3 Water shortage in the Rio Bravo/Rio Grande basin

The main instrument for solving water issues at the border between Mexico and the United States is the bilateral International Boundary and Water Commission (IBWC), created in 1944 when the two countries agreed to share the waters of the Colorado River and the Rio Bravo (called the Rio Grande in the US). This agreement *establishes water quotas to be delivered to each country*.

Increasing use of water for agricultural purposes, shifts in crops, growth in drinking water consumption, inefficient water use and worsening pollution, combined with severe drought since 1993, have resulted in *water shortage in the Rio Bravo basin*. There is overexploitation of aquifers, low water levels in reservoirs, and a shortage of water for agriculture and households. The Rio Bravo did not even reach the Gulf of Mexico in February 2001. While this water shortage reflects the *prolonged drought*, it is also due to *poor water management in the region*.

South Texas farmers are demanding that Mexico release part of the flow it is said to owe the United States under the 1944 Treaty. This would have serious consequences for Mexican farmers who depend on the Rio Conchos, as Mexico's reservoirs are already very low. The *water debt* exists because Mexico released less water than foreseen under the Treaty, partly due to severe drought over a prolonged period. The Treaty does not allow either party to remain indefinitely with a water debt. The accumulated debt for the period 1992-97 (1 263 million cubic metres) was paid off in 2001. The Mexican government intends to pay off the debt for 1997-2002 (1 719 million cubic metres) over the period 2002-07. The Treaty specifies that Mexico must pay its water debt in the Rio Bravo basin. There is disagreement concerning the parties' exact obligations (i.e. the volume to be provided and when). In July 2002 Mexico agreed to release, on a contingency basis, 90 000 acres feet of water (6% of what it owes). More information will be available soon on this issue, which has been taken up at presidential level.

In 2001 Mexico proposed convening a binational summit to develop an *overall sustainable management plan for the Rio Bravo basin*. In 2002 the two governments agreed to invest jointly in water conservation, sustainability and efficiency measures in the region and a system to provide reliable information on the water resource. The North American Development Bank (NADB) has proposed funding USD 40 million of the USD 420 million Mexican programme for improvement of irrigation and municipal infrastructure. Mexico has also announced eleven irrigation modernisation projects in the north of the country. Outlays in Mexico to modernise irrigation over the next four years will amount to USD 154 million. The Mexican Water Commission has decided to allocate USD 100 million over five years for water conservation.

It is clear that less water would be used in the Rio Bravo region if irrigation were more efficient. *Subsidisation of irrigation water* provided on both sides of the border contributes to worsening water scarcity. Better water pricing is called for, but water management in the Rio Bravo basin could also be improved.



Mexico's *rapid population growth* makes it difficult to increase the share of the population with access to public water supply (Figure 3.1). Over 22.3 million people were connected to water supply for the first time in the period 1990-2001; in the same period, however, the population grew by over 14.5 million, so that the total number of people not connected to water supply fell by only 7.8 million.

These national figures do not reveal the *wide variability among states, or between urban and rural areas*. For example, only about 70% of the population of Guerrero and Veracruz had access to water supply at the end of this period, compared with over 99% in Aguascalientes. Urban areas were better serviced than rural ones: 97% of urban dwellers in large cities (over 50 000 inhabitants) had running water, compared with 91% in medium-sized towns (between 2 500 and 50 000 inhabitants) and 70% in rural areas (communities with fewer than 2 500 inhabitants). One-quarter of the Mexican population currently lives in rural areas.

The increasing penetration of *drinking water disinfection* was effective in limiting a resurgence of *cholera* in the early 1990s. Only a single cholera case was reported in 2001, compared with over 16 000 in 1995; there have been no deaths since 1998. The PNH objective of disinfection of 95% of all water supplied by drinking

Table 3.3 **Water outlook, 2025**

	Situation 2000	2025 BAU <sup>a</sup>	2025 sustainable growth
<b>WATER SUPPLY</b>			
Water losses in urban networks (%)	44	44	24
Coverage of drinking water services (%)	88	88	97
<b>WASTE WATER</b>			
Coverage of sewerage services (%)	76	76	97
Proportion of waste water treated (%)	23	60	90
<b>IRRIGATION</b>			
Area modernised (million hectares)	0.8	1.1	5.8
New areas (million hectares)	..	0.49	1.00
Water losses (%)	54	51	37
Water use (billion cubic metres)	72 <sup>b</sup> /79	85 <sup>b</sup> /91	75 <sup>b</sup> /80
Annual investment in water sector (MXN billion)	14	16	30

a) Business-as-usual.

b) Accepting restrictions on irrigation demand in case of drought.

Source: PNH 2001-06.

water systems by 2000 was very nearly achieved at 94.3% (Table 3.4), up from 84.5% in 1991. By the end of 2001, 95.8% was disinfected.

Very good performance was recorded in *extending full treatment of drinking water*. Installed plant capacity reached 2.5 km<sup>3</sup>/year in 2000, exceeding the PNH target of 2.4 km<sup>3</sup>/year (Table 3.4). However, plants with a total installed capacity of 0.1 km<sup>3</sup>/year were idle since their operators could not afford to keep them running. Only about one-quarter of total volume of drinking water supplied is treated beyond simple disinfection.

Despite expansion of the water supply infrastructure in recent years, *poor service* frequently detracts from this achievement. Many systems, notably in rural areas, cannot provide a continuous or sufficient supply of water and service interruptions are common. Many pipe systems are in poor condition due to lack of maintenance; close to 40% of water is lost through leakage. These problems are directly linked to the management and financing problems discussed later in this chapter.

Table 3.4 Performance in provision of water services

	2000 target <sup>a</sup>	2000 achievement	2001 achievement
<b>WATER SUPPLY</b>			
Total population served (million inhabitants) (urban + rural)	86.8 (68.0 + 18.8)	88.3 (68.6 + 16.9)	87.2 (69.8 + 17.4)
Drinking water disinfection (% of volume supplied nationwide)	95.0	94.3	95.8
Drinking water disinfection (country-wide capacity in km <sup>3</sup> /yr)	..	9.4	9.5
Drinking water treatment plants (country-wide capacity in km <sup>3</sup> /yr)	2.4	2.5	2.7
<b>WASTE WATER</b>			
Access to sanitation <sup>b</sup> (million inhabitants) (urban + rural)	75.7 (60.6 + 15.1)	73.9 (64.7 + 9.2)	75.3 (65.9 + 9.4)
Municipal sewage treatment <sup>c</sup> (km <sup>3</sup> /yr)	2.59	1.70 <sup>d</sup>	1.80 <sup>e</sup>
<b>IRRIGATION</b>			
Rehabilitate existing schemes (km <sup>2</sup> )	8 000	8 087	..
New schemes (km <sup>2</sup> )	1 040	796	..

a) From PHN 1995-2000.

b) Sewerage, septic tank or direct drainage to a water body.

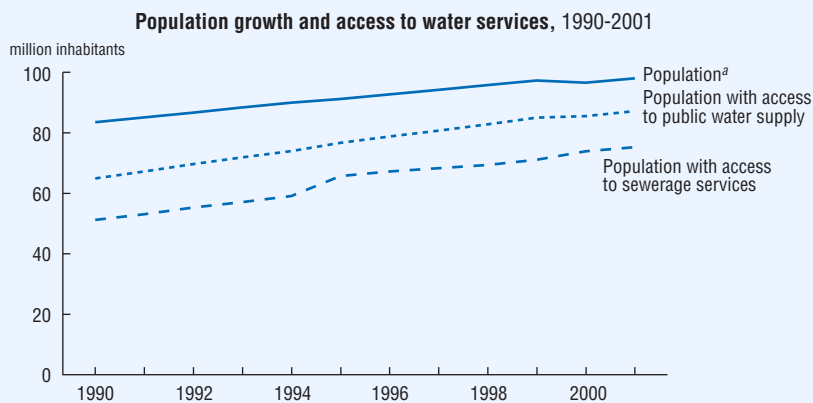
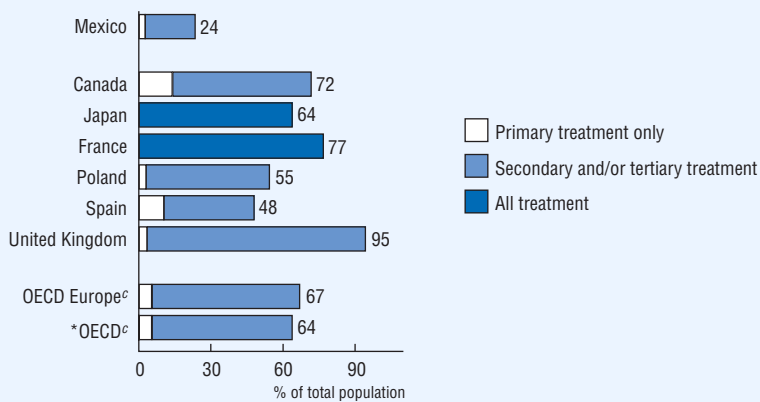
c) Installed capacity, excluding individual treatment facilities at hotels, schools, shopping centres, etc.

d) Of which 0.22 km<sup>3</sup>/year at non-operating facilities; volume actually treated, 1.45 billion cubic kilometres per year.

e) Of which 0.21 km<sup>3</sup>/year at non-operating facilities.

Source: CNA.

Figure 3.1 Access to water services

**Population connected to public waste water treatment plants, 2001<sup>b</sup>**

a) CNA end-year population.

b) Or latest available year.

c) Secretariat estimates.

Source: CNA; OECD.

At the end of 2001, *10.8 million Mexicans (of which 7.5 million in rural areas) lacked access to piped water supply*. In urban and some rural areas without such access, water is often delivered by public or private tanker trucks. In poor areas, smaller quantities are sold by (informal) vendors at prices as much as five to ten times as high as those of public supplies.

## 2.2 Sanitation services

At the end of 2002, about 76.4 million people had access to sanitation services. Thus the PNH 1995-2000 target of 75.7 million *was met*. As in the case of access to water supply, the individual target for urban areas was exceeded while progress fell seriously behind in rural areas (Table 3.4). In Mexico the *term sanitation service (alcantarillado)* refers to sewerage networks, septic tanks *and direct drainage to a gully, ravine or water body*; the figures cited are therefore not comparable with those for sewerage connection rates in other OECD countries. Mexico's sanitation coverage rate is below average compared with the Latin America/Caribbean region or with North America. Lack of access is particularly marked in rural areas, notably in south-east Mexico.

Over 22.7 million people gained *access to sewerage services* in the period 1990-2000; 76.3% of the population was connected by the end of 2000, of which 64.7 million in urban and 9.2 million in rural areas. These figures include connection to a sewerage network (81%), septic tank (15%) or other type of drainage. The number of people not connected fell from 32.3 to 22.7 million in the same period (Figure 3.1).

## 2.3 Waste water treatment

Mexico still has *a long way to go* regarding treatment of municipal and industrial waste water. Only 24% of the population is connected to public waste water treatment, far below the OECD average (Figure 3.1). At the end of 2002, only 27% of sewage collected by the country's sewerage systems was actually treated. The 2001-06 PNH original target was to increase this share to 65% by 2006; the less ambitious revised target (which is also the Presidential target) of 41% may be more readily achievable (Table 3.1). Only 15% of the total volume of industrial waste water generated was treated.

Adoption of the official *Mexican standard NOM-001-ECOL-1996* in January 1997 was an ambitious attempt to overcome the shortfall in waste water treatment as rapidly as possible. This standard set deadlines by which communities and industrial dischargers of various sizes were required to satisfy effluent limits stipulated

in the standard. Non-compliance entailed sizeable fines. The first deadline (January 2000) applied to the 139 municipalities with over 50 000 inhabitants, and to all industrial discharges with BOD<sub>5</sub> or suspended solids content above 3 tonnes per day. It is unlikely that such a large and complex task could have been accomplished in just three years, even if adequate finance had been available. Few of the municipalities and industries concerned met the deadline. Collecting the very high non-compliance fines imposed by the standard proved unfeasible. A new system has since been put in place.

At the end of 2001 the combined installed capacity of the 978 municipal waste water treatment stations was 1.80 cubic kilometre per year, *short of the 2.59 km<sup>3</sup>/year targeted in PNH 1995-2000* (Table 3.4). Some very large treatment plants (designed capacity 1.58 km<sup>3</sup>/year) have been planned for Mexico City but are not scheduled to come on line before 2006. Guadalajara (Mexico's second largest city, with 4 million inhabitants) has no treatment at present but a large plant is planned.

Almost 60% of total installed treatment capacity is designed for secondary treatment (41% activated sludge methodology and 18% stabilisation ponds, the effluent from which can be used to irrigate agricultural crops). The remainder of facilities use a variety of other methods, including advanced primary treatment (11%) and aerated lagoons (7%).

*Treatment of industrial waste water* also requires much improvement. Only 0.80 of an estimated 5.4 cubic kilometres of industrial waste water generated every year is processed in industrial waste water facilities. By far the largest share of industrial waste water, in terms of volume and organic load, is generated by the sugar and petrochemical industries (Table 3.5). Little information is available on industrial discharges of other contaminants (e.g. heavy metals and persistent organic pollutants).

The national inventory of industrial waste water treatment plants identified 1 485 such plants in 2001, of which 1 405 were in operation. About 34% of these plants' *installed capacity* was designed for primary treatment only and 62% for secondary level; 4% of plants were designed for advanced treatment.

The *operating performance* of both municipal and industrial waste water treatment plants often does not meet design specifications. No formal evaluation studies are available for municipal plants. However, according to the National Water Commission (CNA) only 503 of the 1 405 industrial plants in operation (treating about one-third of the total volume of industrial waste water treated) complied with the conditions of their discharge permits. Again, the challenge is not just to build new infrastructure but also to ensure that existing facilities are well maintained and operated, so that anticipated environmental benefits are realised. Authorities are already making greater efforts to provide staff training through a specialised training centre. Implementation

of transparent quality assurance procedures, such as those in ISO 9000 or ISO 12000, would also improve operational performance.

Table 3.5 **Industrial waste water generation, 2000**

Industry branch	Volume of waste water generated (m <sup>3</sup> /second)	Organic load (1 000 tonnes/year)
Sugar	45.6	1 869
Chemical	13.4	635
Petroleum	7.0	1 247
Iron and steel	4.5	93
Pulp and paper	4.5	85
Textile	2.9	196
Coffee	1.5	80
Beer	1.4	95
Food	1.2	39
Farming (animal husbandry)	0.7	33
Metallurgy	0.2	2
Tanneries	0.1	13
Viticulture	0.1	5

Source: PNH 2001-06.

### 3. Irrigation and Groundwater Abstraction

Mexico has the world's seventh largest irrigated area (6.3 million hectares under irrigation). About 21% of the population is engaged in agriculture, which contributes 4.1% of Mexican GDP. Irrigated areas account for one-quarter of total agricultural land area and over one-half of total agricultural production. Agricultural water use represents about 78% of estimated total national water abstraction of 72 km<sup>3</sup> (of which 29 km<sup>3</sup> from groundwater). In light of the dominance of the agriculture sector in total water use, *demand management* and *further improvement of water efficiency in irrigation* are the keys to satisfying the future overall water needs of an expanding population and economy.

#### 3.1 Irrigation

*Institutional reform of public Irrigation Districts* (Irrigation Management Transfer Programme), which began in 1989, has almost been completed. Management of

about 98% of Mexico's 82 Irrigation Districts had been transferred from the CNA to irrigators (Water User Associations) as of mid-2001 (a total of 34 000 km<sup>2</sup>, compared with just over 29 000 km<sup>2</sup> in January 1997). In addition, management of 16 of 18 Drainage Districts has been transferred to farmers (Box 8.2). The CNA met the PNH target of rehabilitating 8 000 km<sup>2</sup> of existing irrigation schemes; the target of creating 1 040 km<sup>2</sup> of new irrigated area was not met (Table 3.4).

Progress has been made towards the *main purpose* of irrigation reforms: improving water user associations' ability to collect user fees to cover the costs of administration, operation and maintenance of Irrigation Districts. Beyond that, it is difficult to assess the performance of the reforms (in terms of productivity per unit of land or per unit of water); many other factors both physical (e.g. droughts, crop changes) and economic (e.g. agricultural reforms, crop changes) affect productivity. It seems clear, however, that management transfers have given farmers greater autonomy and confidence (Chapter 8).

Progress has also been made in *average efficiency of water use* in irrigated agriculture, which is currently at around 46% overall (off-farm plus on-farm), up from 40% five years ago but still well short of the 60 to 65% considered technically feasible. The CNA remains responsible for reducing losses in distribution (off-farm) systems; during the 1990s it increased distribution efficiency from 61.6 to 63.7%. Several CNA programmes help farmers in both Irrigation Districts and Irrigation Units (around 30 000 communal and private systems, with a combined nominal irrigated area of 27 000 km<sup>2</sup>) to improve water use efficiency on-farm.

### 3.2 Depletion of groundwater aquifers

Groundwater abstraction represents about 38% of natural recharge when calculated on the national scale. There is serious and *worsening overexploitation* of some individual aquifers. Half the volume of abstracted groundwater is pumped from over-exploited aquifers. In 1975, 32 of a total of 654 aquifers were considered overdrawn; there were 8 by 1985 and 96 by 2000. Overexploitation is causing saltwater intrusion in coastal aquifers in several states (e.g. Baja California and Sonora).

Since about two-thirds of groundwater abstractions are used in agriculture (serving one-third of total irrigated area), *improving the efficiency of pumped irrigation* is essential to reduce the rate of groundwater depletion. The CNA operates a programme for sustainable management of groundwater (MASAS, financed by the World Bank) in which committees of stakeholders attempt to reduce aquifer draw-down. Another programme aims to encourage efficient water and energy use in irrigation units. The effectiveness of these programmes is unlikely to be enhanced by the *low*

*electricity tariffs* that apply to irrigation pumping, which create incentives to grow water-intensive crops and should be considered an economically inefficient and environmentally harmful production subsidy.

#### 4. Economic and Financial Aspects of Water Management

The amount of the CNA's annual budget *partly depends on the agency's capacity to obtain revenue* from water abstraction, pollution and mineral taxes, and service fees from its activities as a provider of bulk water to communities and irrigation schemes. Water taxes provide the lion's share of the revenue (Figure 3.2). Revenue collected represented between 50 and 82% of the agency's annual budget in the period 1995-2001.

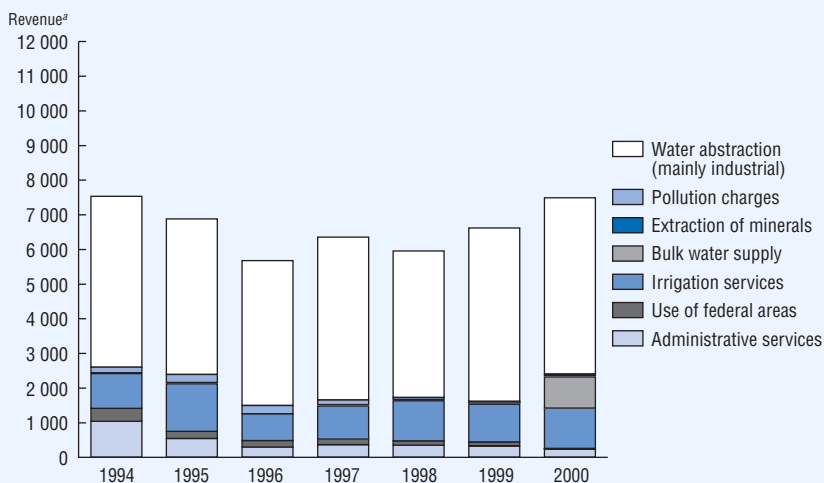
##### 4.1 Expenditure on and financing of water infrastructure

*Public and private investment in the water sector* in 2001 was estimated at roughly MXN 13 billion, or close to 0.25% of GDP. This figure comprises MXN 9.3 billion (72%) in public investment by central, state and local governments and MXN 3.7 billion (28%) in private investment by industry. Public investment consisted of MXN 2.7 billion in water supply, sewerage and sewage treatment, MXN 4.6 billion in irrigation and MXN 2.0 billion in flood management. In 2002 current expenditure on public water supply infrastructure was MXN 5.8 billion, most of which (87%) in urban areas.

*Total PAC expenditure* (i.e. investment and current public and private expenditure on water-related pollution abatement and control) can be estimated at around MXN 10 billion in 2001. This is equivalent to about 0.2% of GDP, a figure well below that in most other OECD countries. Public investment in water supply, sewerage and sewage treatment *has fallen drastically since the early 1990s*; in 2001 it was the lowest for at least 11 years (Figure 3.3).

Concerning distribution of *public investment in water supply, sewerage and sewage treatment*, urban areas (with 75% of the population) received about 69% in 2001 and rural areas (with 25% of the population living in communities of less than 2 500 inhabitants) received 31% (Table 3.6). Proportionally there was similar investment in water supply in urban and rural areas, but sewage treatment investment was almost wholly directed at urban areas. With respect to purpose, 51% of investment country-wide was in water supply, 15% in sewerage services, 33% in sewage treatment, and 1% in efficiency improvement and institutional capacity building in rural areas.

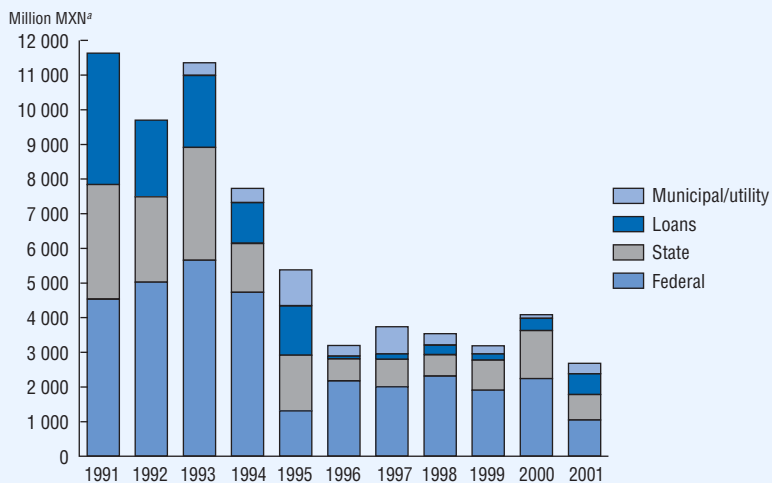


Figure 3.2 CNA revenue<sup>a</sup> from various charges, 1994-2000

a) In million MXN at constant 2001 values.

Source: CNA.

Figure 3.3 Public investment and financing sources for water supply, sewerage and sewage treatment, 1991-2001



a) At constant 2001 values.

Source: CNA.

*Financing investment* in water supply, sewerage and sewage treatment infrastructure is carried out using a mix of Federal, state and local (municipal and utility) sources, as well as through loans (e.g. World Bank, Inter-American Development Bank). The relative contributions of each source have tended to fluctuate quite strongly from one year to another, as has the overall level of investment (Figure 3.3). Investment costs are not taken into account in pricing water services.

Table 3.6 **Public investment in water supply, sewerage services and waste water treatment, 2001**

	Total <sup>a</sup>		Water supply		Sewerage services		Waste water treatment	
	MXN million	(%)	MXN million	(%)	MXN million	(%)	MXN million	(%)
Mexico	2 725	100	1 393	100	399	100	898	100
of which:								
Urban <sup>b</sup>	1 877	69	727	52	275	69	870	97
Rural <sup>b</sup>	848	31	666	48	124	31	28	3

a) Includes MXN 35.8 million for institutional development.

b) Urban and rural populations represent 75% and 25% of the population, respectively.

Source: CNA.

## 4.2 Environmental taxes

Mexico established a system of *water abstraction charges* in 1982. Their level is set in the annual Federal Law on Water Taxes. This law establishes different rates for specific types of uses (drinking water, industrial, agricultural), which are also determined by the relative scarcity or abundance of an area's water resources. For example, in 2002 the general tax rate for water abstraction ranged from MXN 1.05 (wet areas) to MXN 13.39 (dry areas) per cubic metre. The rate for drinking water ranged from MXN 30.73 to MXN 265.24 per thousand cubic metres. The agriculture sector still benefits from a nil tax rate; this is currently under review.

*Pollution charges* were introduced in 1991, with annual rates established in the same law. Rates are established for some 120 different contaminants (physical, organic and inorganic substances) and for types of water bodies (e.g. use for drinking water supply, irrigation, protection of aquatic life) to which effluent is discharged. Pollution taxes are payable for discharges with contaminant concentrations in excess of effluent limits defined in the law.

*Total revenue from water abstraction and pollution charges* was just over MXN 5 billion in 2000 (Figure 3.2). This revenue was generated almost exclusively (99%) from abstraction rights paid by industry and from hydrogeneration (65% and 25%, respectively, of the total). Drinking water utilities accounted for some 7%. The small amount of revenue from pollution taxes is explained by water utilities' refusal to pay these taxes over the past six years. The utilities' accumulated debt, including unpaid fines for non-compliance with standard NOM-001-ECOL-1996, reached MXN 72 billion in 2001, when the debt was forgiven and a new system adopted.

### 4.3 Water pricing

*Water tariffs are set by individual water utilities* (most of which are owned by municipalities) in accordance with Federal and state laws. Water is generally delivered below cost. The price of water would need to be in the order of MXN 5 per cubic metre for tariffs to reflect the full capital and operational cost of delivering it. Average actual recovery in 2001 was MXN 1.73 per cubic metre of water. The tariff structure is usually progressive, with different tariffs applying to households (lowest), the commercial sector and industry (highest); some cross-subsidisation exists in favour of domestic users. There is great variation in price levels across the country. Price trends have also varied from one place to another in the past five years. The average monthly water bill for a family decreased slightly, from MXN 67.6 to MXN 62.0 (at constant 2001 prices) in the period 1997-2001; consumption also fell slightly, from 27.2 to 26.5 cubic metres per year.

*Total revenue from water bills* received by water utilities amounted to MXN 13.5 billion in 2001. These utilities have improved their capacity to obtain payment for the water they produce. Figures produced by 320 utilities show that the invoiced volume of water rose from 46.2 to 60.7% of production in 1996-2001. National trends are not necessarily representative of all states. Water prices in some states have not kept up with inflation. Utilities' ability to invoice and collect payment of water bills still varies widely.

The CNA is a *bulk water supplier to Irrigation Districts*. It charges on a per hectare basis. Prices depend on the cost of supply and range between USD 30 and USD 60 per hectare per year. The CNA is moving to increase the recovery of its operational and maintenance cost to above the 70 to 80% rate of the late 1990s, but this is difficult in dry years when it cannot actually supply the volume of water agreed on with the irrigation modules.

#### 4.4 Water trading

The National Water Law permits *banking and trading of water*. Trading or swapping irrigation water is common practice. Rules governing such trades are established for each Irrigation District. Within an irrigation module (part of a district) water can be freely exchanged among farmers. For trading between modules, approval by the CNA is required as it is the bulk water supplier. Regulatory approval by the CNA is also required if water trading involves a change in the water's use (e.g. from agricultural to industrial).

### 5. Water Governance

#### 5.1 Enforcement of regulations

Mexico now has a record of all water concessions and discharge permits issued throughout the country. It can therefore exercise greater control over pressures on water resources. As of mid-2001, over 99% of the 420 000 withdrawal concessions and permits to discharge to national waters had been entered in the CNA's Public Register of Water Rights (REPGA). Total water concessions (i.e. rights to take water) are 69 billion cubic metres per year, or 95% of the estimated 72 billion cubic metres per year of use for consumption. Total discharge permits entered in the REPGA are 8 billion cubic metres per year. The REPGA brings *greater transparency* to Mexican water management; all information in the register is available on Internet.

Completion of the REPGA has enabled the CNA to step up efforts towards better *enforcement of the conditions of withdrawal concessions and discharge permits*. Special attention will be needed in order to achieve greater industry compliance with standard NOM-001-ECOL-1996. The CNA is preparing to enforce compliance with the standard's 2005 deadline. To this end, its governing body has approved the establishment of a new Department of Inspection and Monitoring and is hiring additional staff (the CNA currently employs 160 inspectors). The number of inspections is being increased from about 1 500 to 6 700 per year. In 2002 almost 30% of water withdrawal inspections focused on industry and services, one-quarter on agriculture and one-quarter on verifying the validity of permits; the remaining 20% were carried out in response to complaints. Non-compliance will have greater consequences for violators in the future. One of Mexico's largest paper industries was closed down in 2002 for exceeding pollutant limits in its waste water discharge. This was the first time the CNA had carried out such an action.

## 5.2 Performance of water utilities

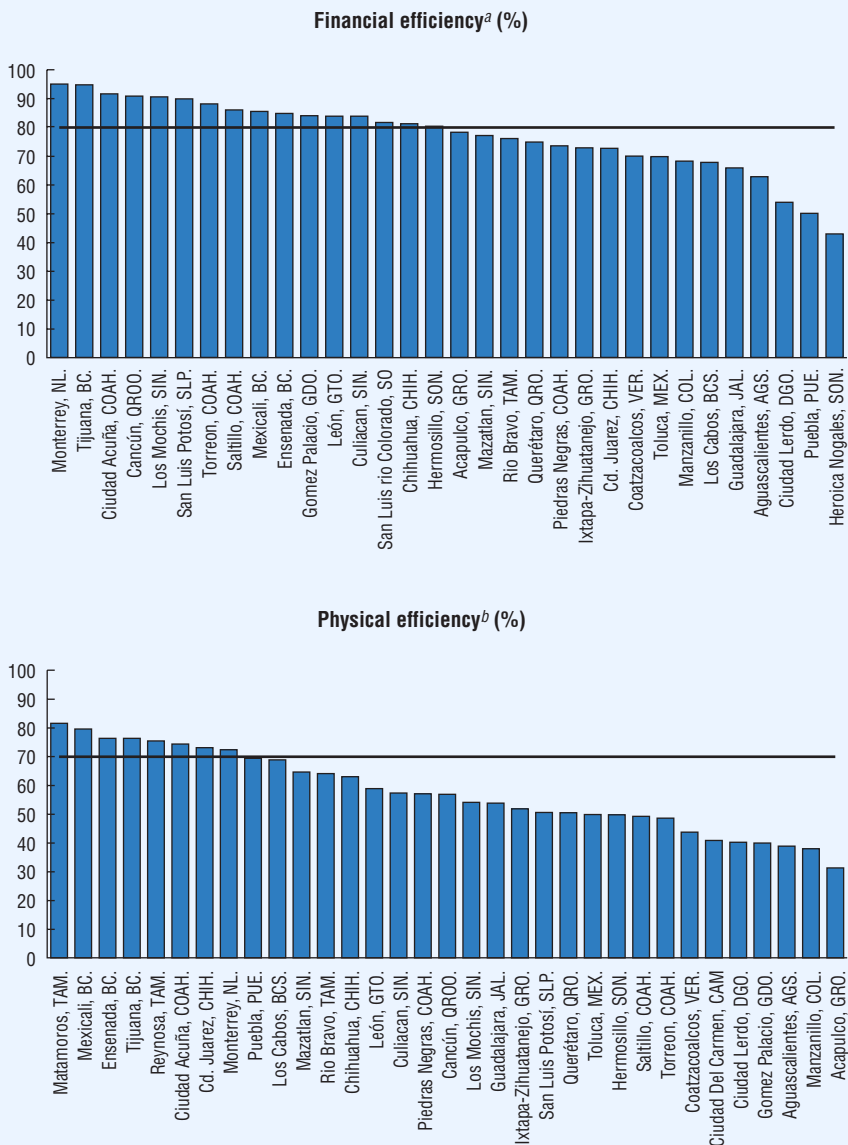
The *central water management issue in Mexico concerns the need to increase investment* (including through public-private partnerships) in building and rehabilitating communal water infrastructure. The authorities recognise that water utilities must be put on a sound financial footing to attract private capital. This will require institutional measures as well as increasing consumers' awareness of water as an economic good, including fostering their willingness to pay for water services. Basic to this issue is the need for a *practical and fair price-setting mechanism* that takes account of financial imperatives, together with the obligation to provide access to clean water for all. Current proposals for a new regulatory agency are designed to address this problem.

*Ending the vicious cycle in which customers are unwilling to pay for poor quality service, and utilities do not have the means to improve their efficiency*, is of fundamental importance. Utilities' overall efficiency can be measured as the product of financial (i.e. ratio of the amount of water actually paid for by customers and the amount delivered) and physical (i.e. ratio of the amount of water actually delivered to customers and the amount of water produced) efficiency. Water utilities in Mexico show a wide range of performance with respect to both types of efficiency. Financial efficiency ranged from 43 to 95% in 2001, and physical efficiency from 32 to 82% (Figure 3.4).

The 2002 version of the annual Federal Law on Water Taxes represented an important step towards securing investment finance. It earmarked the revenue from abstraction and pollution taxes for investment in water infrastructure, and made access to these funds *conditional on utilities agreeing to pay water taxes* in the future. Water utilities were also forgiven unpaid water taxes and unpaid non-compliance fines incurred when they failed to meet the deadlines of standard NOM-001-ECOL-1996.

Under the *Programme for the Modernisation of Water Utilities* (PROMAGUA), municipalities who pay the Federal government for their consumption of Federal water are given back their water consumption fee and may benefit from preferential loans from the National Bank for Public Works and Services (BANOBRAS). The aim is to increase collection of payments (payment discipline) while promoting urgently needed investment in water and waste water infrastructure. The purpose of PROMAGUA is also to improve the operation of water utilities in cities of over 50 000 and to attract private capital for financing new infrastructure. BANOBRAS support is conditional on a utility signing up to a long-term strategic development plan. The level of support depends on the utility's efficiency, with less support for those that have already achieved a certain level. Support also depends on the type of private sector involvement (i.e. public-private partnership with either public or private majority participation, a service contract or full concession to the private sector). The Infrastructure Investment Fund (FINFRA) supplements the funding available through

Figure 3.4 Financial and physical efficiency of water utilities, 2001



a) Ratio of the amount of water actually paid for by consumers and the amount delivered; expressed in %.  
 b) Ratio of the amount of water actually delivered to customers and the amount of water produced; expressed in %.  
 Source: CNA.

the CNA by MXN 2 billion per year. A parallel programme (PSSAPSCR) aims to strengthen the institutional capacity of state and municipal water service delivery organisations *in rural areas*. Since its inception in 2002, 35 municipalities (in 22 states) have participated in the PROMAGUA scheme and MXN 2.3 billion has been invested. The target is to involve 418 municipalities, accounting for 70% of Mexico's urban population.

### 5.3 *Creating a “culture of water” and promoting stakeholder participation*

Mexican authorities recognise that to achieve sustainable water management, it will be necessary to instil a conservation ethic among water users as well as greater willingness to pay for water services. To this end, they are currently attempting to establish a sound “*culture of water*”. The CNA has set up the Citizen's Movement for Water, and many CNA programmes have a consciousness-raising component. A long-term effort will doubtless be required to modify often deeply rooted convictions and attitudes. Pursuant to the new Federal law on public access to information, the general public has had access to information on water quality at Mexico's main beach resorts (once a month) since April 2003.

The government also actively promotes *stakeholder participation*. A national Water Consulting Council and 26 State Citizen Water Councils have been established. Much of this activity so far has been driven by the CNA, but eventually there is the promise of genuine two-way communication about sustainable water management. NGOs such as Cultura Ecologica, which are actively engaged in information dissemination promoting stakeholder participation, could play a role in bringing about such a development. The river basin councils established during the last few years also increase the level of stakeholder participation (Box 3.4).

### 5.4 *Decentralisation of water management*

Significant steps have been taken to decentralise water management since the 1998 OECD Environmental Performance Review. The 1992 Act on National Waters (LAN) provided for the creation of the *river basin councils*. One such council had been created by 1997; there were 25 by October 2002, and six basin commissions, seven basin committees and 57 groundwater committees had also been established. The councils, commissions and committees (which differ only in terms of the size of the basins they cover) are not agencies in their own right, but catchment-based co-ordinating forums that bring together water users and government organisations at different levels.

### Box 3.4 Lake Chapala

The case of Lake Chapala may serve as the *epitome of the key Mexican water management issues*. Located just south of Guadalajara, the capital of the state of Jalisco, Chapala is the largest natural lake in Mexico. It lies in Mexico's major and most densely developed river basin, the Lerma-Chapala-Santiago-Pacífico basin. Issues to be addressed in this basin include water demand (which outstrips supply), overexploitation of groundwater, inefficient agricultural water use, inefficient urban water supply, water quality, floods and droughts. In particular, Lake Chapala suffers from reduced inflows from the Lerma River as a result of increasing water withdrawals in upstream states.

The first Mexican *river basin council*, established in 1989, was that for the Lerma-Chapala. It was followed four years later by the first master plan for the catchment area. A water allocation agreement was signed by the five riparian states, but it has not yet been sufficient to restore water levels in Lake Chapala. In December 2002 the Mexican Senate declared the Lerma-Chapala-Pacífico region an ecological restoration zone. Despite various initiatives to improve stakeholder involvement, it has been difficult for the various parties to build up trust and reach agreement on further measures. Neither has it been easy to achieve effective public participation in the absence of long-established structures or traditions of public consultation.

Water use is at the core of the *conflict*. The traditional attitude that any water reaching the sea is wasted persists. However, there are also those who point out that much of the water is used to grow water-intensive crops yielding low returns (e.g. wheat and corn). One aim of the Strategy for Water Management Modernisation in the Lower Lerma Basin is therefore to encourage farmers to switch to higher-value and less water-intensive crops.

States are encouraged to pass their own *state water laws* (27 states have done so) and establish State Water Commissions (13 have done so). The CNA has drawn up a model state water law to support this process. Good progress has been made in devolving the eight most important federal water programmes to the states and to various user organisations. Decentralisation has been accompanied by increasing transfers (MXN 1.3 billion in 2001) from the federal budget to lower levels. The revision to the Law on National Waters approved by Congress in May 2003 strengthens both decentralisation of water management and the integrated watershed management approach.

Decentralisation is *changing the CNA's role* towards one of standard setting, specialised technical support, and construction and maintenance of strategic water infrastructure. The CNA is also becoming smaller; in late 2002 staff numbered 19 500, or half the total when it was set up in 1989. About 85% of CNA staff work in regional offices and have operational functions (e.g. in Irrigation Districts).



# 4

## WASTE MANAGEMENT\*

### Features

- Municipal waste management
- Hazardous waste management
- From informal to modern recycling of municipal waste
- Transfrontier movements of hazardous waste
- Contaminated sites

\* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “maintaining the integrity of ecosystems” of the 2001 OECD Environmental Strategy.

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- *enforce waste regulations* and reduce *illegal disposal* of hazardous and municipal waste, at national and local government levels;
- continue to enhance *hazardous waste* management, and to improve monitoring of hazardous waste generation, by working towards the completion target for the national registry (100% coverage by 2006);
- implement the newly adopted framework legislation for *municipal waste management*; increase the waste management capacity of municipal authorities and operating enterprises;
- develop a national strategy and local programmes to reduce urban and hazardous *waste generation*;
- increase *investment in infrastructure* (e.g. new sanitary landfills, closure of illegal landfills) for municipal waste management and extend services to medium and small cities;
- improve and modernise *recycling and reuse of municipal waste*, introducing producer responsibility for selected waste streams and taking social factors into account (e.g. the role of the informal sector); increase *composting of organic waste*;
- speed up identification of *contaminated sites*; develop and implement a national remediation strategy.

## Conclusions

Significant efforts have been made to improve *hazardous waste management* in Mexico. Treatment and disposal capacity is increasing steadily and rapidly, with proper waste management capacity reaching 50% of hazardous waste generation and 100% of biological and infectious waste generation. A system to monitor hazardous waste generation, treatment and disposal has been established and its coverage is expanding. The inter-ministerial framework for managing use of toxic chemicals has been active, and efforts to promote substitution of non-hazardous for hazardous substances have been strengthened. Work to identify *contaminated sites* has begun, with these sites being prioritised according to the urgency for remediation. Remediation has been initiated at two sites.

In contrast, *municipal waste management* is at an early stage. Framework legislation has recently been approved but it remains to be implemented. Proper disposal capacity is so inadequate that over half of municipal waste is sent to uncontrolled and illegal

landfills. Local governments do not have the capacity for proper waste management. Most households do not pay for waste collection. While a deposit-refund scheme was recently proposed for plastic bottles, there is still little use of economic instruments. Though part of municipal waste is recycled in the informal sector, recycling rates in Mexico are among the lowest in any OECD country. Little has been done to address waste streams of concern (e.g. tyres, used oil, plastic packaging).



## 1. Objectives and Institutional Framework

The General Law on Ecological Balance and Environmental Protection (LGEEPA, 1988 and 1996) is the current *legal basis for waste management*. It includes the Hazardous Waste Regulation and provides the basis for issuing of Official Mexican Standards (NOMs), e.g. on hazardous waste classification and operation of landfills. A more comprehensive law on waste management, currently being discussed in Congress, could be approved in 2003. This law would address *current legislative and regulatory gaps* regarding municipal waste (collection, disposal and recycling), special wastes (e.g. tyres, batteries and plastic bottles), closing of uncontrolled landfills and dumps, and remediation of contaminated sites.

In Mexico waste is classified as hazardous or non-hazardous, with distinct *institutional arrangements* for regulation and policy implementation. *Hazardous waste* includes industrial waste with corrosive, reactive, explosive, toxic, flammable or biological-infectious characteristics. Establishment and implementation of hazardous waste regulation falls exclusively under the jurisdiction of the Federal government. SEMARNAT may work in co-ordination with state authorities on controlling lower-risk hazardous wastes; its enforcement administration (PROFEPA) inspects and monitors compliance with legislation, including that concerning transfrontier movements of hazardous waste. States are responsible for regulating management of non-hazardous waste from household, commercial and industrial sources; municipalities implement related state regulations and carry out waste collection and disposal.

SEMARNAT is responsible for meeting Presidential waste management *targets*, as well as quantitative targets under the National Environment and Natural Resources Programme (PNMA) 2001-06. Waste management goals and targets are included in the Programme to Halt and Reverse Air, Water and Soil Pollution and the National Crusade for a Clean Mexico. National targets primarily focus on hazardous waste management. The National Crusade and the 100 Cities Programme of the Ministry of Social Development set objectives regarding municipal waste management (Table 4.1). The Basel Convention provides the framework for national objectives concerning transfrontier movements of hazardous waste.

Table 4.1 National waste management policy objectives and targets

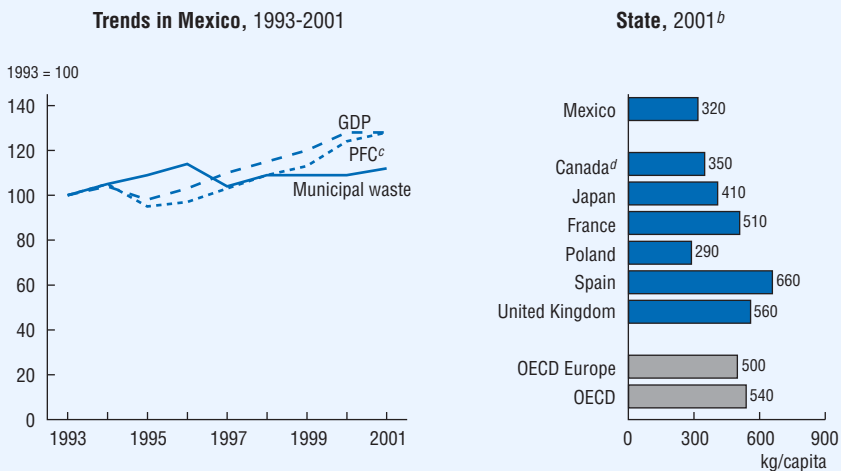
Programme	General objectives relevant to waste management	2006 targets
Presidential targets 2006		Increase annual capacity for hazardous waste treatment and disposal to 7.2 million tonnes.
National Environment and Natural Resources Programme (2001-06)		
Programme to Halt and Reverse Air, Water and Land Pollution	Carry out certification (ISO 9001:2000) to promote industrial waste management. Carry out a national inventory of hazardous waste.	Increase annual industrial capacity for hazardous waste management to 6.4 million tonnes. Complete registry of generators of hazardous waste and materials.
National Crusade for a Clean Mexico	Achieve integrated management of industrial and municipal waste, including hazardous waste. Develop municipal and regional waste management programmes and strengthen institutional capacities. Carry out environmental education in co-ordination with the private sector. Facilitate access to financing sources.	Train all local authorities that are part of the Sustainable Cities Programme in solid waste management. 15 waste management projects with financing.
National Programme of Urban Development (1994-2000)	Modernise infrastructure for basic urban services, including collection and disposal of solid waste.	
100 Cities Programme	Support municipal waste management.	

Source: SEMARNAT.

## 2. Waste Generation Trends

*Municipal waste generation* in Mexico increased from 28 million tonnes to 31.5 million tonnes between 1993 and 2001, mainly reflecting rapid population growth, high rates of internal migration and resulting urbanisation, and changes in consumption patterns associated with rising standards of living. Per capita generation of municipal waste was 320 kg in 2001, significantly lower than the OECD average (Figure 4.1). There are wide regional variations, ranging from 248 kg to 485 kg per capita in 1999. Mexico City accounts for 62% of national waste generation; its share of the national population is about 18%. Annual growth in municipal waste generation is between 1% and 3%, depending on the locality.

Figure 4.1 **Municipal waste generation<sup>a</sup>**



a) In interpreting national figures, it should be borne in mind that survey methods and definitions of municipal waste may vary from one country to another. According to the definition used by the OECD, municipal waste is waste collected by or for municipalities and includes household, bulky and commercial waste and similar waste handled at the same facilities.

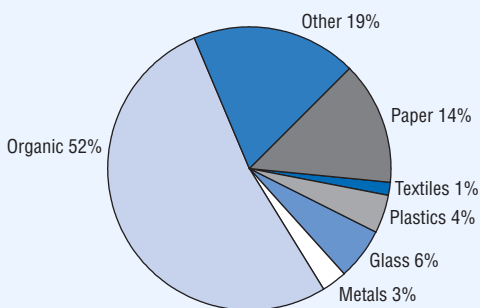
b) Or latest available year.

c) Private final consumption.

d) Household waste only.

Source: OECD.

Figure 4.2 **Municipal waste composition, 2002**



Source: OECD.

Most (84%) municipal waste is household waste. The rest comes mainly from public offices, commercial establishments and small industries. Organic waste represents 52% of municipal waste, and packaging waste (glass, paper, plastics, metals) represents 27% (Figure 4.2). The share of non-organic and recyclable waste increased significantly during the 1990s. *Municipal waste composition* is not homogeneous across Mexico. In the south and in rural areas most waste is organic; the share of organic waste is lower in the north and in urban areas.

By 2000, 27 280 enterprises (including the country's largest generators) were identified as generating 3.7 million tonnes of hazardous waste. While total *hazardous waste generation* in Mexico is unknown, the remaining unidentified generators (mostly medium, small and micro enterprises) are believed to contribute a relatively small share. More accurate data should be available by 2006, when SEMARNAT is scheduled to complete its national registry of hazardous waste generators. The chemical, electronics, metal processing, petrochemical and steel industries are major sources of hazardous waste.

### 3. Municipal Waste Management

With the preparation of the first comprehensive legal framework for municipal waste management, Mexican authorities have realised the *large-scale challenge* they face. There is a general lack of infrastructure for collection, treatment, and particularly disposal; municipalities and related operators have inadequate technical and financial capacity. At the same time, waste generation continues to increase rapidly.

#### 3.1 Collection and disposal trends

It is estimated that close to 20% of municipal waste generated in Mexico is not collected but is disposed of illegally in the street, abandoned spaces, ravines or water courses. Illegal dumping of solid waste often results in improper operation of sewerage and drainage systems, becoming a disease vector and creating public health risks. A high proportion of waste from large metropolitan areas is collected and disposed of in landfills; a significant share of waste from small towns and rural settlements is sent to open dumps (Table 4.2). *Waste services need to be expanded*, particularly to medium and small localities.

*Landfilling* is currently the only organised municipal waste disposal method. The 77 landfills identified handled about 18.6 million tonnes in 2001, less than 60% of total municipal waste generated (Table 4.3). Most (64) were controlled landfills, which handled 15.2 million tonnes. However, not all landfills that are "controlled"

(i.e. fenced and overseen by local authorities) are sanitary, that is, located and designed in an environmentally sound manner. There is evidence that leachate from some controlled landfills has caused soil and groundwater pollution. The amount of municipal waste sent to uncontrolled landfills dramatically increased to 3.3 million

Table 4.2 **Municipal waste collection and disposal**, by type of settlement

	Sites (number)	Population (million)	Collection rate (% municipal waste)	Appropriate disposal <sup>a</sup> (% municipal waste)
Large metropolitan areas	7	31	95	85
Cities in the 100 Cities Programme	126	31	80	43
Small cities	267	29	70	6
Settlements in rural areas	199 600	8	60	0
Mexico total	200 000	99	83	53

a) Disposal in controlled landfills with good sanitary standards.

Source: SEDESOL.

Table 4.3 **Municipal waste disposal**, by type of facility

		1999	2000	2001
Landfills	Number <sup>a</sup>	97	76	77
	Quantities (1 000 tonnes)	16 936	16 912	18 604
Controlled landfills	Number <sup>a</sup>	70	71	64
	Quantities (1 000 tonnes)	16 429	14 491	15 252
Uncontrolled landfills	Number <sup>a</sup>	27	5	13
	Quantities (1 000 tonnes)	507	2 421	3 351
Open dump sites	Number	..	..	..
	Quantities <sup>b</sup> (1 000 tonnes)	13 286	13 096	12 141

a) Number of landfills used in the year.

b) Quantities disposed of are estimated as total municipal waste generated, minus quantities in controlled and uncontrolled landfills, minus recovery and recycling.

Source: SEDESOL.

tonnes, in part because the disposal capacity of controlled landfills had not kept pace with rapid growth in waste generation. About 40% of total municipal waste generated (12.1 million tonnes) ends up in unidentified illegal open dumps. Of 5.2 million used tyres disposed of in 2001, 90% are estimated to have been sent to uncontrolled landfills or open dumps.

### 3.2 Recovery and recycling trends

In 2001, 28% of total municipal waste generated (9 million tonnes) was potentially recyclable but only 8% (742 000 tonnes) was actually recycled. Recycling rates in Mexico are highest for metals (19%), glass (13%), paper and cardboard (7%) and plastic (0.1%). Recycling of old batteries is still at an early stage. These rates are *significantly below the OECD average* and have not improved over the last decade. Actual recycling rates are probably higher than these figures suggest, as there is significant recovery and recycling in the informal sector (Box 4.1). Despite the relatively high organic materials content of municipal waste, there is virtually no *composting* at municipal level with the exception of some pilot initiatives. Separate collection and recycling should be explicitly addressed in municipal waste management strategies (along with the potential for composting) and time-bound targets set. Legalising informal sector activities in recovery and recycling should also be given urgent consideration. Whenever feasible, waste scavengers should be involved in operating modern transfer stations and recycling centres (under much improved hygiene and safety conditions) in order to improve their social and economic situation.

### 3.3 Policy measures

The few economic instruments used to facilitate municipal waste management include material recovery, recycling and waste minimisation. Very few municipalities implement *user charges* for municipal waste collection and disposal, though there are some pilot initiatives, particularly along the US border. Municipal waste management is mainly carried out through regulations and *Federal government funding* for infrastructure development. Official Mexican Standards (particularly NOM-083-ECOL-1996) and corresponding state regulations prescribe design and construction specifications for municipal landfills. States and municipalities have invested in waste management infrastructure through direct Federal government transfers (Ramo 33) or loans from the National Bank for Public Works and Services (BANOBRAS). The Ministry for Social Development (SEDESOL), together with SEMARNAT, has provided technical and administrative assistance to develop waste management capacity building in states and municipalities. In 2003 SEMARNAT signed a voluntary agreement with plastic



### Box 4.1 From informal to modern recycling of municipal waste

In Mexico the *informal sector* plays an important role in municipal waste recycling. Municipal waste collectors and *scavengers* (pepenadores) segregate and collect recyclable waste, which is then handed over to a limited number of recycling plants via a network of intermediaries. Recycling takes place at different stages. During collection, “pre-scavengers”, who are municipal waste collectors, help separate recyclable waste. They earn additional income by selling some recyclable materials to intermediaries, often doubling or tripling their wages. Scavengers and their families work (and in some cases live) in landfills and illegal dumps, separating recyclable waste and selling it. Estimates of the number of scavengers in Mexico vary from 25 000 to over 30 000; over half are concentrated in Mexico City. They have large families (six children on average) and over half the adults are women, many of them single mothers. A survey in seven cities showed that 40% of scavengers had no formal education, 10% had been educated for less than two years and only 4% had completed elementary education. Scavengers work under poor hygienic conditions and are exposed to disease vectors. Their life expectancy at birth is estimated at 65 years (compared with 76 years for the Mexican population as a whole).

In the State of Mexico *scavengers have formed associations* at the three main landfills: the Association of Selectors of Solid Waste of the Metropolis (San Juan de Aragón landfill), the United Front of Pepenadores (Bordo Poniente landfill) and the Pepenadores Union of Rafael Gutiérrez Moreno (Santa Catarina landfill). These well organised associations have become important social actors. In the municipality of Los Reyes La Paz, where the Santa Catarina landfill is located, the Pepenadores Union periodically negotiates payments in cash or in kind (e.g. washing machines, refrigerators) with the municipal authorities. In municipalities with smaller landfills scavengers are organised by families, with elected representatives.

Efforts to *modernise municipal waste management*, particularly to increase the productivity of recycling activities and close illegal open dumps (or turn them into sanitary landfills), have long been hampered by strong resistance from scavengers, who fear loss of income if such measures are implemented. Attempts to incorporate the scavengers in the formal sector have generally been unsuccessful, as they entail offering them minimum wage jobs (their actual income is in fact much higher). Some municipalities have taken new initiatives to provide scavengers with equipment, organisational assistance and training to continue collection and recycling under improved hygienic and environmental conditions. Educational, health and nutrition programmes for their children are also offered. Limited public awareness of waste recycling has hindered modernisation of such low-productivity recycling schemes. Scavenging activities are heavily influenced by local markets and prices, which in turn depend on processing plant location and transport costs. Thus recyclable waste prices are subject to wide regional variations.

producer associations to increase recycling of polyethylene terephthalate (PET) bottles, based on the principle of “shared responsibility”. The agreement is aimed at integrated municipal waste management, and encourages the recycling industry to invest USD 87 million between 2003 and 2006. The target is to recover and recycle 2 610 million PET bottles annually by 2006. Activities under this agreement have already started in larger metropolitan areas such as Mexico City, Monterrey, Guadalajara, Cancún, Veracruz and San Luis Potosí.

Between 1993 and 1998, SEDESOL supported municipal waste management through the *100 Cities Programme*. This programme was part of the National Programme of Urban Development, which mobilised USD 75 million for construction of landfills and transfer stations, development of municipal master plans for waste management, training of technical staff, and promotion of private sector participation through concessions and service contracts. Overall, the programme assisted 126 small and medium-sized cities (i.e. 207 municipalities with a total population of 34 million or about half Mexico’s urban population). Since 1999, financial support has been channelled through Federal government transfers (Ramo 33) while SEDESOL has continued to provide technical assistance.

In 2001 SEMARNAT launched the *National Crusade for a Clean Mexico*. The Crusade is an awareness and training campaign that promotes integrated waste management for both municipal and hazardous waste (Table 4.1). Its main objective is to foster sustainable waste collection, disposal and recycling through technical assistance and technology transfer to states and municipalities. The Crusade also helps local governments obtain access to financing for the development of waste management infrastructure (e.g. BANOBRAS, private investment, foreign direct investment) to supplement transfers from the Federal government. Some 1 500 municipal authorities have already participated in regional training courses on integrated waste management. The First Meeting of Municipal Presidents for Environmentally Responsible Waste Management was held in Aguascalientes. School awareness campaigns have been launched in various municipalities in the State of Mexico. Such efforts to increase local governments’ waste management capacity, as well as public awareness of separate waste collection and the need to pay for waste services, should be further strengthened.

### *3.4 Financing of municipal waste management*

Waste management is largely financed by municipalities’ *general budget*. Only about 20% of the operating costs of municipal waste services is currently recovered from user charges. The objective should be to progress towards full recovery of operating costs and partial recovery of investment costs. Provision of specialised waste services – under direct municipal authority or through independent contractors –

would greatly improve operational efficiency and cost recovery. Operators of these services could also benefit from economies of scale by serving several municipalities. Some attempts to introduce user charges have failed; in Puebla the population reacted to privatisation of waste services by dumping waste in the streets. Efforts to achieve cost recovery should be gradual and be accompanied by information campaigns.

Mexico requires investments of over USD 1.7 billion to upgrade municipal waste infrastructure. About USD 200 million per year is spent for this purpose. In addition to *Federal government transfers* (Ramo 33), local governments have access to credit and (to a lesser extent) grants from BANOBRAS. Between 1995 and 2000 BANOBRAS identified over USD 380 million in available funds for general municipal investments (including in waste management). Less than USD 15 million was spent, reflecting a lack of technical and administrative capacity to plan and manage infrastructure investment projects.

Under NAFTA the *North American Development Bank* (NADB), in co-ordination with the Border Environment Co-operation Commission (BECC), grants loans to municipalities in the northern border region for investments in municipal waste collection, construction of sanitary landfills and closing of open dump sites. NADB funded about USD 17 million in municipal waste infrastructure investments between 1995 and 2000.

*Mexico is in a transitional period.* Core infrastructure still needs to be established, including for municipal waste management. It will not be possible in the short term to rely entirely on wider application of user charges for waste services to cover all investment costs. However, measures should be taken to reduce local governments' great dependency on Federal government transfers, grants and external credits to cover infrastructure investment costs. *Enhancing municipalities' capacity* to raise fiscal revenue locally (e.g. with a landfill tax) or to issue bonds in capital markets should be considered. Advantage should be taken of economies of scale through developing waste management at the regional level, with shared landfills serving several cities.

## 4. Hazardous Waste Management

### 4.1 Recycling, treatment and disposal trends

Mexico has made significant progress in developing its *infrastructure capacity for hazardous waste management*. Some USD 155 million has been invested (including increasing private investment), creating 3 000 direct jobs and 5 900 complementary ones. In 1994 about 12% of estimated total hazardous waste generated was considered to be adequately treated and disposed of. In 2002 total installed capacity reached

7.3 million tonnes, surpassing the 2006 target of 7.2 million tonnes. However, an unknown amount of hazardous waste is still illegally disposed of in municipal landfills or open dumps. Mexico must take further steps to ensure that regional infrastructure distribution better meets regional demands. Such strategic planning requires better information on hazardous waste generation (e.g. volume of each waste stream, location of generators). This information is being collected by SEMARNAT in its registry of hazardous waste generators. Mexico is a net importer of hazardous waste (Boxes 4.2 and 9.3).

Most hazardous waste management infrastructure is for *treatment* (72% of tonnage installed capacity); the rest is for recycling (25%), incineration (2.4%) and reuse (0.6%) (Figure 4.3). Hazardous waste being recycled includes metals, solvents and waste oils, as well as old containers of hazardous materials (Table 4.4). A 1996 voluntary agreement between SEMARNAT, the National Chamber of the Cement Industry and the La Cruz Azul Co-operative promotes recycling of waste oils as an alternative fuel in cement furnaces. Waste oils are also used as an alternative fuel in production of lime, steel and sugarcane and in power plants.

*Biological and infectious waste* generation is estimated at around 200 tonnes per day (1.5 kg/bed/day). In contrast with other waste streams, installed capacity to handle this type of waste has grown rapidly (from 34% in 1996 to 100% in 2000), reflecting financial support at major hospitals and clinics. However, all such waste is not adequately treated and disposed of. Existing facilities are mainly concentrated at the centre of the country, leaving a number of states without coverage. Moreover, transport, storage and treatment are not adapted to widely dispersed small and medium-sized generators.

## 4.2 Policy measures

*Hazardous waste regulation* (under LGEEPA) includes seven 1993 national standards (NOMs) issued to classify types of hazardous waste and their testing procedures, and to provide for the location, design, construction and operation of confinement sites. A NOM was issued in 1995 for biological and infectious waste, and another in 2001 for PCBs. All hazardous waste generators, as well as those responsible for collection, transport, storage, recycling and disposal, are required to obtain permits from SEMARNAT and to comply with mandatory recording and reporting requirements.

In 1995 the *national hazardous waste management strategy* was refocused towards prevention and recycling. To promote waste minimisation and prevent industrial accidents, the Integrated Industrial Hazardous Waste Management and Minimisation Programme, and the Priority Assistance Environmental Management Programme,

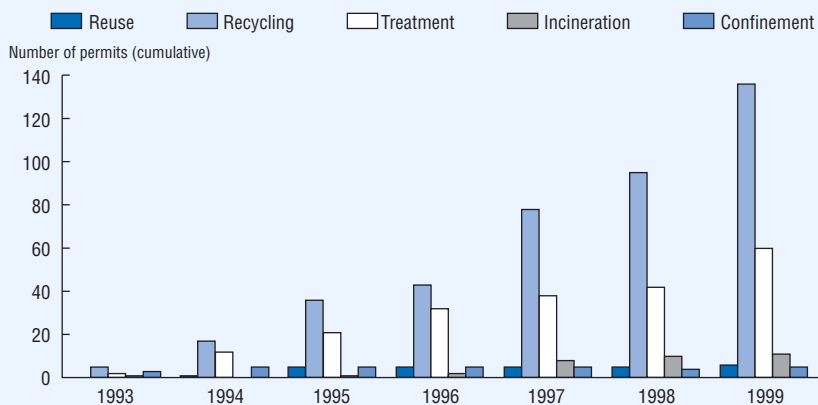
### Box 4.2 Transfrontier movements of hazardous waste

The 1988/1996 LGEEPA provides the legal framework for transfrontier movements of hazardous waste. It incorporates the requirements of the *Basel Convention*, which Mexico ratified in 1991. The import of hazardous waste for storage or final disposal is banned; only import for treatment, reuse or recycling is authorised. Hazardous waste generated from raw materials temporarily imported for the maquiladoras must be exported to the country of origin, though compliance with that condition is low. (This is also consistent with the 1983 La Paz Agreement with the United States on the protection and improvement of the environment in border areas.) For exports it is obligatory to obtain the *tacit (amber list) or written (red list)* consent of the authorities in importing countries, and to comply with the rules established in the Basel Convention and the 1992 OECD Council Decision on the control of transfrontier movements of wastes destined for recovery operations. The same applies to transit through Mexican territory of hazardous waste destined for another country. The amendments to the Basel Convention (in 1998) and to the OECD Council Decision (in 2002) merging the amber and red lists are not yet reflected in Mexican legislation (Chapter 9).

SEMARNAT is the federal agency responsible for controlling hazardous waste movements and developing *tracking systems*. HAZTRACK was developed in 1992 to track transfrontier movements of hazardous waste and materials between Mexico and the United States. However, this scheme tracks only a portion of actual waste movements. About two-thirds of the waste shipped as hazardous from Mexico to the United States is unregulated in the US and thus not accounted for in the tracking system. Differences in definitions of hazardous waste, make “cradle-to-grave” tracking of certain types of waste generated in Mexico and exported to the US impossible.

Mexico is a *net importer of hazardous waste*. Electric arc furnace dust shipped from the US to Mexico for metal recovery makes up most of the imports; the volume continues to increase (159 000 tonnes in 1995, 276 000 tonnes in 2000). Empty containers of hazardous products and old lead batteries are also shipped from the US to Mexico for recycling. The export volume is far lower, though there has been a steady increase (6 000 tonnes in 1995, 97 000 tonnes in 2000). This increase may reflect improvements in reporting as well as a decrease in illegal dumping of hazardous waste in Mexican territory (exported waste is primarily that for which Mexico does not have treatment capacity). In 2000 most exported waste consisted of PCBs for treatment and disposal in France, Germany, the Netherlands and Spain. Oil-drilling sludge is exported to the US, where it is not considered hazardous. Residual waste after metal recovery from fly ash imported from the US is exported back. In 2002, 51 export authorisations for over 864 000 tonnes, and 132 import authorisations for 325 700 tonnes of hazardous waste were issued.

Figure 4.3 Hazardous waste management infrastructure, 1993-1999



Source: SEMARNAT.

Table 4.4 Hazardous waste recycling capacity, 2001  
(tonnes per year)

Waste stream	Installed capacity
Metals	540 993
Solvents	224 088
Waste oil (lubricant oil)	164 207
Containers (of hazardous materials)	87 754
Paints	18 135
Other waste oils	3 668
Textiles	300
Fuel recycling	1 255 088
Other substances	45 891
Total	2 340 124

Source: SEMARNAT.

both address use of hazardous materials in industrial processes with a view to promoting substitution. The Inter-ministerial Commission on the Control of Processes and Use of Pesticides, Fertilisers and Toxic Substances (CICOPLAFEST) was established in 1987 with the involvement of the ministries of agriculture, environment, health and trade. It issues import licences, develops regulations, and assesses and registers new chemicals. Safety issues are addressed through audits and inspections by PROFEPA, as well as through voluntary programmes such as the Chemical Industry Integral Responsibility Programme and the Integral Environmental Management Programme.

Completing the *national registry of hazardous waste generators* is one of SEMARNAT's priorities. Nearly half of total waste generated (by weight) has been registered to date, but only about 8% of the estimated number of enterprises. While large and easily identifiable generators have been registered, small and medium ones have not. The Hazardous Waste Tracking System (SIRREP) operates at national level in association with HAZTRACK, an information system developed with the US Environmental Protection Agency to track transfrontier movements of hazardous waste and materials between the two countries (Chapter 9). The Chemical Substances Management Information System of CICOPLAFEST promotes safe handling of hazardous materials, information exchange and public participation.

SEMARNAT has made significant efforts to work with industry and service providers to increase hazardous waste recycling. The Mexican Network of Environmental Waste Management (REMEXMAR) advises each Federal entity on how to identify waste minimisation opportunities, exchange experience and information, promote training and education (particularly in small and medium-sized industries) and support the development of information systems. Such *participatory approaches* have contributed to the recent growth of hazardous waste recycling activities.

While command and control instruments still prevail, the introduction of *deposit-refund systems* is being considered for batteries, lubricant oils and tyres. Attempts have been made to introduce insurance and bonds to ensure safe transport and disposal of hazardous waste, and to address the issue of abandoned contaminated sites (Box 4.3). However, the financial sector has not yet demonstrated an interest in such schemes.

### Box 4.3 Identification and remediation of contaminated sites

The *inventory of contaminated sites* carried out in the mid-1990s does not yet provide an adequate overview of the extent of soil contamination in Mexico. PROFEPA has identified 224 (abandoned or illegal) sites contaminated with hazardous waste, which are classified in three categories according to urgency for remediation: population exposure to risk; impact on sensitive ecosystems; and vulnerability of groundwater bodies serving urban areas. There may be 955 contaminated sites. Most (75%) are the result of chemical accidents in the early 1990s and the rest are due to illegal disposal of hazardous waste (15%) or storage and disposal of hazardous materials without adequate control (10%).

To facilitate development of a comprehensive *remediation* programme, the inventory urgently needs to be expanded. Given the limited human and financial resources of PROFEPA, a new approach should be considered requiring local governments to identify contaminated sites, establish responsibilities for remediation and ensure that remediation takes place. Since December 2001 the Mexican Commission for Environmental Infrastructure (COMIA) has promoted investments in site remediation. A site in Baja California has already been remediated by the responsible party, and another site in that state is in the process of remediation.

*Legislation concerning soil contamination* focuses on prevention through risk management (e.g. pollution abatement, waste management, control of hazardous material and activities). The LGEEPA does not address remediation of contaminated sites. Introduction of specific regulations and standards in this area should be considered, particularly for site development involving changes in land use and for closing legal and illegal landfills and other waste management facilities. A project to regulate high-risk activities and activities involving the handling of hazardous waste and materials was launched in 1998.



# 5

## NATURE AND BIODIVERSITY MANAGEMENT\*

### Features

- International commitments
- A megadiverse country
- Developing a network of protected areas
- Financing nature and biodiversity conservation
- Deforestation and combating it

\* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “maintaining the integrity of ecosystems” of the 2001 OECD Environmental Strategy.

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- integrate *biodiversity* concerns into the planning, execution and evaluation of public policies (e.g. agriculture, forestry, tourism, rural development), in line with the National Biodiversity Strategy and National Biodiversity Action Plan;
- significantly increase *financial resources* (from public, private and international sources) for biodiversity conservation at national, state and local levels, including through user charges;
- further develop the National System of *Protected Natural Areas*: extending its geographical and ecological coverage; providing resources to develop and implement management plans; promoting the establishment of biological corridors; and stimulating participation by private initiatives, as well as indigenous and local communities, in their conservation;
- foster recovery of *endangered species* populations, protecting their natural habitats and reducing illegal trafficking in wild species;
- support conservation and management of terrestrial and aquatic ecosystems *outside protected natural areas*; expand *ecological land planning*;
- combat *deforestation*, particularly for tropical woods and forests: strengthening reforestation programmes; promoting sustainable forest management; encouraging forest certification; and redirecting agricultural subsidies in forest areas to finance public ecological assets;
- consolidate *information systems* on Mexico's biological diversity and introduce *monitoring and evaluation* of biodiversity related policies and actions;
- promote new laws to regulate the access to and sustainable use of *genetic resources*, consistent with international trade and multilateral environmental agreements.

## Conclusions

As a megadiverse country, Mexico hosts approximately 12% of the world's total biodiversity. It is a world centre of origin and domestication of food germ plasm. Mexico now has a *complete legal and institutional framework* with which to tackle challenges relating to conservation and sustainable use of biodiversity. It has adopted a model National Biodiversity Strategy and is taking steps to define and implement a National Biodiversity Action Plan. Biodiversity and natural resource policies since the 1990s have aimed at changing production activities with adverse environmental impacts and using biological resources in a sustainable way. *Designated protected areas* increased substantially during the review period. This was accompanied by the

establishment of the National Commission for Protected Natural Areas and the National System of Protected Natural Areas, adoption of a number of management plans, and increased funding from public, private and international sources. The National Forestry Commission was created in 2001 to implement the National Forest Strategy, whose objectives are to reduce rural poverty, increase the share of forestry in GDP and reduce deforestation by 75% over the period 2001-25. This led to a 15-fold increase of Mexico's budget for forest management and to enactment in 2003 of a new law for sustainable forest management. Concerning species, some progress was made with conservation and recovery projects for several priority species and the System of Units for the Conservation, Management and Sustainable Use of Wildlife, which covers over one-third of the national territory. The introduction of *incentives for conservation* and sustainable use of biodiversity (e.g. charges at marine national parks, proposed payments for environmental services to forest communities implementing biodiversity conservation initiatives) is a positive step.

However, *important problems requiring solutions can still be identified*. Mexico's biological wealth is *seriously threatened* and is undervalued as a primary factor in socio-economic development. Biodiversity loss and issues have been associated with the pressures created by inadequate earlier development policies: conversion of natural habitats to unsustainable agricultural schemes, deforestation in temperate and tropical forests, overgrazing of arid zone vegetation, illegal trade in threatened species, conservation conflicts in protected areas, lack of integrated coastal zone management programmes, risks of genetic contamination. The *deforestation* rate is still extremely high (among the highest in the world). Despite progress in managing protected areas, these areas account for under 10% of the territory and some types of ecosystems are under-represented; human, material and financial resources are still insufficient, leaving a sizeable number of protected areas without management plans. In the last few years the number of endangered *animal and plant species* has increased. There is a lack of specific legislation regulating access to and sustainable use of genetic resources.



## 1. Policy Objectives

Under Mexico's international commitments, the main *objectives of conservation policy and biodiversity management* are as follows:

- develop national strategies, plans or programmes for conservation and sustainable use of biodiversity, co-ordinated with sectoral plans and policies;
- promote protection of ecosystems and maintenance of viable populations of wild species in their natural environment, restore degraded ecosystems, and promote recovery of endangered species;

- establish an effective and representative system of protected natural areas;
- regulate access to the Mexico's genetic resources;
- generate incentives for conservation and sustainable use of biodiversity;
- develop educational, research and capacity-building programmes for identification, monitoring, conservation and sustainable use of biodiversity.

The general framework and objectives of Mexico's policy for conservation and sustainable use of biodiversity and natural resources were established in the *National Environment Programme 1995-2000* and the various specific programmes for its implementation (e.g. the Programme for Protected Natural Areas of Mexico 1995-2000, the Programme for the Conservation of Wildlife and Productive Diversification in the Rural Sector 1997-2000, and the Forest and Soil Programme 1995-2000).

A 1998 study which evaluated the state and use of biodiversity in Mexico was the basis for setting national priorities and developing the *National Biodiversity Strategy*. This Strategy, in effect since 2000, is in line with the UN Convention on Biological Diversity (CBD). It is based on three main elements: the National Biodiversity Information System, the National System of Protected Natural Areas, and the System of Units for the Conservation, Management and Sustainable Use of Wildlife. The proposed National Plan of Action on Biodiversity will need to set out actions, actors and procedures for implementing the lines of action established in the Strategy.

The previous National Programme was superseded by the *National Environmental and Natural Resources Programme 2001-06*. With respect to biodiversity, it operates through various programmes including the Strategic Programme for Arresting and Reversing the Loss of Natural Capital, the Strategic Programme for Conserving Eco-systems and their Biodiversity, the National Forest Programme 2001-06, the National Crusade for Woodlands and Water, and the 2001-06 Work Programme of the National Commission for Protected Natural Areas, all of which establish quantitative targets (Table 5.1). In 2002 the Ministry of Environment and Natural Resources (SEMARNAT) was included in the System of Presidential Targets, which involved monthly measurements of the performance of departments of the Federal Public Administration with respect to their operational objectives.

Mexico is party to a number of international agreements in this area (Box 5.1). It has played a very active role in developing and implementing some of them (e.g. CBD). Biodiversity and natural resource management performance can further be assessed based on the recommendations of the *1998 OECD Environmental Performance Review of Mexico*:

- pursue the implementation of existing plans and programmes on nature protection, integrated coastal zone management, forestry, soils and fisheries; closely

- monitor progress achieved; further strengthen institutional capacity for enforcement;
- pursue the implementation of innovative approaches to reconcile biodiversity protection and natural resource use, such as the marketing of specific wildlife products and services and community sustainable development projects;

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**Table 5.1 Quantitative conservation and biodiversity targets, 2001-06**

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Conclude technical side of 15 regional ecological land use planning initiatives; ensure adoption of corresponding State Ecological Land Use Planning in all states.

Draw up and implement 18 Official Mexican Regulations relating to use and conservation of natural resources; update 28 others.

Increase natural protected areas to 20 million hectares.

Increase to 90 the number of protected natural areas with adequate administration.

Increase to 60% the protected natural areas and priority regions for conservation involved in a biological corridor or a state conservation system.

Increase to 100% the natural protected areas and regions with Regional Sustainable Development Programmes that satisfactorily comply with the Conservation Information, Monitoring and Evaluation System.

Carry out ecological restoration on 60% of the land area of natural protected areas.

Collect MXN 100 million annually via natural protected area charges.

Increase to 100% the land area of the National System of Natural Protected Areas on which inspections and surveillance take place.

Develop social participation programmes on 90% of natural protected areas.

Maintain and improve populations of priority species on 80% of natural protected areas.

Increase to 70% the inspections that do not detect irregularities in compliance with conditions for use and protection of protected marine species and areas.

Increase to 19.7 million hectares the national land area under the Wildlife Conservation Management Units regime.

Reintroduce or recover 10 priority wildlife species.

Increase forested land area by 1 million hectares, taking into account restored areas and commercial forest plantations.

Reduce the land area affected by forest fires by 35%.

Reduce the deforestation rate by 18%.

Incorporate 4 million hectares for sustainable forest use.

Create and promote the market for environmental services (600 000 hectares).

Promote integration and certification of five regional value chains for businesses involved in the forest products industry.

Achieve 12.1 million m<sup>3</sup>/year timber harvesting and non-timber forest output of 100 000 tonnes/year.

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*Source:* PNMA 2001-06.

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### Box 5.1 International commitments

Since 1996 PROFEPA has verified compliance with the *CITES Convention* in Mexico through the Inspection Programme for Ports, Airports and Borders. In 2002 more than 4 600 inspections for wildlife were carried out in ports, airports and border posts, resulting in 8 563 confiscations. Between 2001 and 2003 PROFEPA confiscated half a million specimens subject to illegal traffic and export. However, lack of personnel seriously affects effective implementation of CITES. Six Comprehensive Centres for the Conservation, Management and Sustainable Use of Wildlife (CICAVS) rescue and rehabilitate confiscated wildlife for possible reintroduction into the wild. Proposals to regulate cactus seeds and carey turtles were outlined at a Conference of the Parties to adopt specific agreements allowing regional CITES compliance. Mexico has supported the shark convention and related arrangements. *Illegal trade* is still an important threat to conservation of many wild species.

Mexico was one of the first countries to ratify the *Convention on Biological Diversity* (CBD). Commitments derived from the CBD have been incorporated into legal instruments including a new General Law on Wildlife. Mexico developed its country study in 1998; it presented the state of the country's biological resources and prepared a national biodiversity strategy in 2000. Mexico promoted the *creation of the Group of Like-minded Megadiverse Countries* (Group of Cancun), consisting of 15 countries rich in biodiversity, with the intention of encouraging sustainable use of genetic resources and equitable distribution of their benefits – notably in favour of local and indigenous communities which have preserved these resources for mankind. In 2002 Mexico hosted the first Ministerial Meeting of the Group of Cancun, with participation by Brazil, China, Colombia, Costa Rica, Ecuador, India, Indonesia, Kenya, Peru, South Africa and Venezuela. These countries adopted the *Cancun Declaration*, addressing mutual concerns and priorities related to conservation and sustainable use of biological diversity. Particular emphasis is given to protecting the rights of indigenous people with respect to traditional knowledge, and to fostering biodiversity conservation by those who have long acted as its guardians (Box 7.2). The Cancun Declaration may affect WTO discussions on trade-related aspects of intellectual property rights (TRIPS), as well as discussions at the World Intellectual Property Organisation (WIPO) and at the OECD. The *Cartagena Protocol* on Biosafety, which Mexico adopted in January 2000 and ratified in 2002, establishes an obligation for every country to adopt adequate legal and administrative measures to implement its precautionary principle with respect to living organisms. This protocol also establishes the principle of prior information agreement, making it possible to prohibit the import of these organisms where there is scientific uncertainty.

Mexico ratified the 1994 *Convention to Combat Desertification* in 1995 and submitted two progress reports. Nationally, modifications of the LGEEPA have involved including aspects of soil conservation and restoration; the National Soils Inventory has been created together with a system for monitoring land degradation. The 2001 Sustainable Rural Development Act provides for creation of a National

**Box 5.1. International commitments (cont.)**

System to Combat Desertification and the Degradation of Natural Resources. Soil erosion is one of Mexico's most serious ecological problems. 154 million hectares (78% of total land area) is affected; 60 and 80 million hectares suffer from severe and very severe erosion. Erosion continues to degrade an additional 150 000 to 200 000 hectares annually.

Concerning the *Ramsar Convention*, Mexico presently has seven sites designated as Wetlands of International Importance, with a surface area of 1 103 976 hectares. Almost 90% of this area was designated in 1995 and 1996. An additional state reserve was established in Yucatán in 2000.

One of the four priority work areas of the *North American Commission for Environmental Co-operation* is biodiversity conservation. The *Trilateral Committee for the Conservation and Management of Wildlife and Ecosystems* was set up in 1995 with the aim of strengthening co-ordination, co-operation and development of associations among agencies responsible for wildlife in Mexico, Canada and the US regarding conservation and management programmes and projects. The *Joint Mexico-Central American Declaration*, including countries of the Central American Commission for the Environment and Development, aims at promoting, implementing and consolidating policies that foster sustainable development, conservation, wise use of natural resources and protection of the region's ecological environment. CONABIO has taken part in three Central American fora on the Technical Committee on Biodiversity, the *Meso-American Biological Corridor* and the Meso-American Biodiversity Information System.

Unlike some other Latin American countries, Mexico has not ratified the 1979 *Bonn Convention* on the Conservation of Migratory Species of Wild Animals. Neither is it a party to the 1994 *International Tropical Timber Agreement*, which aims at promoting and facilitating trade in tropical timber from sustainably managed sources. Mexico argues that a level playing field must be achieved between countries with tropical forests and those with boreal and temperate ones.

- ensure more autonomous management of protected areas, involving strengthened relationships with research institutions, NGOs and the public;
- secure sufficient and accessible funding to implement the natural protected area programme and species protection programmes; strengthen priority setting;
- strengthen ecological physical planning; further promote public awareness and participation; continue research on biodiversity and natural resources;
- complete and adopt the national biodiversity strategy;

- implement, with appropriate deadlines, the strategy for sustainable forestry, agriculture and animal husbandry; further strengthen and integrate policies and programmes that combat deforestation (e.g. reforestation programmes), especially in tropical areas; ensure sufficient co-ordination with programmes for rural development and agriculture; integrate biodiversity and forest issues in agriculture policies.

## 2. Legal and Institutional Framework

The 1988 *General Law on Ecological Balance and Environment Protection* (LGEEPA) establishes as a legal principle of ecological policy that natural resources must be used in such a way that biological diversity is maintained. This law was amended in 1996 to place greater emphasis on sustainable use of natural resources compatible with their conservation, and again in 2000 and 2001. The 2000 LGEEPA Regulations on Protected Natural Areas support its implementation in relation to the establishment, administration and management of Federal protected areas.

The 2000 *General Wildlife Law* comprehensively regulates conservation and sustainable use of wild species. It includes valuation of the environmental benefits provided by species and their habitats. Together with the 1992 *Forest Law* (amended in 1997, with the objective of contributing to the sustainable development of the forest sector), the General Wildlife Law completes the basic legal framework of biodiversity policy.

There are various related specialised agencies: the *National Institute of Ecology* (the regulatory and administrative agency concerned with ecological issues and natural resources), the office of the *Federal Attorney for Environmental Protection* (PROFEPA), the *National Commission for the Knowledge and Use of Biodiversity* (CONABIO) (an inter-ministerial institution co-ordinating research activities related to knowledge, conservation, sustainable use and dissemination of biological diversity) and the *National Commission for Protected Natural Areas* (CONANP) (which administers Federal protected areas since 2000).

## 3. Species and Ecosystem Conservation

Mexico's *biological wealth is extraordinary* (Box 5.2) but the *future is precarious*. One-third of birds and nearly 66% of amphibian, reptile and mammal species are at risk. The wild species whose state and patterns of conservation are in decline are legally protected by Mexican Official Standard NOM-059-ECOL-2001; 2 582 species and subspecies are at risk (161 more than under the previous 1994 standard), of which 41 are probably already extinct in the wild, 1 215 are endangered or threatened with extinction, and 1 326 are subject to special protection (Table 5.3).



### Box 5.2 A megadiverse country

Mexico is one of the 12 *megadiverse countries*. With 1.3% of the land in the world, it hosts about 12% of the known terrestrial biota with very high endemism. With respect to Latin America and the Caribbean, Mexico contains the five main types of terrestrial ecosystem listed by WWF, nine of the 11 main types of habitats in the region and 51 of the 191 eco-regions identified. Of these 51 eco-regions, 14 (covering over 40% of national territory) have priority at international level regarding their biodiversity and current conservation status (Table 5.2). There are nine large natural *vegetation types* in Mexico, classified according to their ecological characteristics.

The *total number of known species* in Mexico is about 65 000. There are thought to be at least 212 000, as many areas and many taxonomic groups have not yet been studied in detail. The most important states in terms of species richness are Oaxaca, Chiapas, Veracruz and Guerrero. There are about 23 000 known *plant species*, including algae, bryophytes, pteridophytes and phanerogams. The total number could be about 36 000 (i.e. over 10% of the world's known species); 10 000 (40%) are endemic. There are at least 6 000 known species of *fungi* in Mexico (i.e. 9% of the world total). Mexico's *vertebrate fauna* are among the richest in the world, with over 5 000 species (the equivalent of almost 10% of those in the world); about 1 000 (20%) are endemic. *Invertebrate species* number almost 30 000, taking into account only marine invertebrates and arthropods, of which nearly 7 000 (almost 25%) are endemic to Mexico.

The *genetic diversity* of Mexico's wild species is very poorly known. However, given the country's great territorial spread and environmental heterogeneity, the genetic variability of many of them is very high. Some species which are potentially of direct use to people (e.g. wild maize species) show considerable variation but are under threat due to current rates of deterioration of natural ecosystems. Mexico is regarded as one of the world's most important centres of genetic diversification in plants and one of the *areas where agriculture originated*. Some 120 cultivated plant species belonging to 39 families originated in Mexico, including cocoa, kidney bean, maize and tomato. Mexico's contribution to domesticated breeds of animals has been less important. It has produced 12 different breeds: two horse, three pig, one goat species, four sheep and two cattle.

The *National Biodiversity Information System* (SNIB) integrates taxonomic, ecological, geographic and bibliographical information related to Mexico's biodiversity and biological resources. It has data on 8 176 000 specimens – this has increased by 3 676 000 since 1998. Under the mandate established by the Convention on Biological Diversity, Mexico has put into operation a *Clearing-House Mechanism* via the CONABIO website to promote and facilitate technical co-operation and information exchange on biodiversity conservation and sustainable use. It has also promoted a *Worldwide Biodiversity Information Network* (a computerised network of botanical and zoological collections in universities and research centres).

Table 5.2 Global priority eco-regions in Mexico, 1998

Eco-region type	Area ('000 hectares)
Pine and oak forest of the western Sierra Madre	20 437
Wetlands of central Mexico	36
California coastal sage chaparral	2 710
Cactus scrub of northern Sonora	9 796
Dry forest of Jalisco	1 997
Dry forest of Balsas	16 110
Transvolcanic pine and oak forest of Mexico	7 280
Pine and oak forest of the southern Sierra Madre	4 113
Dry forest of Tamaulipas and Veracruz	4 086
Moist forest of Tehuantepec	14 675
Savannah of Tabasco and Veracruz	925
Palm savannah of Jalisco	55
Alpine tundra of Mexico	15
Xeric scrub of Puebla	682
Total	82 917

Source: CONABIO.

Table 5.3 Species of wild flora and fauna at risk, 2001

	Probably extinct in the wild	Endangered	Threatened	Subject to special protection	Total at risk <sup>a</sup>	Total number <sup>b</sup>
Mammals	7	43	124	121	295	491
Birds	19	72	107	173	371	1 054
Reptiles	0	15	109	342	466	704
Amphibians	0	6	42	148	196	290
Freshwater fish	11	70	74	30	185	..
Arthropods	0	16	11	19	46	..
Fungi	0	10	25	7	42	..
Vascular plants	4	141	350	486	981	10 819
Total	41	373	842	1 326	2 582	

a) Total at risk or extinct. Sum of previous columns.

b) Total number of species known.

Source: NOM-059-ECOL-2001.

Since 1997 the Projects for Recovery and Conservation of Priority Species (PREP) have mainly been designed to save and *protect species* included in an internationally recognised risk category. The National Technical Advisory Committee for the Recovery of Priority Species has 23 technical subcommittees working on conservation and sustainable use of wildlife; each provides technical advice to a PREP. The majority of priority species benefit from conservation of a large part of their habitats. A programme on *invasive exotic species* is intended to define national priorities and a strategy for prevention, control and eradication of invasive species.

Mexico has a high proportion of *threatened ecosystems*. The main pressures are related to spread of agriculture and livestock production, use of ecologically unsound forms of farming and forestry, expansion of urban and industrial areas, and development of communications and energy infrastructure. The demographic explosion of the last 40 years has contributed to all these pressures. The *Ecosystem Monitoring Programme* uses remote sensing techniques; it identifies qualitative and quantitative space-time changes in land use and distribution of vegetation. *Priority Terrestrial Regions* have been identified, whose ecosystems are richer and more specific than in the rest of the country and which have significant ecological integrity. There are 151 of these regions covering over 50 million hectares (over one-quarter of the territory). In addition, 110 *Priority Wetland Regions* have been identified and characterised based on their biological diversity and social and economic patterns, and 70 *Priority Marine Regions* on the basis of their high biodiversity and inherent features, patterns of use of biotic resources, and types of threat to which they are vulnerable.

#### 4. Developing a Network of Protected Areas

Since 1994 the number of Federal protected natural areas has increased from 100 to 148. New protected natural areas include ecosystems such as coral reefs, coastal lagoons, inland wetlands, marine ecosystems, xerophile scrub and deciduous tropical forest. Total Federal *protected area* has increased from 13.5 to 17.5 million hectares of land and marine areas (+30% since 1994) (Table 5.4 and Figure 5.1); over 13 million hectares is land area (7% of the territory). In 2002 the island of Espiritu Santo in Baja California Sur was declared a nature reserve through a land expropriation scheme. Other conservation decrees were issued in that year for Las Brisas nature sanctuary, the Tuxpan Reef system in Veracruz, the Isla de Guadalupe reserve on Mexico's Pacific coast, and the Balam Caax region of the Yucatán peninsula. According to 1998 data, there are a total of 176 state and municipal protected natural areas covering some 2 million hectares in 22 states (1% of the territory). However, there are still natural ecosystems and areas of high biodiversity, including marine areas and dry tropical forests, that urgently require some form of protection.

Table 5.4 Number and size of Federal natural protected areas, 2002

	Number of areas	Surface area (‘000 hectares)	Share of natural protected areas (%)
Biosphere reserve	32	10 467	59.8
National park	66	1 346	7.7
Natural monument	4	14	0.1
Natural resources protection area	2	223	1.3
Flora and fauna protection area	24	4 847	27.7
Sanctuary	17	2	< 0.1
Other categories	4	602	3.4
Total	149	17 502	100

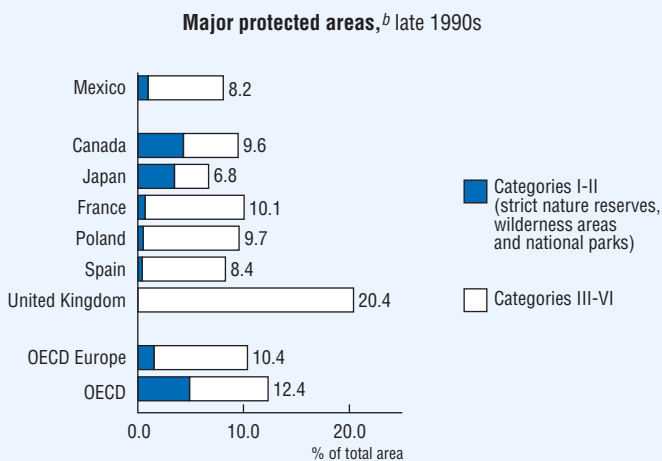
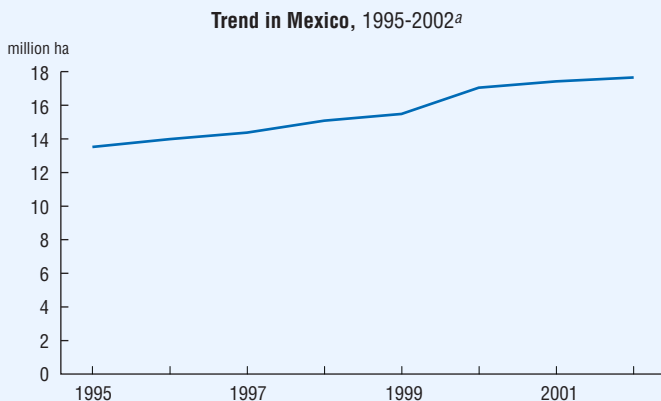
Source: CONANP.

The proportion of the territory under protection is *below the OECD average* (Figure 5.1). Nearly 60% of surface area under protection belongs to *biosphere reserves*. Most of these are managed for sustainable use of natural ecosystems (IUCN category VI); few are strict nature reserves (IUCN category Ia). The second most important type of protection (27% of protected territory) consists of protected areas of flora and fauna (IUCN category VI). National parks (IUCN category II) account for 7% of total surface area under protection. There are various other categories of protected areas, including forest reserves (IUCN category VI). The *National System of Protected Natural Areas* (SINAP) includes natural areas of special national importance due to their biodiversity and ecological characteristics; 41 natural areas are currently included, one of which is state-administered. The 40 Federally-administered natural areas cover almost 10 million hectares (i.e. 55% of the total designated area).

Up to 1995, almost all protected natural areas lacked adequate personnel, management programmes and budgets; the only instrument for their protection was the decree creating them (i.e. they had only a virtual existence). Currently 60 areas, selected on the basis of their importance, size and representativeness, have operating budgets with which to finance basic personnel, basic equipment, operating costs and the development of a management programme; 30 already operate under a *management plan*.

Despite this progress, protected natural areas face management problems relating to land tenure and pressures caused by human settlements within or around them. Many are on communal land, giving rise to *conflicts* between nature conservation and utilisation by rural communities. In 1996 the *National Council for Protected Natural*

Figure 5.1 Protected areas



a) 2002 refers to June.

b) IUCN management categories I to VI; national classifications may differ.

Source: CONANP; IUCN; OECD.

*Areas* was created as an advisory and support body for the formulation, execution and evaluation of policy on the establishment, management and surveillance of Federal protected natural areas. With the same objective of *stimulating and strengthening social participation*, technical advisory councils have also been set up in some protected areas to strengthen participation by the social sectors involved in conservation. In 2002, 731 site inspections and 1 300 monitoring operations were carried out in protected natural areas, leading to the issuance of 134 administrative notifications and 132 sanctions for a total of MXN 3.2 million of fines levied.

The responsibilities of the National Commission for Protected Natural Areas (CONANP) were extended in 2001 to include the Regional Sustainable Development Programmes (PRODERS) aimed at *reducing poverty and the marginalisation of rural communities* in areas with high and fragile biodiversity. These programmes, previously oriented only to conservation, explicitly introduced the concept of sustainable use in protected natural areas. They operationalise integrated sustainable development models for conservation and management of natural resources in over 250 rural communities. PRODERS cover over 700 000 hectares; in 2002 MXN 16 million in subsidies was provided to a total of 41 PRODERS regions in 21 states (Chapter 7).

## 5. Sustainable Management of Biodiversity

### 5.1 Terrestrial species

Wildlife Conservation Management Units (UMA) are private, communal or municipal sites where, on a voluntary basis, alternative schemes of production in the rural sector compatible with biodiversity conservation are promoted through *rational and planned use of the wild fauna species* they contain – giving priority to habitat maintenance. These schemes are subject to registration, approval of a management plan and certification of production. The number of UMA and the area they occupy have shown continuous and substantial growth, from 586 (1.9 million hectares) in 1996 to 5 009 (19.1 million hectares) in 2002 (Table 5.5).

Complementary Projects in Areas of Sustainable Wildlife Management (PAMS) were established in 2001. These are geographical areas, defined in terms of their ecological characteristics, whose main objective is *sustainable use of wild fauna* with a widened range of possibilities for conservation and sustainable use of wild species through integrated land management.

SEMARNAT grants to heads of UMA and PAMS the right to use the habitats and species living there, along with co-responsibility for their preservation. This is achieved through strict compliance with the area's *management plan*, which requires

SEMARNAT's authorisation before operations can begin. For the plan to be approved and authorised, it must guarantee conservation of ecosystems and their components as well as the viability of existing populations of wildlife species – with special emphasis on those at risk in the case of any kind of use.

The UMA and PAMS (together with the Integrated Centres for Conservation, Management and Sustainable Use of Wildlife, CICAWS) constitute the *System of Units for the Conservation, Management and Sustainable Use of Wildlife* (SUMA). This system has 5 009 UMA under intensive and extensive management (19.1 million hectares, mostly in northern Mexico) together with 21 PAMS (50.6 million hectares in 17 states). Thus, the *SUMA now consists of 5 030 areas with registered management plans* and covers almost 35.5% of the national territory, allowing conservation and sustainable use of 1 157 Mexican wildlife species.

Table 5.5 Trends in number and size of UMA,<sup>a</sup> 2002

	Number of units	Surface area ('000 000 hectares)
1995	586	1.9
1996	839	4.3
1997	917	6.0
1998	2 027	10.0
1999	2 959	12.7
2000	3 531	14.7
2001	4 432	17.5
2002	5 009	19.1

a) Wildlife Conservation Management Units.

Source: SEMARNAT.

## 5.2 Aquatic and marine species

Both inland and marine *aquatic ecosystems* are highly affected by human activities. These ecosystems receive large amounts of urban, industrial and farm effluents and suffer from over-use of their biotic components as food sources. Extensive areas of mangrove swamps and wetlands have disappeared as a result of development of oil infrastructure, the spread of livestock production and prawn fisheries, urban expansion and tourism. Of some 1.5 million hectares covered by over 800 coastal lagoons, it is estimated that around 700 000 hectares requires rehabilitation. Attempts have been

made to alleviate the degradation and loss of *wetlands* with the designation in 1995 of six new RAMSAR sites, as well as that of *reefs* through accession to the International Coral Reef Initiative. The way the government has tackled *coastal zone* issues has lacked cohesion. Plans affecting coastal areas are scattered among different public institutions without clear linkages. In practice, there are no specific programmes for *integrated management of coastal zones* (a policy for which SEMARNAT is responsible at Federal level).

Particular attention is paid to *marine species* through the National Programme of Conservation of Turtles and the National Programme for Research on and Conservation of Marine Mammals (Box 9.1). In the Alto Golfo/Rio Colorado Delta Biosphere Reserve, efforts are underway to prevent extinction of the Vaquita marina (*Phocoena sinus*), the smallest cetacean and an endangered species. In 2002 SEMARNAT adopted an agreement under which marine areas that form part of the national territory, and those over which Mexico has sovereignty and jurisdiction, are designated as *refuges for large whale species*. These areas cover over 3 million km<sup>2</sup> of Mexico's Exclusive Economic Zone. *Fishing* is the cause of over-exploitation and diminishing populations of many species of commercial value, and thus of the exhaustion of fishing grounds and damage to marine ecological networks. In 2002 the Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA) issued the controversial official standard NOM-029-PESC-2000 on "responsible fishing" in shark and ray fisheries. This standard authorises use of long lines and drift nets in protected natural areas, which SEMARNAT had opposed effectively (Chapter 9). In 2002 PROFEPA carried out 3 010 inspections and 5 776 monitoring operations in protected areas and other critical zones to promote the conservation and sustainable use of marine species. In addition, 1 896 shrimp boats were inspected and certified for use of turtle excluder devices. Through the National Programme of Coastal Ecosystem Analysis, 221 of 279 shrimp farms were inspected and 12 shrimp producing units were shut down for non-compliance with standards.

Since 1991, under a binding multilateral agreement, *Mexican tuna intended for export to the United States must be labelled "dolphin safe"*. This agreement, meant to eliminate the method of encircling pods of dolphins with mile-long nets to catch tuna (commonly used in the eastern tropical Pacific Ocean), has had significant trade implications. In the mid-1990s Mexico threatened action against the United States on the grounds that its dolphin protection laws violated WTO free trade rules. In 2003 research findings by the US National Marine Fisheries Service concluded that this controversial fishing method had "no significant adverse impact" on dolphins, clearing the way for tuna caught off the Mexican coast to be imported by the US (Box 9.1).



## 6. Financing Nature and Biodiversity Conservation

*National public financing has not provided the necessary resources* to establish and maintain protected areas. While CONANP's budget increased by almost 55% (from MXN 147 million in 2000 to almost MXN 227 million in 2002), it is still half of what would be desirable in the present phase of consolidation of CONANP and the National System of Protected Natural Areas. Through a USD 25 million donor agreement with the Global Environment Facility (GEF) signed in 1992, a project was established to support the primary operating and management needs of 10 protected natural areas chosen for their great biological wealth and endemic species. USD 8.7 million was spent by 1997; the remainder was used to create the *Fund for Protected Natural Areas* as a private investment fund, the interest on which finances basic operations in the 10 protected areas along with funding from budgetary sources (ranging from 10 to 40% of the budget of individual areas). A second donation (USD 31.1 million) was agreed with GEF in 2002 to finance consolidation of SINAP, including USD 22.5 million for an investment fund for 12 additional protected areas. Mexico is expected to provide USD 27.5 million in matching funds. In addition, 26 protected natural areas have been assisted through *financing from private enterprises* to execute conservation projects.

In 1996 the Income Tax Act was amended to make *donations to NGOs carrying out conservation projects in protected natural areas tax deductible*. In 2001 the Legislative Assembly reformed the Federal Law on Duties and approved the instrument on *charging for use, enjoyment and exploitation of marine national parks* to finance conservation of biological resources; in 2002 MXN 11 million was collected and invested in equipment, operation and management of the natural areas that generated them. This system of user charges and investment fund should be extended to terrestrial natural protected areas. From 2003, protected areas with the infrastructure and administrative capacity to charge entrance fees are no longer required to transfer revenues to the Treasury but can use them to promote eco-tourism and scientific research. Within the National Forest Fund, a mechanism for *payment for environmental services* to communities provides a financial reward for initiatives that contribute to conservation of biological diversity. The first two pilot projects have been identified; technical guidelines for their execution are being prepared.

*Other economic instruments* currently available for biodiversity conservation are financial support to rural communities from PROCYMAF for the preparation of sustainable forest management plans; income from royalties on collection of biological material; charges for hunting permits issued by communities that own land on which game is hunted; charges for other hunting permits and permits to capture and sell songbirds and ornamental birds; issuance of CITES certificates and licences to import

and export specimens, parts and by-products of species of wild flora and fauna; charges for inspections of cross-border movements of wildlife; and charges for administrative procedures relating to wild flora and fauna.

## 7. Sustainable Forest Management

Official figures on the extent of *forest cover* in Mexico vary greatly, depending on their source. According to the National Forest Inventory 2000-02, total forested area is some 128 million hectares (66% of the territory), including woodlands, forest, arid zone vegetation, hydrophile and halophile vegetation and mixed areas. Arboreal areas, consisting of woodlands and forests, occupy some 64 million hectares (only 50% of forested area and less than 33% of the territory). However, according to the 2000 land use and vegetation map prepared by the National Institute for Statistics, Geography and Information (INEGI) from aerial photographs in the period 1996-99, some 69 million hectares is occupied by forest biomass (temperate woodlands and tropical forests) (Table 5.6).

### 7.1 Deforestation

Mexico has *one of the world's highest deforestation rates*, around 1.1% per year. Based on preliminary information from the National Forest Inventory 2000-02, some 770 000 hectares of arboreal forest (of which 510 000 was tropical forest) per year were lost between 1993 and 2000. Thus, Mexico *would have lost over 95% of its original tropical forests*, over 90% of its mesophile woods and over half of its temperate woodlands. The main immediate causes of deforestation and forest degradation are forest fires (which have affected an average of 300 000 hectares per year since 1999), illegal logging, extensive livestock production (mainly in the arid north) and, above all, clearing for agricultural purposes. Inadequate management of forest areas is the underlying problem. There is an on-going effort, involving government and academic institutions, to produce updated and precise land cover information for better identification of the *extent of deforestation* and of areas with a high conversion rate.

Over 12 million people inhabit forested areas. Most are highly marginalised and live in extreme poverty. In the areas with the greatest biodiversity, 3.3 million people live in such conditions. This population exerts *excessive direct pressure on natural resources*.

Areas where deforestation rates tend to be lowest are also those under communal and municipal ownership which are subject to regulated management schemes (and where forestry activity has become a regional development alternative) and protected natural areas (where the deforestation rate is 10 times lower than in unprotected

areas). The Programme of Certification of Communal Rights and Titling of Urban Plots has led to fragmentation of forest cover, reflected in the *conversion of woodlands and forests to agricultural land*.

Table 5.6 **Vegetation types, 2000**

	Surface area ('000 hectares)	Share of national territory (%)
Temperate forest	34 667	17.7
Conifer forest	7 792	
Conifer and oak forest	12 993	
Oak forest	12 058	
Cloud montane forest	1 824	
Tropical forest	34 388	17.6
Evergreen and sub-evergreen tropical forest	11 178	
Semi-deciduous tropical forest	4 679	
Deciduous tropical forest	17 901	
Low thorny tropical forest	630	
Scrub	55 798	28.5
Xerophilous scrub	49 590	
Mezquital	3 197	
Chaparral	3 011	
Grassland	16 427	8.4
Induced grassland (not cultivated)	6 696	
Natural grassland	9 731	
Other types of vegetation	9 847	5.0
Sandy desert vegetation	2 161	
Halophilous vegetation	5 304	
Hydrophilous vegetation	2 254	
Palm forest	128	
Total	151 127	77.2

Source: INEGI.

## 7.2 Policy responses

Lack of continuity, owing to unstable and changing policies, is a main reason for the shortcomings of forestry sector operations. For this reason the *National Forestry Commission* (CONAFOR) was set up in 2001 as a decentralised agency of SEMARNAT. Its purpose is to promote production, conservation and restoration in forestry, and to

participate in formulating and implementing sustainable development policies. It also aims to halt deterioration of forested land by encouraging growth with quality. Other key measures to promote and develop sustainable forestry in the last few years have included enactment in 2003 of the new General Law on Sustainable Forest Development and the expanded use of fees for the provision of environmental services. Consequently, the Federal government's investment in the forest sector dramatically increased, from MXN 200 million in 2000 to MXN 2.6 billion in 2002.

The new *Forestry Act* includes the concept of *sustainable forest management*. It stresses the mitigation of environmental impacts and the pursuit of a balance with social and economic objectives. Of the approximately 21.5 million hectares of primary and secondary woodlands and forest on which sustainable production of timber is estimated to take place, only some 40% is under any type of technical management for commercial timber exploitation. The situation is worse in arid and semi-arid regions, (almost 30% of forest area). Though the headquarters of the international Forest Stewardship Council (FSC) are in Mexico (Oaxaca), forest certification is insignificant in Mexico. Less than 150 000 hectares has sustainable forest management certification about 1 million hectares is in the process of certification.

In response to accelerated loss of natural vegetation, a *National Reforestation Programme* launched in 1995 promoted restoration of an average 150 000 hectares per year of forest cover, achieving a 20% annual survival rate. In Mexico as a whole, nearly 225 000 hectares was replanted in 2002. In the last few years the Programme of Direct Support to the Countryside has encouraged reforestation of marginal agricultural land through direct payments to farmers, though applying them to a very small area. Since 1998 the *Hotspots Monitoring Programme* has operated annually during the dry season to provide information in real time to combat forest fires.

Of Mexican territory covered by forest vegetation or primarily potential forest land, 80% is publicly owned. Inhabitants generally do not have adequate organisational and technical schemes for sustainable management of forest ecosystems. To take advantage of traditional decision-making mechanisms and natural resource management in these agrarian communities, the *Forest Resources Conservation and Sustainable Management Project* (PROCYMAF) was implemented. Partly financed by the World Bank, it was conceived as a way to plan and establish integrated strategies for sustainable use of forest resources. In 2002 the project was implemented in 375 communities and 13 states. In particular, Oaxaca provided support to 104 communities, with a budget of MXN 46 million. This has allowed common lands (including ejidos) to be included in sustainable forest use schemes with FSC certification. After four years' operation, the area of forest under management has increased by 30%, timber production by 62% and the communities' income from forestry by 283%.

The main forest programme is the *Forest Development Programme* (PRODEFOR), launched in 1997. Its purpose is to support sustainable production projects, and to stimulate conservation and restoration of forest resources in natural woodlands through access to a subsidy scheme. When incorporated into CONAFOR in 2001, its budget increased substantially; the 2002 budget was MXN 386 million. This programme has not been adequate to promote forestry activity, as a raft of problems remains to be properly addressed (lack of organisation, training and entrepreneurial experience in communities and ejidos; some archaic relationships between producers and industrial enterprises that use forest products). Productive chains need to be created as part of a vertical integration policy (from forest exploitation to industrial wood processing). This would draw on existing interdependencies within the forest productive system and demonstrate knock-on effects among productive sectors and even among enterprises.

The *Programme for the Development of Commercial Forestry Plantations* (PRODEPLAN), operational since 1997, aims to support the establishment and maintenance of commercial plantations to make Mexico self-sufficient in forestry products. By law, these plantations must be established on non-forest land, contributing to the recovery of land suitable for forestry. From the 1970s until the point of transfer to CONAFOR in 2001, there were only 58 commercial forestry plantation projects in Mexico (60 000 hectares). In 2002 PRODEPLAN contributed to the incorporation of nearly 97 000 hectares under forest plantation, with a total investment of MXN 660 million (of which MXN 502 million from PRODEPLAN).

# 6

## ENVIRONMENTAL-ECONOMIC INTERFACE\*

### Features

- Planning and programming
- Decentralisation
- Sectoral integration
- Features of the Mexican energy sector
- Enforcing compliance with environmental law
- Financing gap

\* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “decoupling environmental pressures from economic growth” of the 2001 OECD Environmental Strategy. It takes into account the latest OECD Economic Surveys of Mexico.

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- fully take into account environmental concerns should *fiscal reform* be completed; there is a strong need for an increase in revenues to invest in environmental infrastructure;
- improve the environmental effectiveness of *energy and transport taxes*, differentiated according to air pollutant emissions and fuel efficiency; consider wider use of green taxes (petrol surcharge) to internalise environmental externalities and raise revenues;
- remove *environmentally harmful subsidies* (e.g. electricity and water) whilst giving due consideration to social concerns (e.g. replacement by direct income support for poor farmers and households so as not to distort price signals);
- improve *institutional integration within agriculture policies*, including through creating an environmental unit within the Ministry of Agriculture, Rural Development, Fisheries and Food;
- prepare a strategic environmental assessment of *transport policy*, including measures to reduce urban traffic congestion and develop rail and sea freight traffic, based on cost-benefit analysis;
- finalise the *strategy on energy and the environment*, with nationwide objectives and targets and expected completion dates, including for PEMEX and the Federal Electricity Commission's facilities;
- improve *enforcement of environmental legislation*, especially for nature and forest protection, by enhancing the human and financial capacity of PROFEPA and fostering partnerships with police authorities; review water related enforcement and compliance and include waste water discharge in integrated pollution control licences;
- extend the application of the *user and polluter pays principles* through better pricing of water and waste services, with due regard to social constraints;
- review the scope for introducing *new economic instruments* such as product charges on hazardous waste streams, air emission charges, payments for environmental services and water pollution charges;
- expand *environmental infrastructure*; in particular, increase related spending (e.g. from public, private and international sources), improve efficiency in the provision of environmental services, and develop public-private partnerships in the water and waste sectors;
- accompany decentralisation of environmental management to states and municipalities through commensurate *devolution of powers to tax and charge for environmental services* and determined efforts to build local administrative and technical capacity;
- formalise *institutional integration* mechanisms relating to sustainable development; further integrate environmental concerns into economic, fiscal and sectoral policies (e.g. transport, energy, agriculture, tourism).

## Conclusions

### *Integrating environmental concerns in economic decisions*

Attaining sustainable development has become increasingly an explicit aim of the strategic National Development Plan (issued by the Office of the President and covering six year periods, based on a 25-year outlook). This plan provides the framework for the programming of much Federal public expenditure by sectors. *Environmental programming* is co-ordinated with other sectoral programming. The National Environmental and Natural Resources Programme is issued every six years. The Programme to Promote Sustainable Development in the Federal Government seeks to include sustainable development targets and action plans in sectoral planning. “Presidential” targets have been set for all ministries, including performance requirements in terms of environmental outcomes and public administration. Two national crusades have been launched, to raise public awareness of tropical deforestation and water resources and of waste management. Since 2001, the Ministry of Environment and Natural Resources (SEMARNAT), which oversees air, water and waste management as well as nature conservation and forestry, has participated in inter-ministerial economic, social and law and order meetings. There is *institutional integration* of environmental concerns within tourism policies (e.g. national eco-tourism programme, Agenda 21 for the tourism sector) and within energy policies (resulting in lower energy intensity and weak decoupling of total final energy consumption from economic growth, fuel switching from oil to natural gas, improvement of road fuel quality). Prices of *road fuel* have steadily increased. A petrol surcharge was levied in Mexico City’s metropolitan area to raise revenue for environmental activities; it has been discontinued.

However, Mexico has not achieved strong *decoupling* of environmental pressure from economic growth as has been done in some other OECD countries. This reflects its development choices as well as rapid population growth. Major sources of direct *environmental pressure* include road traffic, industrial and agricultural production, and energy production and consumption. Road freight traffic increased by 78% between 1990 and 2001, while industrial production, agricultural outputs and primary energy supply rose by 43%, 33% and 24%, respectively. *Market-based integration* has remained very limited. There have been many proposals to improve energy pricing and transport taxation, but few have been put into practice. Excise duty on fuels, designed to protect public revenue and consumer prices from fluctuations in world oil prices, and taxes on vehicles could be further differentiated according to environmental externalities. No strategic environmental assessment is carried out in the case of *transport sector policies*. Limited efforts have been made to influence modal split, resulting in a 78% increase in road freight traffic over the decade. There is very little



institutional and market-based integration within the *agricultural sector*. On the contrary, support is provided for the development of intensive irrigated production, and the various agricultural and rural development programmes are designed and implemented with little regard to environmental protection. Progress in developing *renewable energy sources* has been slow, and further investments are needed to expand natural gas production and distribution to meet targets.

### *Implementing environmental policies and developing the environmental infrastructure*

*Environmental legislation* progressed during the review period. The General Law on Ecological Balance and Environmental Protection (covering air, sea and fresh water quality, hazardous waste, soil, protected areas, environmental impact assessment and noise) was updated in 1996 to introduce *integrated pollution control* for air, water and waste (introducing a Single Environmental License) and, in 2001, to establish the right of *public access to environmental information* and to strengthen public participation. New general laws were recently enacted on wildlife protection (2000) and on waste management (2003). In addition, all states have created their own environmental legal regimes. An increasing number of environmental offences are considered in the criminal code, and penal sanctions have been taken (e.g. for arson in forests). *Emission standards* are now linked to environmental quality objectives for recipient bodies. *Voluntary industry audits* have led to the granting of clean industry certificates. *User charges for Federal marine reserves* have recently been introduced and will be extended to terrestrial protected natural areas. Efforts are being made to develop public-private partnerships in the water sector.

However, though Mexico has recognised the severe environmental degradation confronting it, time as well as sustained and continuous efforts will be required to implement and fund its environmental policies. Devolution of environmental policy implementation has not been accompanied by adequate capacity building at state and municipal levels. This *implementation gap* reflects, in particular, the complex and sometimes unclear distribution of environmental competency across levels of government and limited local authority to raise revenues from taxes or charges. The scope of *environmental enforcement* has been broadened to address unsustainable use of natural resources (e.g. illegal forest cutting) but without the necessary parallel increases in staff and budget of the Federal Attorney for Environmental Protection (PROFEPA). Irrigation Districts continue to be inspected separately by the National Water Commission (which both inspects and enforces its own irrigation schemes), while individual irrigation schemes (50% of irrigation water) are virtually uninspected. There is wide scope to extend the use of *economic instruments*, particularly in air and

waste management. User charges for water and waste water services are set below cost recovery levels. Farmers are exempt from water abstraction charges. *Pollution abatement and control expenditure* has remained low by OECD standards. In fact, there are very large needs with respect to environmental infrastructure (e.g. water supply, waste water collection and treatment, waste infrastructure) which reflect cumulated underinvestment in such infrastructure and rapid population increase in urban areas. Given Mexico's environmental objectives, there is a *financing gap*: insufficient Federal spending on environmental protection, limited application of the user and polluter pays principles, the limited revenue-raising ability of states and municipalities and low reliance on external financing all explain Mexico's difficulties.



## 1. Sustainable Development

### 1.1 Planning and programming

*Planning and programming* constitute the framework for much of Mexico's Federal public administration activity. Under the Constitution, the government is required to present a *National Development Plan* (PND) including a section on environmental protection. The PND, issued by the Office of the President, sets out the main aims and priorities that should guide Mexico's economic development over a six-year period. Under Article 26 of the Constitution, problems related to environmental pollution and exploitation of natural resources are considered national priorities. The PND is translated into a set of programmes which are the basis for much of public spending.

In the past two decades real GDP has grown by about 2% per year, barely keeping pace with *population growth* (Box 6.1). Growing concern about the environment is responsible for a wide range of policy objectives. The 1995-2000 National Development Plan defined integrated strategies and generated a new spirit in public policy. Environmental protection and economic development are now perceived as linked, and the aim of attaining *sustainable development* has been made explicit. The 2001-06 PND has three main objectives:

- *social and human development*: improve the well-being of the population, develop education, ensure equity, and strengthen human capital and government capacity;
- *growth with quality*: develop the national economy, increase competitiveness, promote balanced regional development, and create conditions for sustainable development;

### Box 6.1 The economic context

With GDP of USD 611 billion (2001 prices and exchange rates), the *Mexican economy is the eighth largest in the OECD*. However, GDP per capita (USD 9 300 at 2001 prices and purchasing power parities) is among the lowest (Figure 6.1). These data mask the existence of a dual economy with dual consumption and production patterns (a rural sector where poverty is widespread and an urban economy with developed formal and poor informal sectors). Total government spending is constrained by low revenue, which at around 20% of GDP in 2000 is one of the lowest among OECD countries, with a substantial proportion related to oil and hence volatile. More than half of budgetary spending (excluding interest payments) is allocated to social development (education, health and social protection, including poverty alleviation). Public sector debt, at about 23% in 2000 and 2001, is much lower than in most OECD countries, but including liabilities created by the banking sector rescue package it stands close to 43%.

During the 1980s and 1990s Mexico suffered two deep recessions (the 1982-83 debt crisis and the 1994-95 peso crisis). Real GDP grew at 2% per year, *barely keeping pace with population growth*. Thus the standard of living (GDP per capita at constant prices and purchasing power parities) only just recovered its level of 20 years ago. Healthy economic recovery following the peso crisis (5% annual GDP growth in 1996-2000) was reflected in employment, and was accompanied by a steady fall in inflation (below 5% by the end of 2001). There was a sharp slowdown in 2001, reflecting the US slowdown. Real GDP shrank by 0.3% in 2001 and only moderate positive growth (0.9%) was recorded in 2002. The recovery should gain momentum from mid-2003, based on higher exports and improving confidence. GDP growth is projected at close to 4% in 2004.

Services contribute close to 68% of GDP, industry 28% and agriculture, forestry and fishing together 4.3%. *Exports of goods* represent about 28% of GDP, with manufactured goods, petroleum products and agricultural goods accounting for 87.3%, 9.8% and 2.5% of total exports in value. Almost 90% of Mexican exports go to the US, which makes for a high degree of synchronisation of its cycle. Mexico ranks seventh among the 144 World Trade Organisation (WTO) member countries for both exports and imports (by value). Mexico adhered to the GATT in 1986; it signed the North American Free Trade Agreement in 1993.

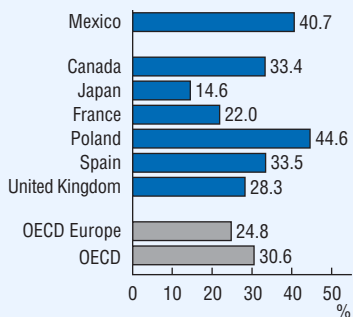
According to the National Population Council (CONAPO), over 1.2 million households (5% of the national total) receive *remittances* from relatives in the US. The value of such remittances (estimated at close to USD 10 billion per year) is twice that of net farm exports and tourism earnings (in 2000-01).

Over the past 15 years Mexico has engaged in *wide-ranging structural reforms* to make its economy more open and flexible. The role of the Federal government has been reduced and many State-owned enterprises (airlines, utilities, telecommunications firms, steelmakers, railways) have been privatised. The electricity sector has not yet been reformed. A reform proposal is under discussion; it does not envisage privatisation of CFE and PEMEX, the State electricity and oil monopolies.

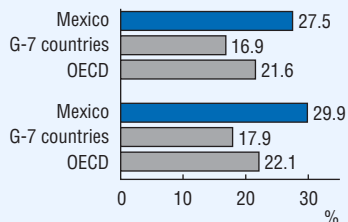
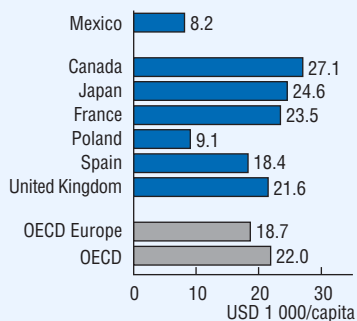
Figure 6.1 Economic structure and trends



**GDP<sup>a</sup> growth, 1990-2001**



**GDP<sup>a</sup> per capita, 2001**



a) GDP at 1995 prices and purchasing power parities.  
Source: OECD.

- *law and order*: improve co-operation among authorities, make progress towards decentralisation, fight corruption, govern with transparency, and guarantee public security and justice.

Sustainable development has been designated a national priority whose purpose is “growth with quality”; environmental protection is another national priority aiming at “social and human development”. Every ministry, including SEMARNAT, has adopted a *national sectoral programme* consistent with the PND and based on its own long-term (25-year) strategic outlook. Sectoral programmes serve as policy guides, specifying goals, strategies and policies in each sector to be implemented during the next six years. The 2001-06 *National Environment and Natural Resources Programme (PNMA)* is a framework document with six main goals:

- *integrated ecosystem management*: focus on watershed rather than political boundaries in the management of water, land, air quality, forests and biodiversity;
- *policy integration*: sustainable development should be the shared responsibility of Federal ministries and institutions;
- *environmental management*: halt and reverse environmental contamination and degradation of ecosystems;
- *provision of environmental services*: improve management of natural ecosystems and ensure that those who benefit pay for these services;
- *enforcement of environmental legislation*: strengthen inspection and compliance;
- *public participation and transparency*: publish environmental information and respond to public demand for environmental protection.

The latest PNMA and thematic strategic outlooks until 2025 establish principles to *guide six-year planning of actions by SEMARNAT affiliate agencies* in the areas of forestry, nature conservation, water management, and enforcement of environmental legislation. The PNMA prioritises targets in these areas in relation to broader strategic environmental objectives. It also *establishes links with environmental objectives and targets in ten national sectoral programmes*: agrarian reform (including land tenure reform), agriculture (including rural development and fisheries), economy (including industry, trade and mining), education, energy (including the national oil and electricity companies), finance, health, social development, tourism and transport (including communication). From 2002, as part of the programme to promote sustainable development of the Federal public administration, each ministry must report to the President of Mexico at the end of the year on progress in meeting its interim environmental targets (called *Presidential targets*). Targets for the following year will then be set accordingly.

The PNMA recommends *decentralisation of environmental management* with full attention to environmental protection in major regional plans (e.g. Plan Puebla Panama), and to the role of indigenous communities and to gender issues in environmental programmes. It establishes two *national crusades*, identifying objectives and regions where government actions should be focused in alliance with civil society. These crusades address tropical deforestation and protection of water resources (crusade for forests and water), and waste reduction and recycling (crusade for a clean Mexico). Many other thematic plans (e.g. the 1997-2000 wildlife conservation programme and the 2000 National Biodiversity Strategy) do not observe the six-year framework but include environmental objectives. There is no national waste management programme. Local air management programmes have been developed for seven large metropolitan areas.

## 1.2 Institutional integration

### *At the Federal level*

In recent years Mexico has developed new mechanisms to promote institutional integration of environmental policy, particularly since the creation of the Environment Ministry in 1994 (called the Ministry of Environment, Natural Resources and Fisheries, or SEMARNAP, until 2000 and the Ministry of Environment and Natural Resources, or SEMARNAT, thereafter). Since 2001 SEMARNAT has been represented by its Secretary (i.e. Minister) on the *three inter-ministerial commissions* concerned with human and social development, growth with quality, and law and order, demonstrating that environment is not a sectoral issue but must be integrated into the agenda of national priorities. The *National Consultative Council for Sustainable Development* (CNDS), with representation from governmental organisations and NGOs, was created in 1995 to promote integration of environmental concerns into policy making and to evaluate periodically the environmental impact of policies and programmes. At the same time, four regional consultative councils for sustainable development were established to co-ordinate with state, regional and national organisations.

SEMARNAP was restructured into SEMARNAT following the transfer of responsibility for fisheries to the present Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA). This institutional change also reflected the government's commitment to more efficient and effective environmental management through *separation of production-related activities from supervisory and regulatory functions*. In the nature conservation area this change led to the creation in 2001 of both the National Forestry Commission (CONAFOR) and the National Commission for Protected Natural Areas (CONANP), with responsibilities for reforestation and forestry activities and management of protected areas, respectively. The National

Institute of Ecology (INE) has been downsized and restructured and is currently a strategic research institute. Responsibilities for supervising waste management, evaluating environmental impact assessment (EIA) and issuing environmental permits have been transferred to the new under-ministry for environmental management; the under-ministry for environmental regulation and promotion is now responsible for evaluating environmental standards. In the water management area the National Water Commission (CNA) continues to exercise full authority over productive and regulatory matters. The staff and budget of the Federal Attorney for Environmental Protection (PROFEPA) remain virtually unchanged despite a steady increase in enforcement duties.

SEMARNAT contributes to energy policy making through its participation in the Working Group on Fuel Policy, together with the Ministries of Energy, Economy, and Finance and Public Credit as well as the Federal Electricity Commission (CFE) and PEMEX. Close co-ordination has been established between SEMARNAT and the Ministry of Tourism (SECTUR). This has facilitated *environmental impact assessment* of the Nautical Staircase tourism development project (which envisions creating a chain of 27 marinas along the coast of Baja California by 2014), in particular preventing construction of a highway in the Vizcaino Biosphere Reserve. There is little co-ordination between SEMARNAT and SAGARPA.

Additional efforts to co-ordinate public policies towards sustainable development are under way within the *Programme to Promote Sustainable Development in the Federal Government* (PDS). Twenty Federal agencies participate in the PDS, which includes targets and action plans. SEMARNAT co-ordinates the work of the four working groups (economy, energy, social affairs and environment) and the President's office convenes the plenary sessions. This should lead to issuance of the first report on sustainable development in Mexico, in which both the processes and projects that promote sustainable development will be documented alongside the barriers and obstacles to sustainable development.

### *Decentralisation*

While Mexico is a Federal republic, its administrative and fiscal structure has traditionally been highly centralised. Since the 1980s, and especially since the mid-1990s, *decentralisation* ("*federalismo*") has become a key policy priority. The General Law on Ecological Balance and Environmental Protection (LGEEPA) (the overarching Federal environmental law) and other environmentally related Federal legislation are complemented by state environmental laws. Ministries and state agencies have offices (delegations) in individual states; states, municipalities and citizens are progressively becoming more involved in choices concerning local environmental issues.

Complex and poorly defined *distribution of environmental competency across levels of government* has impeded decentralisation of environmental management. The general principle is that states are competent in areas not expressly reserved for the Federation. Municipalities have powers with respect to specific aspects in areas under municipal jurisdiction. According to LGEEPA (Article 11), the Federal government may enter into co-ordination agreements with the states (or the Federal District) to carry out specific responsibilities. For instance, the Federal government is solely responsible for hazardous waste and national forest and coastal zone management, but with the consent of SEMARNAT states may take on some of the management responsibilities. The Federal level is still strongly involved in water management at the local level through CNA. Water remains a challenge in regard to the decentralisation process, but the results of recent efforts to devolve water management to river basin councils are encouraging (Chapter 3).

LGEEPA (Article 7) entrusts the *states* with use of EIA to control air pollution from selected stationary and mobile sources; administration of protected natural areas; regulation related to non-hazardous waste management; monitoring compliance with Mexican Official Standards (NOMs), and promotion of public participation in environmental policy decision-making. Amendments to LGEEPA in 1996 and 2001 have given additional environmental management powers (e.g. to issue integrated environmental permits and undertake ecological land use planning) to the states. Urban land use planning and regulation are delegated primarily to state and municipal authorities. The Ministry of Social Development (SEDESOL) provides guidance by issuing a national urban zoning plan.

The Constitution (Article 115) gives *municipal authorities* environmentally related powers, e.g. related to public sanitation (municipal waste management, water supply, waste water treatment), land use planning (urban zoning and development), administration of ecological reserves and issuance of building permits. LGEEPA (Article 8) specifies that municipalities are to enforce air quality and noise legislation and to participate in EIA, as appropriate. States and municipalities are to implement environmental information policies. As municipal administrations cannot be re-elected after serving a single three-year term, mechanisms need to be created to ensure the continuity and sustainability of environmental management at municipal level.

Decentralisation of environmental policy should receive adequate financial support at sub-national level. Since 1998 a new budget line in national accounts (Ramo 33) shows *transfers from the Federal budget* to states and municipalities, increasing accountability with respect to decentralised public expenditure. Federal government transfers to states and municipalities increased from 9 to 22% between 1992 and 2002, with steady growth in 1997 and 1998 in parallel with the transfer of more



spending responsibilities (e.g. in education). Transfers have generally met education and health policy objectives, and have sometimes included environmental measures. Most have gone to states and little to municipalities, though this situation is gradually changing (municipalities' share increased from 14% in 1998 to 19% in 2002). Both states and municipalities rely heavily on fiscal transfers to meet policy objectives. The capacity to raise revenue locally has remained extremely limited and has not kept pace with spending increases. The share of *local tax revenue* (state and municipal) in total tax revenue has increased (to a few percent) but remains very low by OECD standards. Efforts are needed to increase government tax revenue including through increasing taxes at the state and municipal level, particularly in relation to local provision of public environmental services.

### 1.3 Market-based integration

Little has been done to introduce a *green tax reform*, though proposals have been made. This is despite Mexico's low tax burden (about 17% of GDP, the lowest rate in the OECD, including 4% of GDP from oil-related revenue) and the need to meet ambitious environmental policy objectives. Distributive implications of full-cost water pricing as well as removal of electricity subsidies (e.g. impacts on farmers and poor households) are among the most challenging emerging policy issues.

#### *Taxes and other fiscal measures*

Revenue from environmentally related taxes is not earmarked for environmental purposes (Tables 6.1 and 6.2). Introduced in 1995, the *petrol surcharge levied in Valley of Mexico Metropolitan Area (ZMVM)* had differentiated rates for leaded and unleaded until leaded petrol was phased out. The revenue was channelled to an environmental trust fund for financing improvements in service stations in the ZMVM (for recovery of organic fumes). The Ministry of Finance and Public Credit (SHCP) stopped earmarking this revenue in 1997 on the principle of public finance efficiency. At 2 cents per litre, the surcharge has limited impact on petrol consumption.

Limited efforts have been made to implement the recommendation of the 1998 OECD Environmental Performance Review of Mexico to adjust the *fuel tax* structure. The complex structure of the current excise duty on fuels was designed (in the 1980s) to protect public revenue when world oil prices began to fall. In Mexico (unlike most other OECD countries) the tax rate is set to minimise fluctuations in final consumer prices (i.e. when world oil prices rise, the tax rate falls and vice versa). Road fuel prices have steadily increased and are now higher than in some other OECD countries (corrected for purchasing power parities) including the US, at current exchange rates (Figures 2.3 and 2.4). In December 2002 retail prices were

Table 6.1 Selected environmentally related taxes on transport and energy, 2001

Instrument	Rate	Remarks
<b>ENERGY</b>		
Excise duty on fuel	Determined by international reference price, domestic price, and administrative and transportation costs (petroleum-based liquid fuels). Determined by international reference price, prevailing domestic price of "magna" PEMEX petrol, and administrative and transportation costs (natural gas for transport).	Revenue (USD 9 223.4 million) from this "special tax on products and services" accrues to general Federal budget. Rate designed to fall as international reference price rises to stabilise final total cost to consumers. Exemptions applied to fuels that do not become definitive exports (according to Customs Law). No exemptions for specific sectors. Refund is given to final consumers of diesel used in agriculture if income is below threshold.
Additional petrol tax in Mexico City	MXN 0.04/litre (leaded, phased out in 1998). MXN 0.02/litre (unleaded).	Levied on petrol sold in Mexico City metropolitan area. Revenues earmarked for environmental trust fund.
<b>TRANSPORT</b>		
Registration tax	USD 160.5–884 (cars, varying by sales price). 5% of sale price (lorries). 5% of sale price (tow cars).	Revenue (USD 493.4 million) from this "tax on new automobiles" accrues to state governments. Exemptions applied to inexpensive and compact automobiles with sale price below USD 8 025, vehicles for definitive export, and vehicles imported by franchise holders. Proposal being considered to introduce environmental criteria to current design on <i>ad valorem</i> basis.
Motor vehicle tax	USD 19.3-325.4/year (motorcycles, varying by engine power). 2.6%-10.4% of value/year (vehicles with capacity of up to 15 passengers, varying by value). 0.245% of value/year (vehicles with capacity of over 15 passengers). 0.245% of value/year (public passenger transport vehicles). 0.245% of value/year (lorries weighing below 15 tonnes). 0.25%-0.6% of value/year (lorries weighing 15-35 tonnes, varying by weight). 0.6% of value/year (lorries weighing over 35 tonnes). USD 825.3 x weight + max. burden of take-off/year (aircraft). USD 55.7/year (jet skis, water motorbikes and surfboards with motors). USD 24.6 x (length - 4) <sup>2</sup> /year (sailboats). USD 193.2 x [length(horsepower/1000)-0.2]/year (other craft less than 10 years old). USD 3.4-743/year (sailboats and other craft over 10 years old, varying by value).	Revenue (USD 1 096.7 million) of this annual tax paid on vehicle ownership accrues to state governments. Exemptions applied to electric vehicles for public transport, aircraft with capacity of over 20 passengers for public transport; boats dedicated to merchant transport or commercial fishing; vehicles and ambulances of the Federation, states or municipalities; vehicles belonging to rentier immigrants.

Source: OECD.

Table 6.2 **Revenue from environmentally related energy and transport taxes, 1994-2001**  
(USD million<sup>a</sup>)

	1994	1995	1996	1997	1998	1999	2000	2001
Energy (excise duty on fuels)	6 452	2 700	2 686	4 339	6 742	9 149	7 004	9 923
Transport (registration tax)	321	104	1	107	244	357	489	493
(motor vehicle tax)	955	505	590	769	732	808	893	1 097
Total ERT <sup>b</sup> receipts	7 729	3 308	3 276	5 216	7 718	10 314	8 385	11 514
Total tax receipts	72 225	47 608	55 210	70 172	67 254	80 656	107 487	..
Total tax receipts as share of GDP (%)	17.2	16.6	16.6	17.5	16.0	16.8	18.5	..
ERT <sup>b</sup> as share of total tax receipts (%)	10.7	6.9	5.9	7.4	11.5	12.8	7.8	..
ERT <sup>b</sup> as share of GDP (%)	1.8	1.2	1.0	1.3	1.8	2.1	1.4	1.9
GDP	419 913	286 795	332 592	400 982	420 340	480 097	581 008	618 066

a) Current prices.

b) Environmentally related energy and transport taxes.

Source: SHCP; OECD.

lowered at 500 service stations along the US border to curb cross-border “gasoline tourism”. To better internalise environmental externalities, introduction of a new petrol tax structure should be considered.

*Registration and motor vehicle taxes* are based on vehicles’ market value. New vehicles imported from the US are duty-free as of 2000. Under NAFTA, import licenses will be abolished in 2004; this will lead to adjustments in the price of vehicles sold in Mexico and facilitate more rapid renewal of the Mexican fleet. Increase in motor vehicle taxes for old (highly polluting) vehicles would stimulate their withdrawal. Used vehicles may be imported from the US by retailers (from 1999) and residents (from 2002) within 100 kilometres of the northern border and in the state of Baja California Sur, provided their use is restricted to these areas. Import restrictions on used vehicles in the rest of Mexico will be removed in 2009. To address environmental impacts associated with the rapid growth of road traffic, differentiation according to fuel efficiency and air emissions should be incorporated into the rate structure of vehicle taxes.

Two fiscal incentive schemes are available to industry for pollution abatement and control (PAC) investment (Table 6.3): *accelerated depreciation* of investments (i.e. a company is allowed higher tax deductions in the year when an investment is

Table 6.3 Selected environmental charges and other economic instruments, 2001

Instrument	Rate	Remarks
<b>WATER</b>		
User charge for public water supply (PWS), sewerage (S) and public waste water treatment (WWT)	USD 0.25/m <sup>3</sup> (unweighted average of volumetric rates and of volumetric charge equivalent to average fixed charges across utilities covering 25% of population, PWS only).	Revenue (USD 1 444.5 million, 2001) collected by water utilities insufficient for full cost recovery but collection rate is improving. Tariff structure is usually progressive, with different rates for households (lowest), the commercial sector and industry (highest); cross-subsidisation exists in favour of households. Great regional variations in price levels.
Irrigation water charge	USD 30-60/hectare (bulk water supply to irrigation districts, varies depending on supply costs).	Revenue (USD 117.53 million, 2000) collected by CNA, achieving about 70-80% cost recovery.
Water abstraction charge	USD 0.11-1.43/m <sup>3</sup> (general rates, depending on type of use and regional water availability). USD 1.43-28.38/thousand m <sup>3</sup> (drinking water, 2002).	Rates set in annual Federal Law on Water Taxes. Revenue collected by CNA (USD 511.48 million, 2000), paid by industry (65%), hydrogenation (25%), water utilities (7%). Exemptions applied to abstraction for agriculture and drinking water for rural towns with less than 2 500 population. A national register of water abstracters is being completed by CNA.
Pollution charge	Determined by quantity and strength (in excess of permissible BOD, COD and TSS levels) of discharge and carrying capacity of recipient body (industrial and municipal waste water discharge).	Revenue (USD 3.07 million, 2000) collected by CNA. Paid mostly by industry. Water utilities accumulated debt reaching USD 7 704 million in 2001 by refusing to pay pollution charges, but debt was forgiven.
<b>WASTE</b>		
User charge for municipal waste collection and disposal	..	Implemented by very few municipalities. Only about 20% of operating cost of municipal waste services is recovered through user charges. A new comprehensive waste law, to be introduced in 2003, should improve implementation of user charge.
Deposit-refund systems (proposed)	..	Proposals for deposit-refund systems being considered for PET batteries, lubricant oil, and tyres.

Table 6.3 **Selected environmental charges and other economic instruments, 2001** (*cont.*)

Instrument	Rate	Remarks
<b>NATURE</b>		
Natural resource user fees	USD 1.83/day/person (diving, water skiing, boating). USD 9.51/day/person (overnight stay). USD 93.23/season/boat (whale watching). Determined by unit or lot (recreational hunting). Determined by unit or lot (collection or capture of wild fauna for breeding, repopulation, reintroduction, transfer or environmental education).	Natural resource user fees for recreational and other activities on Federal lands and marine zones within National protected areas introduced in 2002. Federal government allowed to collect user fees under the reformed Federal Rights Law and Federal Revenue Law. Revenues earmarked to finance wild fauna habitat protection, national park management, and inspections by PROFEPA.
Tradeable hunting rights	Price of hunting rights determined in auctions.	Communities which own hunting license sell right to hunt on their land, but not the license itself. Revenue reaches USD 300 million/hunting season.
<b>INDUSTRY</b>		
Accelerated depreciation	Up to 100%.	Applied to PAC investment by industry, enforced in year investment is made. Companies receive applicable tax returns under Income Tax Law.
Tax exemption	0%.	Applied to imported equipment for PAC, water and energy saving, and waste, risk and noise minimisation. Generates 10-15% cost savings.

Source: SEMARNAT; OECD.

made) and *import duty exemption* for pollution abatement equipment. However, the types of investments and equipment that qualify are not sufficiently clear. The extent to which incentives have induced PAC investment is uncertain – especially in the case of micro, small and medium-sized enterprises with limited access to credit.

### *Removal of environmentally harmful subsidies*

Only limited efforts have been made to implement the 1998 OECD recommendation to remove *extensive electricity subsidies* (USD 6.5 billion in 2001). Cost recovery from households has deteriorated by 20% in real terms since the late 1990s. In 2001 CFE tariffs covered 85 to 90% of costs for industry and services, but only 42% for

households and 29% for farmers. The situation is even worse in the ZMVM, where Central Light and Power Company (LFC) tariffs in 2001 covered only 60 to 80% of costs for industry and services, 27% for residential customers and 17% for agricultural use. Gradual elimination of electricity subsidies, except for low-income households, is planned. In 2002 subsidisation of households was reduced by about USD 500 million. Subsidies were removed for households consuming over 250 kWh/month, and reduced for those consuming between 140 and 250 kWh/month; this represents one-quarter of the population. Subsidised tariffs have remained unchanged for the remaining 75% of the population (which consumes less than 140 kWh/month), as have those for agricultural use. The timing of further reform is unclear (it was recently proposed to increase subsidies for some regions with extreme climatic conditions). To improve price signals, direct income support to targeted beneficiaries (e.g. low-income households) should replace subsidies.

A major agricultural policy reform is designed to improve the market orientation of agricultural production (Chapter 8). Mexico's overall level of agricultural support is low by OECD standards (Producer Support Estimate of 22% in 2002) and the *share of incentives aimed at intensifying agricultural production has fallen* significantly. Lack of water pricing and government transfers to support on-farm irrigation are still significant constraints on sustainable agriculture. Proposals to the Congress in 2001 to extend water pricing to the agriculture sector and to eliminate VAT exemption for pesticides were rejected.

The link between *agricultural policy and forest management* has remained weak. Though decoupled from production, direct payments to the countryside (PROCAMPO), introduced in 1994, have not led to significant changes in agricultural production. The option of using PROCAMPO payments for environmental purposes has scarcely been used, partly reflecting limited institutional integration between the Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA) and SEMARNAT. The environmental effects of PROCAMPO, including changes in pressures on marginal farmland, have not yet been evaluated. The on-going agricultural policy reform provides new incentives for the development of profitable forestry, so long as the environmentally beneficial public services associated with forests are compensated for.

#### **1.4 Sectoral integration**

Further integration of environmental objectives into economic and social decisions was a key recommendation of the 1998 OECD Environmental Performance Review. It is also one of the six main goals of the 2001-06 PNMA. Efforts have been made in the energy, transport and tourism sectors; there is considerable scope for increasing

integration of environmental concerns into agricultural policies (Chapter 8). *Relative decoupling* of environmental pressure has been achieved in the past decade in the industry, energy and (to a lesser extent) transport sectors (Box 6.2).

### Box 6.2 Decoupling environmental pressures from economic growth

Despite the 1994-95 peso crisis, Mexico's *economy grew* by 41% overall between 1990 and 2001, exceeding OECD average growth during this period (Figure 6.1). However, *population growth* of 22% in the same period resulted in per capita income growth of only 15%. Major sources of direct environmental pressure include road traffic, industrial and agricultural production, and energy production and consumption. Road freight traffic increased by 78% in the 1990s while industrial production, agricultural outputs and primary energy supply rose by 43%, 33% and 24% respectively (Table 6.4).

Overall, the *energy intensity* of the economy improved by 12% in the period 1990-2000, reflecting weak decoupling of energy supply from GDP growth. While key *environmental indicators* still showed growth in environmental pressure during the 1990s, the trend in the 1980s (environmental pressure growing faster than the economy) was reversed. Thus weak decoupling was achieved for industrial pollution. An increase in SO<sub>x</sub> emissions can be attributed to power stations and industrial combustion, while NO<sub>x</sub> emissions originated from mobile sources and power stations. Despite growth in agricultural output, nitrogenous fertiliser use remained constant in the 1990s. Water abstraction (78% for agricultural use) had been increasing at alarming rates, but this increase slowed in the 1990s to a rate less than that of agricultural output. As a water-stressed country, Mexico needs to further reduce water abstraction towards strong decoupling. Over 100 of its 258 aquifers are still overdrawn. Other impacts from agriculture and livestock production, notably soil erosion and induced deforestation, appear to have intensified; deforestation rates are among the highest in Latin America and biodiversity is declining. Pollution emissions and resource use by economic sectors need to be reduced significantly if Mexico is to *reposition itself on a more sustainable development path*.

*Strong decoupling* of environmental pressure from GDP, as seen in a number of OECD countries, has not yet been achieved in Mexico. This is reflected in the Mexico's "*Ecological GDP*". This index takes into account not only conventional production-based GDP, but also the environmental damage entailed in reaching that level of production. Environmental damage was estimated at around 10% of GDP during most of the 1990s. About 90% was due to environmental degradation (mostly pollution) from economic activities; 10% represented natural resource depletion. Major efforts are still needed to achieve absolute reduction of environmental pressure.

## Energy

The 2001-06 Energy Sector Programme contains explicit *environmental objectives*: expand use of natural gas and renewable energy; improve fuel quality; retrofit oil-fired power plants to meet stricter air emission standards; promote energy efficiency; and reduce flaring and gas venting in oil production. Other objectives, such as full-cost energy pricing and efficiency improvements in power generation and transmission, would also contribute to environmental protection. Electricity and gas prices have long been below those in other OECD countries but they have become much closer (Table 6.5). Mexico has begun preparation of a strategy on energy and the environment.

Table 6.4 **Economic trends and environmental pressures, 1980-2001**  
(% change)

	1980-90	1990-2001
<b>SELECTED ECONOMIC TRENDS</b>		
GDP <sup>a</sup>	20	41
Population	17	22
GDP <sup>a</sup> /capita	3	15
Agricultural production	18	33
Industrial production <sup>b</sup>	19	43
Total primary energy supply	25	24 <sup>e</sup>
Energy intensity (per GDP)	5	-12 <sup>e</sup>
Total final energy consumption	28	6 <sup>e</sup>
Road freight traffic <sup>c</sup>	32	78 <sup>e</sup>
Passenger car traffic volume <sup>d</sup>	32	25 <sup>f</sup>
<b>SELECTED ENVIRONMENTAL PRESSURES</b>		
CO <sub>2</sub> emissions from energy use <sup>g</sup>	22	24 <sup>e</sup>
SO <sub>x</sub> emissions	..	9 <sup>h</sup>
NO <sub>x</sub> emissions	..	18 <sup>i</sup>
Water abstraction	22	5 <sup>e</sup>
Nitrogenous fertiliser use	49	0 <sup>e</sup>
Municipal waste	..	12 <sup>j</sup>

a) At 1995 prices and PPPs.

b) Includes mining and quarrying, manufacturing, gas, electricity and water, construction.

c) Based on values expressed in tonne-kilometres.

d) Based on values expressed in vehicle-kilometres.

e) To 2000.

f) To 1999.

g) Excluding marine and aviation bunkers.

h) 1994 to 1998.

i) To 1998.

j) 1993 to 2001.

Source: OECD; IEA.



The 1998 OECD Environmental Performance Review recommended further improving *energy efficiency*. The equivalent of around 1% of electricity generated (between 1.5 and 2 TWh a year) is estimated to have been saved since the mid-1990s, mainly due to issuance in 1995 of energy efficiency standards for the industry, agriculture, commercial and residential sectors (e.g. NOMs applying to household appliances, industrial boilers, water pumps, thermal insulation) and energy saving programmes sponsored by the National Commission on Energy Conservation (CONAE), PEMEX and the CFE. Daylight saving time, introduced in 1996, has contributed to electricity saving but only to a limited extent. There is potential for further gains in energy efficiency.

About 22% of Mexico's electricity is generated from *natural gas* (100% in the ZMVM); this share is to reach 61% by 2010. Concerning industrial use of natural gas, its share is to increase to 53% by 2005 (from 37% in 1994) while the share of fuel oil is to fall to 35% (from 55% in 1994). In the ZMVM, industry largely (83%) relies on natural gas and LPG and much less (17%) on fuel oil and diesel. Mexico's demand

Table 6.5 Energy prices in selected OECD countries,<sup>a</sup> 2001

	Electricity		Oil		Natural gas	
	Industry (USD/kWh)	Households (USD/kWh)	Industry <sup>b</sup> (USD/tonne)	Households <sup>c</sup> (USD/1 000 litres)	Industry (USD/10 <sup>7</sup> kcal)	Households (USD/10 <sup>7</sup> kcal)
Mexico	0.05	0.08	103.1	..	163.4	..
Canada	..	..	164.9	347.3	111.7	281.8
Japan	0.14 <sup>d</sup>	0.21 <sup>d</sup>	217.2	409.7	452.7 <sup>d</sup>	1294.1 <sup>d</sup>
France	0.04 <sup>e</sup>	0.10 <sup>d</sup>	154.4	357.3	187.1	410.3
Poland	0.04	0.08	105.4	364.7	173.3	304.0
Spain	0.04	0.11	161.0	349.5	176.0	507.9
United Kingdom	0.05	0.10	177.4	276.4	133.6	286.5
OECD Europe	0.05 <sup>d</sup>	0.11 <sup>d</sup>	150.5 <sup>e</sup>	386.7	157.7 <sup>d</sup>	329.0 <sup>d</sup>
OECD	0.05 <sup>d</sup>	0.11 <sup>d</sup>	189.0	380.5	173.2	351.7
Mexican price/OECD Europe (%)	100	73	69	..	104	..
Mexican price/OECD (%)	100	73	55	..	94	..

a) At current exchange rate.

b) High-sulphur oil.

c) Light fuel oil.

d) 2000 data.

e) 1999 data.

Source: OECD; IEA.

for natural gas grew by 5.6% annually in 1995-2000 and recently exceeded domestic supply (Box 6.3). Demand is expected to increase by 8% annually in 2000-10. To respond to growing demand and to meet fuel mix objectives, further (and large) investments are needed to expand natural gas production and distribution capacity, drawing on Mexico's abundant natural gas reserves.

Some progress has been made in expanding *renewable energy* generation capacity, as recommended by the OECD in 1998. In 2000, 20% of electricity generation originated from renewable sources, mostly (85%) from hydropower. Construction of three large new hydropower plants is planned. Geothermal production energy has grown significantly in the last decade while use of biomass, solar and wind power has remained at the experimental stage. About 5 million people still do not have reliable *access to electricity*; since 85% live in rural areas, connection to the grid would be costly and is unlikely in the foreseeable future. The potential for renewable energy production in rural areas should be further explored (*e.g.* wind power in Oaxaca).

Mexico is the world's ninth largest greenhouse gas emitter (Chapter 9). *CO<sub>2</sub> emissions* from fuel combustion increased by 23% between 1990 and 2000 (Table 9.3). In 2000 the energy sector was the largest source (48%) of *CO<sub>2</sub> emissions*, followed by transport (28%) and manufacturing and construction (16%). *CO<sub>2</sub> emissions* from industry fell by 24% over the decade, while those from the energy sector grew by 67%. In 1999 PEMEX committed to a 1% annual reduction of *CO<sub>2</sub> emissions* until 2010. Mexico's *CO<sub>2</sub> emission intensity* decreased by 12% in the 1990s, remaining below the OECD average. Per capita *CO<sub>2</sub> emissions* are well below the OECD average (Chapter 9).

In 2002 the Ministry of Energy and SEMARNAT jointly developed the *Federal Energy and Environment Programme for Sustainable Development*, as part of a cross-cutting approach to sectoral integration. This programme contains proposals to improve energy intensity and energy efficiency and promotes use of renewable energy. It also stresses the need for significant investment to prevent the negative environmental impacts of the energy sector's activities.

### *Transport*

Mexico has taken *measures to combat air pollution* from transport, responding to very rapid growth in road freight and passenger car traffic (78% and 25%, respectively) in the 1990s (Chapter 2). This has involved improving fuel quality, setting more stringent vehicle emission limit values (CO, NO<sub>x</sub> and hydrocarbons) and making catalytic converters mandatory in new vehicles. However, further reduction of the transport sector's pollution intensity is required. The potential for increasing the share of rail in

### Box 6.3 Selected features of the Mexican energy sector

Mexico's oil and natural gas endowment has played a *key role in its economic development*. Mexico was the world's seventh largest crude oil producer in 2000. The energy sector accounted for 2.8% of GDP, and energy exports represented 9.7% (including crude oil, 9%) of total goods exports in 2000. While oil is no longer the principal source of export earnings, PEMEX continues to make a substantial contribution to the Federal budget. Oil-related revenues accounted on average for about one-third of total tax revenues in the 1990s, making public finance vulnerable to changes in world oil prices.

The energy sector achieved weak decoupling in the period 1990-2000. The *energy intensity* of the economy fell by 12% during the 1990s to 0.19 toe/USD 1 000 GDP, below the OECD average and close to that of OECD Europe. Mexico's *primary energy supply* fuel mix is dominated by fossil fuels (Figure 6.2). While supply increased by 24% between 1990 and 2000, oil's share fell from 67 to 62% and that of natural gas grew from 18.6 to 22%. Demand for natural gas is expected to grow rapidly in the next 10 years with further fuel substitution, especially in electricity generation. The share of coal increased from 2.6 to 4.6% in the same period. Renewable and nuclear energy represented 5.2 and 1.4%, respectively, in 2000. Mexico's *total final energy consumption* (TFC) increased by 6% between 1990 and 2000. The TFC of industry fell by 13%, while that of transport increased by 12%. In 2000 the transport sector was the largest energy consumer (40% of TFC), followed by industry (34%) and the residential sector (21%).

Concerning the *electricity subsector*, two State-owned companies generate most of Mexico's electricity: the Federal Electricity Commission (CFE) at 92% and the Central Light and Power Company (LFC) at 2% (mainly for Mexico City). The balance is provided by PEMEX and the private sector. Electricity generation grew more rapidly (by 66% during 1990-2000) than primary energy supply (24%). Hydrocarbons (oil and gas) accounted for 59% of total electricity production in 2000, followed by hydro (17%), coal (10%), dual systems (7%) and nuclear (4%). Geothermal and wind power together accounted for 3%. In the period 2000-2010 Mexico plans to shift fuel and generation technology further towards cleaner options: the share of natural gas is to increase to 61% and that of combined cycle generation to 52%, while the share of thermal units is to fall from 47% to 14%.

Despite Mexico's abundant oil and gas endowment, *years of underinvestment in the energy sector* are reflected in inadequate capacity to support growing demand. Domestic oil refining capacity has remained unchanged, requiring Mexico to export heavy crude oil and import refined higher quality fuels from the US. PEMEX is carrying out extensive refinery modernisation, which will increase domestic production of high-octane petrol and diesel towards self-sufficiency. Similarly, despite the policy of increasing use of natural gas, insufficient domestic production and distribution capacity have resulted in imports from the US being required in recent years. It was estimated that the Mexican energy sector would need USD 70 billion in investment

**Box 6.3 Selected features of the Mexican energy sector (cont.)**

for modernisation and growth over the next ten years. While this sector is dominated by State-owned companies, the regulatory framework was modified in 1995 to allow *limited private sector participation* in downstream non-strategic areas (e.g. gas distribution and transportation) in order to inject much needed capital. Distribution permits are awarded through public tender, while permits for transportation are granted through application to the Energy Regulatory Commission (CRE). The CRE awarded 21 distribution permits between 1996 and 2001, resulting in construction of 28 000 kilometres of gas pipelines.

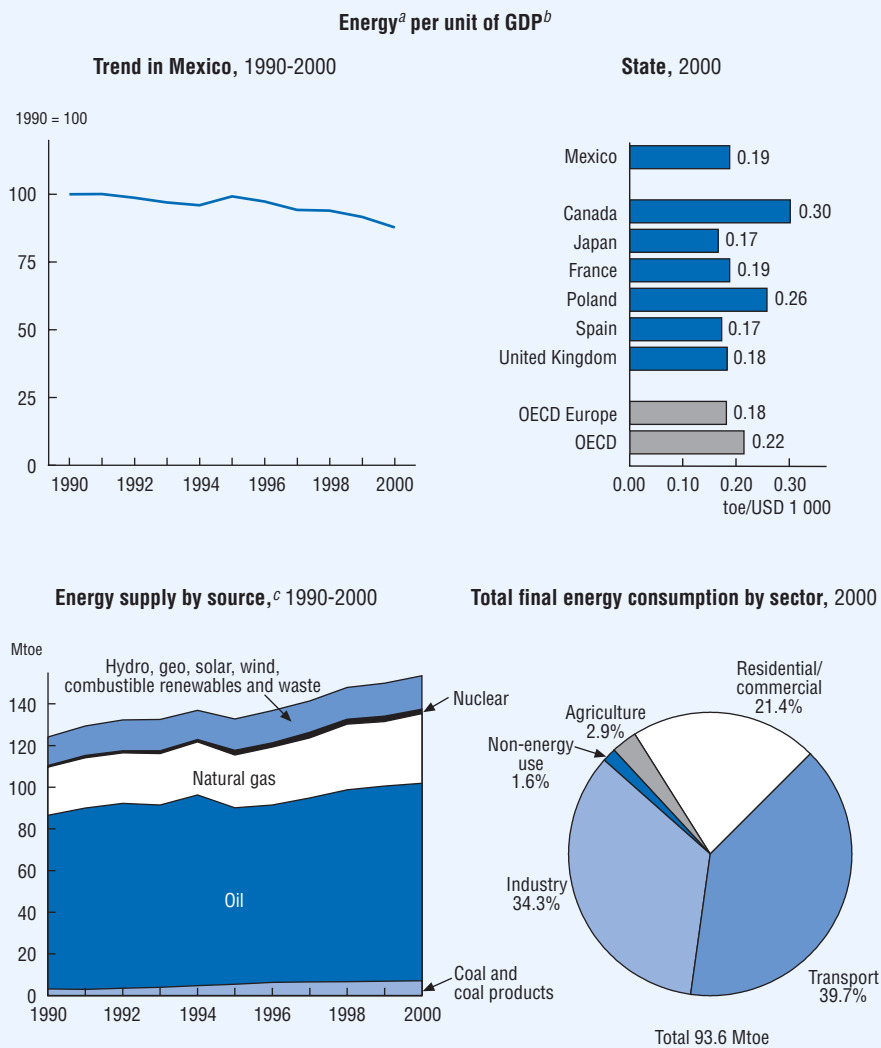
total freight traffic should be further explored. No strategic environmental assessment of transport sector policies is carried out.

PEMEX has made significant investments to improve the *quality of transport fuels*. Leaded petrol was phased out in 1998; the sulphur content of petrol has been reduced, now varying between 300 ppm in metropolitan areas and 1 000 ppm in some regions. Additional investment (USD 3 billion) would allow PEMEX to supply low-sulphur petrol nationwide by 2006 (50 ppm in premium, 300 ppm in Magna). However, fuel quality specifications should be synchronised with technical standards if cars are to meet emission reduction targets. Introduction of vehicles that meet Tier 2 emission standards is scheduled for 2006, while the low-sulphur petrol at 30 ppm needed to meet these standards is not expected until 2009 (Chapter 2). The sulphur content of diesel fuel was reduced in 1993 (Table 2.5).

Most (84%) of the 2.5 million tonnes of contaminants emitted to Mexico City's atmosphere every year originate from its 3.5 million vehicles, of which almost two-thirds from taxis and minibuses. The city's *vehicle fleet* is expected to increase to 4.5 million by 2006 and 5.4 million by 2010. The great majority of the fleet is petrol-burning (there are fewer than 50 000 diesel-burning vehicles). In 1999 the average age of vehicles in Mexico was nine years. Three-way catalytic converters became mandatory for light vehicles in 1993 and for heavier ones in 1996. About 54% of petrol-burning vehicles were equipped with catalytic converters in 1999, compared with 22% in 1993. Emission inspections are supposed to take place every year, but there have been cases of false certificates being issued. Vehicles with Federal license plates (mainly trucks and public buses) are exempt from emission inspections.

Further efforts should be made with respect to *modal split*. Shifts from road to rail freight traffic could be environmentally beneficial. Given the significant investment

Figure 6.2 Energy structure and intensity



- a) Total primary energy supply.  
 b) GDP at 1995 prices and purchasing power parities.  
 c) Breakdown excludes electricity trade.  
 Source: OECD; IEA.

implied, cost-benefit analysis should be undertaken to identify the best available options (Box 6.4).

During the last decade there has been significant investment in modernising Mexico City's *public transport* network, though much remains to be done. The Federal government, together with the Federal District (Mexico City) and Mexico state governments plan to develop a suburban railway to improve access in the north-northwestern part of the greater metropolitan area of Mexico City and to reduce pressure on air quality from use of private vehicles. The Federal government's ambitious plans to build highways, airports and urban bypass infrastructure also include environmental objectives.

#### **Box 6.4 Diversification of the transport sector: railway development**

Restructuring of *freight rail transport* has involved consolidation of several failing lines into a single government-supported entity, followed by privatisation in several steps. Between 1982 and 1987 Mexican National Railways (FERRONALES) absorbed the other four Mexican rail carriers. In the late 1980s FERRONALES deficits exceeded USD 600 million per year. The main constraints were restrictions on pricing policy (any tariff revision had to be ratified by the Federal government) and the low productivity of its 80 000 employees. Contracting out of support services, particularly equipment maintenance, was initiated in 1994. In 1996 the right to operate portions of FERRONALES infrastructure was offered to the private sector through concessions. Major US railroads have purchased minority stakes in these concessions (which must, by law, remain under control of Mexican nationals). Three independent carriers now operate 4 200 kilometres in the northeast (from Mexico City to Laredo, Texas), 6 500 kilometres in the Pacific-north (multiple border crossings) and portions in the rest of the country.

Regular *passenger rail service* is being established between Monterrey and San Antonio, Texas. Since privatisation of the Northwest Railway Company in 1997, over USD 1 billion has been invested in upgrading track and acquiring new locomotives and boxcars; investment of another USD 750 million by 2007 is planned. It is also intended to create a high-speed railway connecting Mexico City with cities in the north and west of the country. A first stage would be construction of a 220-kilometre line from Mexico City to Querétaro (USD 3.5 billion investment). Trains would reach an average speed of 250 kilometres an hour, enabling the railroad to compete with airlines in terms of travel time and cost. With government approval and sufficient financial backing, the first stage of the high-speed train proposal could become reality by 2006.

## *Tourism*

Mexico's *important tourism sector* (representing almost 9% of GDP in 2000) benefits from its very diverse natural and cultural assets. Mexico ranks eighth in the world in international tourist inflow (over 20 million in 2000); there are about two million jobs in this sector. Tourism ranks fourth in Mexico in terms of foreign currency receipts, after net oil exports, manufacturing and remittances by emigrants.

Environmental concerns began to be integrated into tourism policy relatively recently. The 2001-06 Tourism Sector Programme emphasises the need for sustainable tourism. It includes the objectives of improving waste and waste water treatment at tourist facilities, better regulating traffic congestion in tourist areas, and making further use of ecological land use planning in new tourism development projects. A *strategic environmental assessment* of the tourism sector in 2002 led to the release of a pilot national Agenda 21 that proposes introducing a certification scheme for tourist facilities (sustainable tourism award) partly based on environmental performance indicators.

## **2. Environmental Management**

### *2.1 Legal and regulatory framework*

Many articles of the *Constitution* stress the need to protect the environment. Article 4 was amended in 1998 to establish citizens' constitutional right to a healthy environment. Another amendment in 1998 expressly states that Mexico's development must be sustainable. The 1988 *General Law on Ecological Balance and Environmental Protection* (LGEEPA) regulates air, sea and fresh water quality, hazardous waste, soil, protected areas, EIA and noise at the Federal level. Each of the 31 states has created its own environmental legal regime, as has the Federal District. However, distribution of competency does not affect the Mexican Official Standards; Federal standards establish the lower limit for state standards, meaning the latter must be as or even more stringent than Federal ones. On private land LGEEPA calls for ecological land use planning at national and local levels. LGEEPA is complemented by several *other Federal laws directly concerned with environmental protection* (Table 6.6). No legal provisions specifically govern municipal waste management or remediation of contaminated sites, though relevant proposals have been submitted to Congress (Chapter 4).

LGEEPA was amended in 1996 to introduce *integrated permitting and self-regulation*. Industry's environmental performance was previously evaluated according to its compliance with the numerous permits issued for each plant. INE was responsible for monitoring air emissions and toxic substances, CNA for monitoring emissions to water,

and PROFEPA for factory inspections and enforcement of all environmental regulations. Since 1997 the Single Environmental License (LAU) has considerably improved the permitting system. Companies can now use a “one-stop window” to apply for all its environmental permits at one time. The LAU includes Federal, state and municipal regulations on EIA, risk assessment, air emissions, use of national waters, waste water discharges and hazardous waste. By focusing on ecosystems rather than setting industry-specific emission standards, it signals a shift towards integrated pollution control. The LAU first introduced in Mexico City prior to country-wide extension in 1999. Large companies have signed agreements with SEMARNAT since 1996 to mentor small firms in implementing (ISO 14001-based) environmental management systems. Many large Mexican and multinational enterprises (70 to 80%) have an EMS in place, compared with fewer than 20% of small firms.

Environmental standards have also evolved, from uniform sectoral emission and discharge limits to *values based on receiving bodies’ assimilative capacities*. Consequently, the number of environmental NOMs was reduced from 86 in 1995 to 56 in 2000. Streamlining has occurred mainly in the water pollution area; 43 standards for waste water discharge were replaced by only two, covering discharges to national waters and municipal sewers, with limits prescribed according to type of receiving body. There is scope for further rationalisation, particularly in the case of air emissions.

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Table 6.6 **Selected environmental legislation**

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1952	Federal Hunting Law
1986	Federal Law of the Sea
1988	General Law on Ecological Balance and Environmental Protection (LGEEPA), amended 1996 and 2001
1992	Federal Metrology and Standardisation Law
1992	Agrarian Law
1992	Federal Fisheries Law
1992	Forest Law, amended in 1997
1992	Human Settlements General Law
1992	National Property General Law
1992	Soil and Water Conservation Law
1992	Law on National Waters, amended in 2003
2000	General Law on Wildlife
2002	Sustainable Rural Development Law
2003	Federal Law on Government Transparency and Public Access to Information
2003	General Law on Sustainable Forest Development
2003	Law on Waste Prevention and Integral Management

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Source: SEMARNAT.

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In 2001 LGEEPA was amended again to enhance devolution of environmental management to states and municipalities and establish the right of *public access to environmental information and public participation*. The Federal Law on Government Transparency and Public Access to Information was introduced in 2002 (Chapter 7). In 2001 the government also announced that Mexico would carry out an “environmental crusade”. It promised to bring Mexican environmental standards closer to those of the US. More severe penalties are to be imposed on polluting industries, and loopholes in environmental laws are to be eliminated. The new approach to pollution control, based on an “integrated system of direct regulation and environmental management of industry”, emphasises cost-effective pollution abatement measures and allows broader public access to environmental information. Care should be taken that this approach does not depart from its stated objectives but continues to promote environmental protection and international competitiveness in practice.

## 2.2 *Enforcing compliance with environmental law*

The *Federal Attorney for Environmental Protection (PROFEPA)*, a decentralised agency under SEMARNAT, enforces environmental legislation on industrial activities and natural resource management (fisheries and marine resources, forestry, wildlife and protected areas). Its mandate covers hazardous waste and air regulations (water and waste water regulations are the responsibility of the National Water Commission). PROFEPA activities include inspection, administration of fines and penalties for non-compliance and response to public complaints. It operates in all 31 states and the Federal District using a system of delegations; to keep pace with Mexico’s decentralisation policy since the mid-1990s, PROFEPA delegations have progressively been given greater authority and autonomy and the number of EIAs has consequently increased to cover smaller projects. PROFEPA is also responsible for enforcing international agreements such as the Convention on International Trade in Endangered Species (CITES), the Basel Convention (transboundary movements of hazardous waste) and some aspects of bilateral co-operation on environmental issues along the northern border.

Between the creation of PROFEPA in 1992 and the mid-1990s, industry inspections and voluntary audits led to improved levels of compliance and a significant reduction in the number of plant closures. In the mid-1990s the scope of PROFEPA enforcement activities was extended to natural resources, but without a corresponding increase in budgetary resources. The number of *industrial verifications fell and voluntary environmental audits received greater attention* (Table 6.7). Audits, whose costs are increasingly borne by audited firms, lead to preparation of action plans to improve environmental performance, often beyond what is required by regulations. Firms sign agreements with PROFEPA to implement action plans. Clean Industry Certificates

Table 6.7 Monitoring and enforcement by PROFEPA

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 <sup>a</sup>
<b>INDUSTRIAL VERIFICATIONS</b>											
Inspected facilities	4 800	14 917	12 765	12 900	13 108	12 240	9 590	8 671	8 426	5 129	6 870
Without irregularities (%)	15.6	14.0	18.3	27.0	25.7	21.6	21.7	19.8	22.2	22.6	26.0
Minor irregularities (%)	65.2	81.4	78.7	70.9	72.5	76.7	76.7	78.5	75.9	75.3	72.1
Partial closure (%)	17.0	3.7	2.4	1.5	1.3	1.3	1.1	0.9	1.1	1.3	1.0
Total closure (%)	2.2	0.9	0.7	0.5	0.5	0.4	0.5	0.8	0.8	0.8	0.9
<b>ENVIRONMENTAL AUDITS</b>											
Audits initiated	77	119	226	115	158	191	165	294	133	90	174
Remedial action plans agreed		42	51	101	186	153	296	317	279	121	158
Clean Industry certification						115	122	175	332	130	195
<b>NATURAL RESOURCES</b>											
<b>Fishery</b>											
Inspections				..	3 629	3 326	3 362	5 446	3 643	1 928	1 455
Certification of boats					1 772	1 903	1 900	2 052	2 059	2 000	2 051
<b>Forestry</b>											
Inspections				2 645	4 261	5 756	5 650	5 189	6 011	4 200	6 073
Monitoring, critical forests				1 898	1 679	1 551	1 522	3 533	4 605	4 014	6 758
Monitoring, forest health				654	2 012	1 538	3 002	4 484	5 288	3 511	3 192
<b>Natural protected areas</b>											
Inspections						292	801	1 055	564	522	747
Systematic monitoring						1 246	2 321	2 237	2 220	1 932	1 918
<b>Federal marine and terrestrial zones</b>											
Inspection visits				5	411	399	781	643	703	1 141	1 656
Sanctions against offenders				5	239	368	474	460	544	..	317
<b>Environmental impacts</b>											
Verifications				389	538	367	687	1 061	933	895	1 315
Unauthorised projects				180	293	103	18	279	164	..	597
Authorised project out of norm				198	250	39	164	201	200	..	411
Closure of irregular activities				23	21	47	45	32	88	..	140
<b>ATTENTION TO COMPLAINTS</b>											
Number received	1 321	5 937	4 904	5 206	6 429	5 565	5 173	5 420	4 553	4 372	5 864
Resolved (%)	97	88	84	70	50	80	75	61	66	82	56
Being addressed (%)	3	12	16	30	50	20	25	39	34	18	44

a) Figures as of August 2002.

Source: SEMARNAT.

are granted upon implementation. The audit programme began with the largest firms and those presenting major environmental risks, including State companies like PEMEX and CFE. It was subsequently re-oriented towards exporting industries (automotive, cement, chemicals, electronics, food, pharmaceuticals); since 1997 auditing has been extended to micro, small and medium-sized enterprises. The voluntary audit programme led to a collaborative relationship between industry and the enforcement agency. Since 1997 PROFEPA has issued 1 069 Clean Industry certificates.

*Extension of PROFEPA enforcement activities to natural resources* poses a real challenge. Only 321 inspectors out of a total of 3 000 monitor compliance with environmental legislation on Mexico's 64 million hectares of wooded areas (and verify 4 000 forest management permits), in the 148 protected areas and along over 11 000 kilometres of coastline. Illegal logging and forest clearance are widespread and deforestation continues at an alarming rate (Chapter 5). In 2001 the President of Mexico declared clandestine cutting of forests to be a matter of national security and a national crusade was initiated to address tropical deforestation. PROFEPA was granted enhanced prosecution powers, including the right to take legal action in cases of administrative and criminal violations of environmental laws (in close consultation with state and local judicial authorities). PROFEPA had previously been limited to investigating environmental crimes and turning cases over to the Federal Attorney General's office for prosecution in Federal courts. Its inspection activities are now supported by military staff, especially in "ungovernable" forest areas where armed illegal logging takes place. User fees were introduced at national marine reserves in 2001; inspections of these protected areas have increased, while monitoring of fisheries has decreased.

### 2.3 *Environmental charges, user fees and other economic instruments*

Efforts have been made to internalise environmental externalities through *further reliance on market-based instruments* (Table 6.3). A number of water charges are used in Mexico. However, despite achieving higher collection rates (60% of invoiced volume was paid in 2001), water utilities (mostly owned by municipalities) recover only 35% of the *capital and operating costs of supplying water* to households, the commercial sector and industry (Chapter 3). There is cross-subsidisation in favour of households. CNA recovers up to 80% of the costs of supplying bulk irrigation water. It collects water charges, the revenue from which accrues to the general budget. In 2002 SHCP allocated USD 200 million for municipal investment in water and waste water infrastructure. There are charges on *freshwater abstraction*; farmers are still exempt, though irrigation accounts for nearly 80% of total abstraction. To better preserve water resources in dry regions, efforts should be made to progress from a system of water trading administered

by CNA towards one in which supply and demand truly determine prices for each water basin, including a charge on the environmental externality of abstraction. Since 1996 charges must apply to *waste water discharges* to water bodies (pollution charges). These charges were not put into effect for water utilities, and the corresponding cumulated debt of USD 7.7 billion has been forgiven.

Application of the user and polluter pays principles to water and waste water provision should be increased progressively to promote more sustainable use of water resources. Efforts are being made to *develop public-private partnerships in the water sector* (only 24% of the population is connected to public sewage treatment plant). Launched in 2002, the Programme for the Modernisation of Water Utilities (PROMAGUA) has an infrastructure financing fund that provides municipalities with loans to upgrade and expand their water systems if they negotiate public-private partnerships, reform their state water laws and impose full cost recovery. Aguascalientes, Cancun, Puerto Vallarta and Saltillo have entered into major privatisation contracts. Smaller service contracts exist in Mexico City and Puebla. Due consideration should be given to vulnerable users (e.g. low-income households).

Use of economic instruments in waste management is still limited, but proposals for *deposit-refund schemes* are being considered for PET bottles, car batteries, lubricant oil and tyres. The new comprehensive waste management law currently under review by the Congress is expected to provide a legal framework for adoption of such proposals. The new law is also intended to enable broader implementation of *user charges for municipal waste* collection and disposal; these charges currently recover only about 20% of operating costs (Chapter 4).

In December 2001 Congress approved the introduction of user charges for national parks and Federal protected marine areas. In 2002 *charges were introduced for whale watching* in Federal marine reserves in Baja California. Whale watchers pay a fee per boat, depending on the number of passengers who can be carried (five or 20 persons). Use of “eco-tourism fees” is being extended to all marine reserves for activities such as diving. The aim is to pay for nature conservation services and raise revenue to improve administration and develop tourist infrastructure. Revision of the Federal Rights Law allows the government to charge for non-extractive activities in natural areas which are Federal property. Extension of this scheme to terrestrial protected natural areas is under consideration. An important development in the use of eco-tourism fees is that revenues can now be used to help manage protected natural areas and promote public awareness of the need to protect biodiversity (Chapter 5). Within the National Forest Fund, a mechanism has been introduced to introduce *payments for environmental services* to populations living in forests (primarily indigenous communities) as a financial reward for initiatives contributing to conservation of biological diversity. Efforts to evaluate recreational services involving nat-

ural assets have begun, with the intention of allocating the economic rent associated with tourism in protected natural areas to the management of these areas in line with the user pays principle. Another economic instrument has been applied to hunting of wild sheep and other game species; the holder of a hunting license may *auction the right to hunt* (but not the license itself). Revenue from such auctioning, in the order of USD 300 million per season, is used to restore natural habitats and monitor game populations.

In 1999 PEMEX launched a company-wide *CO<sub>2</sub> emission trading* programme to lower emission reduction costs, the first such cap-and-trade scheme in Latin America. PEMEX pledged to achieve 1% annual reductions up to 2010, compared with the 1999 level. There has been good progress towards meeting this target; emissions were reduced by 3.6% in the first three years (from 41.55 million tonnes in 1999 to 40.05 million tonnes in 2002). The extent to which reductions can be attributed to the emission trading programme is unclear.

## 2.4 *Environmental expenditure and financing*

### *Pollution abatement and control (PAC) expenditure*

Pollution abatement and control expenditure by the *public sector* in 2000 (including Federal, state, municipal, water utilities and large public enterprises) is estimated at around MXN 21 billion (0.4% of GDP). This is *one of the lowest rates in the OECD*. Public PAC expenditure varies between 0.5 and 0.7% of GDP in most member countries. Comprehensive monitoring of *private sector PAC expenditure* in Mexico is not carried out. The business sector is estimated to have spent about MXN 18 billion on pollution abatement and control measures in 1998 (63% on waste water, 25% on air emissions, 12% on waste). This means *total PAC expenditure* by business and the public sectors was close to 0.7% of GDP.

### *Financing environmental expenditure*

The Federal budget has remained a major source of financing with respect to environmental expenditure, particularly environmental investment. Most investment by states and municipalities related to water, waste water and waste infrastructure continues to be financed through *transfers from the Federal budget*. The share allocated to environmental and natural resource management grew dramatically between 1995 and 1997 (from 0.7% to 1.4% of Federal budgetary expenditure) following creation of SEMARNAP. The next year there was an overall *decrease*; the share in 2001 was 1.1% (Table 6.8). Mexico City's environmental budget also decreased slightly in real terms between 2000 and 2002, when it was MXN 810 million. A large part (64%) of SEMARNAT's 2002 budget was devoted to water management by the CNA.

However, *Federal resources have been largely inadequate* to fill the large environmental infrastructure gap. The water and waste water sector alone is estimated to require MXN 20 billion a year (twice the CNA budget). The investment gap for municipal waste management is estimated at over MXN 15 billion, while MXN 400 million is invested every year by the public sector. *Low levels of cost recovery from charges on environmental services* (water, waste water, waste) have meant that most public PAC expenditure (70 to 80%) has been on current expenditure and only 20 to 30% on investment. While there are fiscal incentives for PAC investment by SMEs, access to credit remains a limiting factor.

*External funding* between 1995 and 2000 contributed USD 1.4 billion for projects and programmes with explicit environmental objectives (equivalent to 5% of PAC expenditure in the same period). This was mostly through World Bank and the Inter-American Development Bank loans, and to a lesser extent through grants from the Global Environment Facility (GEF) and loans from the North American Development Bank (created in 1993 under a NAFTA “side agreement”). Official development assistance from bilateral sources is limited (Chapter 9).

Overall, insufficient Federal spending on environmental protection, limited application of the user and polluter pays principles, limited state and municipal revenue-raising, and low reliance on external financing all explain this *financial gap*. Each of these factors suggests approaches which could be taken to improve the situation. In particular, on-going efforts towards decentralisation of environmental management at state and local levels need to be accompanied by commensurate *devolution of powers to tax and charge for environmental services*.

Table 6.8 **Federal budgetary expenditure on environment and natural resources, 1990-2001**  
(MXN million<sup>a</sup>)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Expenditure on environment and natural resources	191	305	321	322	821	1 847	2 935	7 397	5 873	9 255	10 328	10 361
% of Federal budget	0.16	0.20	0.18	0.16	0.33	0.64	0.73	1.40	0.98	1.30	1.21	1.11

a) Current prices.  
Source: SHCP.

# 7

## ENVIRONMENTAL-SOCIAL INTERFACE\*

### Features

- Social context
- Income generation through environmental protection
- Poverty, access to basic water services and regional development
- Indigenous communities, natural resources and intellectual property
- Environmental and health progress
- Environmental democracy: information, participation and education

\* The present chapter reviews progress in the last ten years, and particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “social and environmental interface” of the 2001 OECD Environmental Strategy.

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- Further improve health and quality of life, particularly in areas with high marginalisation levels, by reducing the share of people who do not have *access to basic services* (e.g. safe water, basic sanitation, electricity).
- Continue to promote initiatives that contribute to *income and/or job generation* together with environmental improvements (e.g. reforestation, eco-tourism, sustainable forestry), particularly in rural and less developed regions.
- Further strengthen *environmental education and awareness*, especially among young people.
- Continue the development and *use of indicators* to measure environmental progress and related institutional effectiveness.
- Ensure practical implementation of the *right of access to environmental information*.

## Conclusions

In the last five to ten years, Mexico has made significant progress in reducing the health impacts of pollution. In particular, a *drop in child mortality rates* (e.g. from acute gastro-intestinal and respiratory diseases) is related to water disinfection and air quality improvements. An *active policy towards income and employment generation* through environmental/natural resources management programmes is achieving positive and sizeable results. The quantity and variety of environmental information available from national authorities (e.g. data, indicators, environmental accounting, state of the environment reports, Pollutant Release and Transfer Registers) has progressed to an advanced stage, though (as in many other countries) statistics from different agencies are not always consistent and some gaps remain. Mexico recently introduced a new law on *transparency of government activities and public access to information*; this emphasis is reflected in the whole array of its environmental laws and regulations. SEMARNAT and the Ministry of Social Development are committed to work together to certify each other's programmes, with a view to meeting both environmental and social objectives. *Environmental education* in both the formal and non-formal educational systems is commendable, as are attempts to reach the least literate part of the population. Indigenous people have been given extended rights, which should enable them to benefit more from the biodiversity they help conserve.



However, efforts on all these fronts (e.g. health, income generation, education, rights of indigenous communities), as well as improvement of access to environmental services, need to be consolidated and extended. Poverty and regional inequalities hamper further progress. *Access to basic services* such as safe water, basic sanitation and electricity remain inadequate, particularly in less-developed regions and poorer communities (including urban slums). Respiratory illnesses due to urban air pollution, as well as indoor air pollution in rural communities where wood-burning stoves are used, still need to be addressed. While a register of hazardous activities has been established, handling of hazardous chemicals and pesticides (especially by migrant farm workers) still entails significant occupational health risks. There is a correlation between poverty and deforestation, as clearing forested land for subsistence farming is often the only way marginalised farmers can secure a livelihood. In many instances such progress will require not only well targeted programmes and more efficient environmental management, but also increased financing.

With its relatively high growth rate, the population of Mexico has now reached 100 million, with large shares of young people and indigenous populations. Poverty and illiteracy rates are high compared to those in other OECD countries (Box 7.1). Together with high rural-urban migration, including to the megacity of Mexico, these factors represent important social challenges for Mexico's *sustainable development*, including interfaces with environmental management.



## 1. Environmental and Health Progress

Mexico has a relatively high *incidence of illnesses that can be correlated with environmental variables*, especially among vulnerable groups (e.g. children, pregnant women, the elderly). Such environmental variables include access to safe water supply, access to basic sanitation, and exposure to air pollutants or hazardous substances (e.g. lead).

### 1.1 Children's health

The *infant mortality* rate in Mexico (24.9 per 1 000 live births in 2000) is significantly higher than in most other OECD countries, with greater regional differences. While complications during pregnancy and delivery are the most frequent cause, infant deaths due to influenza, pneumonia, and intestinal and acute respiratory infections are also common and may be associated with pollution.

The most common causes of under-five *child mortality* include malformations (birth defects), intestinal infections, influenza and pneumonia. It is possible that

### Box 7.1 Social context: poverty and demographic sustainable development challenges

#### Population

Mexico's rate of *population growth is among the highest in the OECD*, averaging 2% per year throughout most of the 1990s. The population increased by 22% in the period 1990-2001 (Figure 7.1). The growth rate (1.5% in 2001) has slowed in recent years. This nevertheless translates into about 1.5 million new citizens per year, presenting challenges with respect to provision of basic services even if pressures associated with rural to urban migration are not considered. Internal migration, particularly towards the Valley of Mexico Metropolitan Area and its environs and towards the north, remains significant; annual net emigration is about three per thousand. Comprehensive sustainable development policies should address demographic factors, human capital development, consumption patterns, resource use and general quality of life.

The *Mexican population is young* (about 34% under age 15 and over half under 25). This represents both an opportunity and a challenge to realise the potential of the country's human capital through investing in education and health. Total expenditure on education is around 5% of GDP, which is relatively low by OECD standards, especially when considering the very high proportion of school age children compared to the OECD average. *Educational attainment* levels need to be raised: some 22% of the population has an upper secondary or higher education. *Life expectancy* at birth in 2001 was 73.4 years for men and 77.9 years for women.

Average *population density* is over 50 people per square kilometre. Densities in individual states range from low to very high. Almost half the population lives in central Mexico. Yucatán and the northern states have low population densities; the south is characterised by a large number of small rural communities and no nationally important urban centres. Nationally, about two-thirds of the population lives in urban areas. The three largest urban areas are Mexico City (about 17.8 million inhabitants in the metropolitan area and almost 20 million if the entire industrial corridor is counted), Guadalajara (3.4 million) and Monterrey (3 million). Along the Mexican-US border, a string of "twin" cities stretches from Matamoros/Brownsville (Texas) to Tijuana/San Diego (California).

The Valley of Mexico Metropolitan Area (ZMVM) is a *megacity* with very high population density (18.3% of Mexico's total population, 18% of its economically active population) and economic activity, resulting in intensive environmental pressures. In this area 28% of industrial production occurs; 4 million tonnes of waste and 5 million tonnes of air pollutants are generated annually. Over 3 million motor vehicles circulate in the Mexico City area.

### Box 7.1 Social context: poverty and demographic sustainable development challenges (*cont.*)

#### Disparities

Mexico's *regional disparities* persist. Economic performance and per capita income are often higher in the northern and central states than in those in the south and southeast, which are nevertheless more richly endowed with water resources, forest cover, biodiversity and archaeological sites.

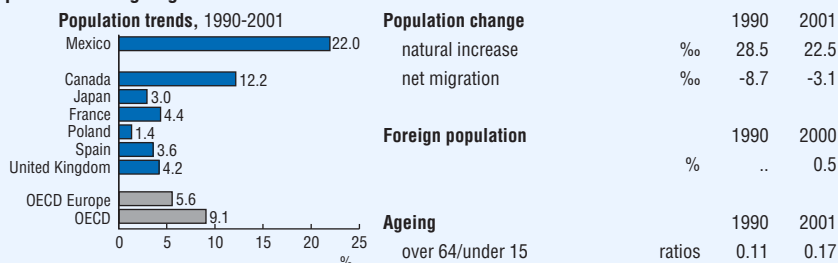
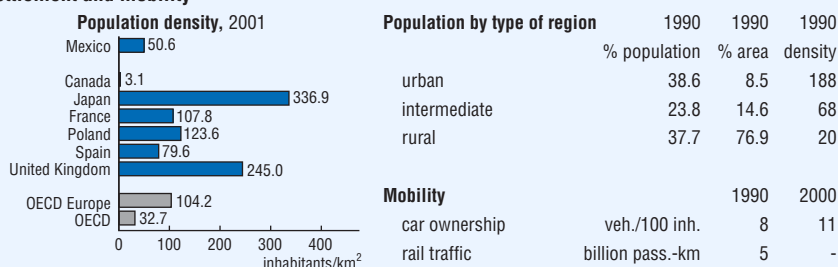
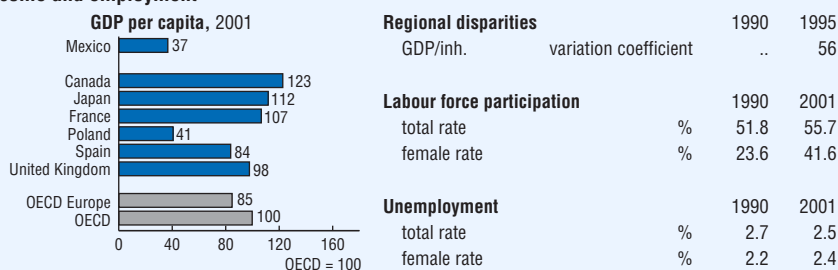
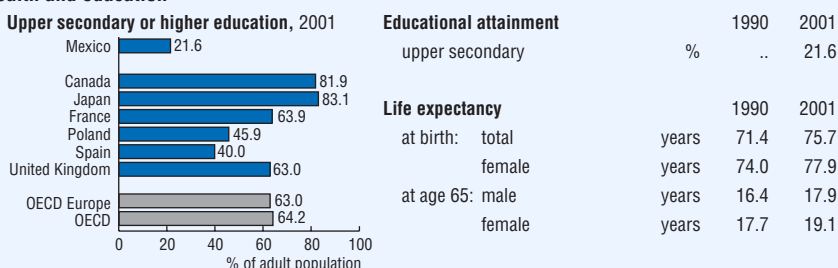
*Income inequality* in Mexico is among the greatest in the OECD. People in the highest 20 percentile earn 16 times as much as those in the lowest 20. *Poverty* (defined in Mexico as not having enough per capita income to afford a basket of basic goods and services – i.e. food, clothing, housing, public transport) is estimated to affect 53 million people in urban and rural areas. Extreme poverty (defined as having income insufficient to afford basic food needs) affected 23 million people in 2000; about two-thirds of them were in rural areas. About 60% of the population is of mixed Indian-Spanish descent and 10% is wholly or predominantly *indigenous Amerindian* (Náhuatl and Maya are the most numerous groups).

In Mexico a considerable share of the land consists of communally owned units called “ejidos”. The 1915 Agrarian Law gave *user rights to ejidos members*, with the ejidos remaining public property that cannot be sold or leased. A 1992 constitutional amendment introduced greater flexibility with respect to the ownership regime of this land in order to improve access and agricultural productivity. Over 70% of Mexican forests are on ejido land.

births with malformations are related to parents' exposure to hazardous chemicals such as pesticides. In recent years, drinking water disinfection programmes have led to a dramatic *decrease in cholera* cases nationally. These programmes are also a factor in the *decrease in child mortality* from diarrhoea and gastrointestinal illnesses (Chapter 3). However, results vary across the country; under-five child mortality due to diarrhoea in 1999 was 43.5 per 100 000 in Chiapas, compared with 25.3 nationally (Table 7.1).

Large urban centres (e.g. Mexico City, Guadalajara, Monterrey) have experienced significant air pollution improvement in recent years (except in the case of NO<sub>x</sub> in Guadalajara) (Chapter 2). This has contributed to a decrease in under-five child mortality due to *acute respiratory disease*. However, further improvement is needed in areas with high marginalisation indices. In rural areas, *indoor air pollution* from use of wood-burning stoves without adequate ventilation is widespread. In 2000 some 17 million people were subject to the effects of firewood or charcoal cooking.

Figure 7.1 Social indicators

**Population and ageing****Settlement and mobility****Income and employment****Health and education**

Source: OECD.

Children under five are especially vulnerable, as they are often in the cooking area. There have been several initiatives to promote use of improved cooking stoves with chimneys in rural areas. Reduced use of leaded petrol may have contributed to decreases in child *blood lead levels*. A national baseline survey of blood lead levels was planned for 2003. Lead in pottery remains an important cause of high child blood lead levels.

Table 7.1 **Marginalisation and health impacts, southern states, 2000**

	Municipalities with a high level of marginalisation (%)	Indigenous people (%)	Child mortality due to diarrhoea <sup>a</sup>
Chiapas	92	24.6	43.5
Guerrero	88	13.9	19.8
Oaxaca	80	37.1	39.8
Mexico	53	7.1	25.3

a) Number per 100 000 children under five years of age, 1999 data.  
Source: CONAPO, INEGI.

## 1.2 Objectives for further progress

Concerning environmental health, *quantitative targets* are established under the *2001-06 Environmental Health Action Programme*. These include: 30% reduction of respiratory illnesses due to exposure to atmospheric pollution and 60% reduction of those due to children's exposure to indoor pollution; 15% reduction of average population exposure to atmospheric pollutants; 70% reduction of incidence of high child blood lead levels; and a guarantee of access to safe drinking water by 70% of the population. For some of these targets, however, baselines are yet to be established.

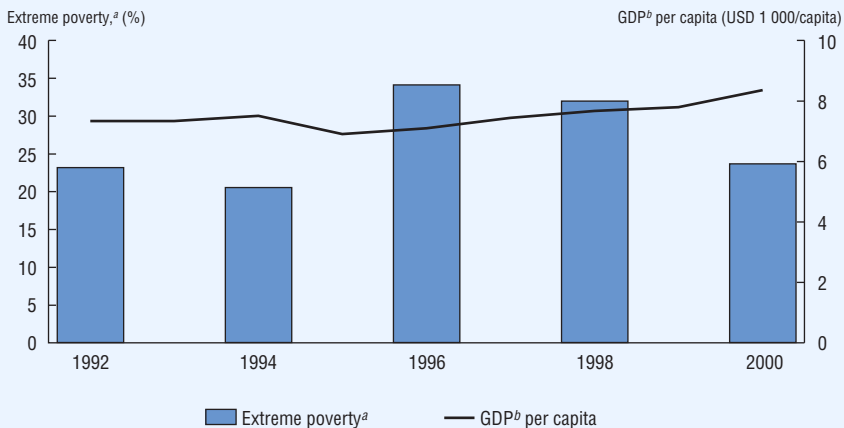
The UN Millennium Development Goals for 2015 include *reducing under-five child mortality rates by two-thirds* (compared to 2000). The World Summit for Sustainable Development (Johannesburg, 2002) also adopted the objectives of *halving by 2015 the share of the world's population without access to safe drinking water and basic sanitation*. Mexico's public health expenditure and its expenditure on environmental infrastructure are currently among the lowest in the OECD.

## 2. Poverty and Access to Basic Water Services

Despite on-going efforts aimed at rural development and poverty alleviation, poverty in Mexico is widespread. Around 53% of the population lived in poverty between 1992 and 2000; about 23% lived in extreme poverty in 2000 (Box 7.1) (Figure 7.2). Of the 25 million Mexicans in rural settlements with fewer than 2 500 inhabitants, 37% have a daily income below USD 1. *Extreme poverty* is highest in indigenous communities (Box 7.2).

To reduce by one-half the share of the population without access to *safe drinking water* and the share without *access to basic sanitation* are key challenges for Mexico. At the end of 2001, 10.8 million people (of which 7.5 million in rural areas) did not have *access to piped water supply*. Over 22 million still lacked *access to any form of sanitary drainage* (i.e. public sewers, septic tanks, outflows to natural water bodies). Access to basic services such as clean water, sanitation, electricity and health and educational services in less developed regions is significantly below the national average (Table 7.2). While the south and southeast (particularly the states of Chiapas, Guerrero and Oaxaca) possess 72% of Mexico's water resources, only half their rural households have access to safe water and fewer than 30% to adequate sanitation.

Figure 7.2 Trend in GDP per capita and extreme poverty, 1992-2000



a) Number of individuals with an income inadequate to meet basic food needs, methodology INEGI/ECLAC.

b) GDP at 1995 prices and purchasing power parities.

Source: INEGI; OECD.

## Box 7.2 **Indigenous communities, natural resources and intellectual property rights**

### *Indigenous people and biodiversity*

The Mexican population includes about 10% *indigenous people* (self-identification as indigenous is among the criteria determining whether individuals or communities are indigenous). There are over 50 ethnic groups and numerous languages and dialects. About 72% of the indigenous population lives in the south and southeast. Indigenous communities are often socially and economically marginalised, with little access to basic environmental, health or educational services.

*Areas in which there are indigenous settlements also frequently have high environmental and biodiversity value.* The states of Puebla, Guerrero, Veracruz, Oaxaca, Chiapas, Tabasco and Yucatán have significant shares of Mexico's indigenous population and of its biodiversity. Indigenous communities are located in and around over 30% of Mexico's major protected areas. Marginal (e.g. extremely arid or mountainous) land is occupied by more than 50% indigenous people. About 90% of the state of Oaxaca's forest resources are on land where indigenous communities are located.

### *National rights of indigenous people*

Recent changes in the Mexican Constitution recognise the *rights of indigenous people* to make decisions concerning their own economic, social and cultural development, including their cultural and historical identity (e.g. beliefs, institutions, spiritual well-being and the land they occupy or use). This is consistent with Agenda 21 (Rio 1992) and with international agreements such as Convention 169 of the International Labour Organisation and the Convention on Biological Diversity (Article 8J).

SEMARNAT's Special Programme for Indigenous Settlements promotes sustainable use of natural resources and conservation of biodiversity in areas where indigenous people live, *values their traditional knowledge and protects their intellectual property rights*. Indigenous communities are to participate in the formulation, implementation and evaluation of plans and programmes that could affect them directly (e.g. land use planning, designation of natural protected areas or national parks, eco-tourism projects).

Public authorities, NGOs and the indigenous communities themselves have entered into partnerships to promote innovative models of *indigenous production and community mobilisation that combine traditional values and modern technology and marketing*. Successful examples include organic agriculture, coffee co-operatives, community forestry enterprises, and nature/cultural tourism. Preliminary results of such initiatives demonstrate the importance of improving livelihoods while retaining cultural values, and of providing seed capital (often more effective than credit or full subsidisation).

### Box 7.2 Indigenous communities, natural resources and intellectual property rights (*cont.*)

#### *International initiative*

Through the creation of the Group of Like-minded Megadiverse Countries (Group of Cancun), Mexico has taken the lead in ensuring that *traditional knowledge* is properly recognised in the evaluation and granting of *intellectual property rights*. The Bonn voluntary guidelines set out clear rules indicating how governments can balance the needs of those collecting genetic resources with the needs of the people who conserve and provide these resources (Chapter 9).

Table 7.2 Selected social indicators: lowest and highest state rankings

	GDP per capita Index <sup>a</sup>		Adult <sup>b</sup> illiteracy (%)		Households with access to clean water (%)		Households with electricity (%)	
5 worst-off	Chiapas	40.2	Chiapas	23.6	Veracruz	70.2	Oaxaca	87.1
	Oaxaca	42.0	Oaxaca	21.8	Guerrero	71.0	Chiapas	87.5
	Zacatecas	52.5	Guerrero	21.2	Chiapas	75.5	San L. Pot.	88.0
	Tlaxcala	53.7	Hidalgo	15.5	Oaxaca	77.4	Guerrero	88.2
	Guerrero	54.3	Veracruz	15.3	Tabasco	77.8	Veracruz	88.7
5 best-off	Chihuahua	146.8	B. Calif. S.	4.2	Tlaxcala	97.5	Aguascal	97.8
	Quintana R.	155.6	Coahuila	4.1	Coahuila	97.8	Morelos	97.8
	Campeche	167.4	B. Calif.	4.0	Colima	97.8	Coahuila	98.3
	N. León	179.3	N. León	3.4	Fed. District <sup>c</sup>	98.5	N. León	98.6
	Fed. District	258.4	Fed. District	3.1	Aguascal.	98.7	Fed. District	99.5

a) National average = 100.

b) Adults over 15 years of age.

c) Part of the Mexico City Metropolitan Area.

Source: Government of Mexico (2000).



There is evidence of some *regressive water pricing*. In areas without piped supply, households depend on water delivered by public or private tanker trucks, sold by informal sector vendors or collected from public fountains, wells or open sources (e.g. lakes, rivers) (Table 7.3). Water sold in small quantities by informal vendors sometimes costs five to ten times as much per unit volume as that from piped public supply.

Population growth and migration to urban areas increase the challenge of reducing (if not closing) the gap in water supply and sanitation infrastructure. *Increased efficiency and financing* of water services and infrastructure for households will be required, as well as more rational management of water resources in industry and agriculture (Chapter 3). Also, to improve cost recovery, consumer awareness needs to be raised to foster “payment culture”.

To better target social assistance and regional development efforts, the National Population Council (CONAPO) has elaborated a *marginalisation index* based, *inter alia*, on indices of adult illiteracy, primary schooling, access to piped water, basic sanitation and electricity, and share of the population earning less than twice the minimum wage (the minimum wage varies among regions). SEDESOL focuses its social development programmes on 250 designated “micro regions” comprising 476 municipalities with high marginalisation levels.

Table 7.3 **Water supply in rural areas: Mexico and selected states, 2000**  
(%)

	Piped water			Other sources		
	In dwelling	On property	From another dwelling	Public fountain	Water tanker	Open source (lake, river)
Rural Chiapas	10.9	40.2	3.1	2.7	1.0	40.6
Rural Guerrero	11.2	28.4	7.7	3.5	1.3	46.3
Rural Oaxaca	9.4	44.0	7.0	2.7	0.3	35.5
Rural Mexico	20.1	40.2	3.8	3.1	2.32	29.2

Source: World Bank.

### 3. Income Generation through Environmental Protection

Low income levels in Mexico reflect three factors in particular: lack of employment opportunities in the formal sector, the high rate of part-time employment (37% of the urban poor and 52% of the rural poor work less than full-time), and low wages which, even for full-time workers, can be inadequate to keep them out of poverty. *Unemployment rates are low* in Mexico compared to those of other OECD countries; among the rural poor they are even below the national average.

#### 3.1 Income generation through environmental programmes

Mexico has implemented several programmes that seek to exploit *synergies between environmental/natural resources management and employment/income generation*, especially in marginalised and rural areas. The Temporary Employment Programme (PET), the largest employment/income generation programme, is implemented jointly by four ministries (Social Development, Agriculture, Transportation, Environment). With a budget in 2000 of MXN 4 billion, PET generated about *1 million short-term jobs*. The programme targets extreme poverty by making intensive use of low-skilled labour in infrastructure and environmental projects. There is a focus on areas designated as high-priority conservation zones, as susceptible to natural disasters or as experiencing serious environmental degradation. At least 78% of PET funds must be allocated to priority “micro regions” with high marginalisation levels. In practice, PET benefits participants who do not have access to year-round jobs and who are poorer than non-participants in their own communities. However, it does not reach the smallest and most isolated rural communities since those with fewer than 2 500 inhabitants are ineligible.

The National Reforestation Programme (PRONARE, launched in 1992) generates about *100 000 temporary jobs annually*, reducing migration to urban areas. Mexico’s *forestry sector* represents 1% of GDP and 100 000 permanent jobs. Marginal farmers *clear forested land* (often by burning) for subsistence agriculture and animal husbandry. The Forestry Development Programme (PRODEFOR, launched in 1998) creates more lasting employment impacts through structural improvements in the forestry sector. It encourages investments aimed at improving competitiveness in the production chain, for example by creating efficient production units and facilitating market access. It also encourages more diversified use of forest resources (non-timber production, eco-tourism), forest protection (fire prevention measures) and regeneration (preparation for reforestation). PRODEFOR’s employment impacts have varied over the years, at between 5 000 and 32 000 direct jobs (and 9 000 to 15 000 indirect jobs) annually. By 2000 it had assisted over 14 000 ejidos (communally owned land) and

owners of other types of land, so that about 500 000 hectares of forest was subject to sustainable forestry practices. Mexico's forests should be further seen as an economic asset for rural development; sustainable forestry should continue to be promoted, particularly in mountainous areas, to reduce rural poverty and contribute to environmental protection.

### 3.2 *Environmentally related employment*

Mexico is currently compiling statistics on *environmentally related employment* by sector (public, private, academic institutions, advocacy organisations) and by types of activities (cleaner technology, pollution prevention, natural resources management). While official national data are not yet available, environmental jobs are estimated to account for about 1% of total employment. This is in line with most other OECD countries (i.e. between 1 and 1.5%).

The net employment impacts of Mexico's environmental policies have not yet been fully assessed. However, *hazardous waste management* has led to *new business opportunities and employment*. As demonstrated by the 2006 Presidential targets, Mexico gives high priority to increasing hazardous waste management capacity (Chapter 4). Over MXN 1 million has been invested since the mid-1990s, generating about 3 000 direct and 6 300 indirect jobs in waste management companies. Growth is expected to continue. Within the *municipal waste recycling* sector there is both market and employment potential, which should be developed with proper attention to the important role already played by the informal sector. *Waste scavengers*, who work under very poor conditions, fear displacement if municipal waste recycling is modernised. The recycling market should be made more efficient, with consideration given to labour-intensive technologies that could be used by former scavengers but under better working conditions (Box 4.1).

One approach to the economic and social development of the poorer regions, especially in the south and southeast, is to promote *natural and cultural resources* as an asset for *tourism* development. Mexico, which ranks eighth in the world in tourist inflows (20.6 million tourists in 2000), has approximately two million jobs in the tourism sector. This economic activity is fourth in importance nationally in terms of currency receipts, after oil production, manufacturing and the large amount of remittances from emigrants. However, local environments and populations should benefit from tourism. Efforts to evaluate and charge for the benefits of nature and biodiversity have already begun in Mexico. Environmental user charges for natural and marine protected areas (introduced in 2002) are a step in the right direction; these charges might be extended to the rainforests of the south and southeast.

## 4. Environmental Democracy: Information, Participation and Education

### 4.1 Environmental information

SEMARNAT, its decentralised agencies, and the National Institute for Statistics, Geography and Information (INEGI) are the key institutions producing *a wide range of environmental information* (on soil, forests, biodiversity and protected natural areas, air and water quality, groundwater abstraction, hazardous waste generation, pollutant releases and transfers). The recommendations of a 1996 OECD review of Mexico's environmental information system have largely been implemented. Initiatives taken by Mexico include publishing an environmentally adjusted Net Domestic Product, organising an environmental information forum, and making special efforts with respect to the least literate share of the population.

Since 1986 SEMARNAT has produced *the National State of the Environment Report* every two years, as required by law. *Environmental data* are regularly published, are available on the Internet and are presented in an appropriate form in educational material targeted at the least educated. The first National Compendium of Environmental Data, published jointly by SEMARNAT and INEGI in 2000, was the basis for the 2002 edition of the National State of the Environment Report. SEMARNAT's Geographical Digital Library (on-line since 2001) contains 174 digital environmental maps, at national and state levels, on themes including protected areas, climate and soil.

The quantity and quality of environmental information on the SEMARNAT and INEGI web sites are high compared with the sites of some other ministries or agencies. However, a vast body of environmental information is scattered in *numerous databases with overlapping data*, which are sometimes inconsistent and outdated. The *National System of Environmental Information* is being developed to integrate, synthesise and analyse the wide range of statistical and cartographical information generated by different agencies.

*Environmental indicators* began to be developed jointly by SEMARNAT (INE) and INEGI in 1997. Based on the National Economic Accounts (adjusted to cover various environmental dimensions previously not accounted for), an environmentally adjusted Net Domestic Product was produced by INEGI in 2002. As part of the National Environmental Indicators System, updating of the OECD Core Set of Environmental Indicators for Mexico is to be completed by 2003. Additional indicators for sustainable tourism, transport and agro-environmental measures will be available in 2003-04. The current administration is committed to the environmental and sustainability targets and indicators in the programmes of the 14 institutions responsible for fiscal, economic, agricultural, energy and transport policies.

## 4.2 Access to environmental information

The Federal Law on Government Transparency and Public Access to Information, introduced in June 2002, guarantees *public access to government information*. It requires every government entity to make available on the Internet information such as regulatory framework, budget, internal audits, subsidies and contracts for public works. This law reinforces the objective of facilitating *access to environmental information*, as expressed by the 2001-06 National Environment and Natural Resources Programme (PNMA) and LGEEPA. It is expected to lead to better public access to environmental information and to greater transparency of SEMARNAT.

Much environmental information is available on the Internet, but access is sometimes difficult or restricted. Fewer than 5% of Mexicans currently have *Internet access*. “E-Mexico” is a Presidential initiative to establish public information centres with free Internet access in indigenous and poor rural communities. Besides these efforts, information dissemination using print, audio-visual and other media is continuing, with attention given to populations with low literacy levels (e.g. provision of material on pesticide use).

## 4.3 Public participation

The Mexican Constitution establishes the obligation to organise a democratic planning system. The Planning Law guarantees democratic participation by different social groups, through representative organisations, in the formulation of the National Development Plan and its programmes. The whole array of Mexico’s environmental laws and regulations (e.g. the LGEEPA, and the Forestry, National Waters and General Wild Life Laws) already establish the *regulatory framework for public participation*. For example, environmental audits and environmental impact assessments must include public consultation processes.

Formulation of the 2001-06 PNMA involved 125 *citizens’ consultation* sessions, with analysis and incorporation of their contributions and comments on a number of environmental policy issues. In turn, the PNMA emphasises public participation in SEMARNAT’s policy setting and programme implementation. While mechanisms for public participation and consultation are formally in place, implementing these mechanisms will require further progress.

## 4.4 Environmental education

Education is an area in which there has been great progress, but challenges remain. *Adult illiteracy* in Mexico is still high at about 10%, varying from 3 to 23%

across regions. (Table 7.2) In areas with the highest marginalisation levels, two-thirds of the population has not completed primary school.

Great emphasis is being placed on environmental education. The 2001-06 National Development Plan includes a strategy to promote education, training, capacity building and social communication, as related to environmental protection and sustainable use of natural resources. The 2001-06 *PNMA* emphasises environmental education, public awareness and behavioural change. Numerous local awareness-raising initiatives exist (Box 7.3).

A joint effort by the Ministry of Public Education and SEMARNAT (through the Centre for Sustainable Development Education and Training, CECADESU) to strengthen the national curriculum's environmental and sustainable development content resulted in about one-third of *primary school teachers* being trained in environmental education. Within two more years all teachers will have received such training. SEMARNAT has agreements with many institutions of *higher learning* concerning research and degree programmes. It actively promotes *non-formal education* via radio and TV, as well as environmental fairs, contests and competitions (e.g. Ecology Merit Award, Native Youth National Award). Numerous SEMARNAT programmes (e.g. on water, air, natural disaster risk management) have information and training elements. NGOs play an important role in disseminating environmental information and in local education.

### Box 7.3 Local initiative: “peso-for-peso” school-based recycling programme

In 1994 the municipality of Tepatitlan (state of Jalisco) introduced a programme for *waste recycling and awareness raising in schools*. The recyclables collected are exchanged “peso-for-peso” for *school supplies* (e.g. notebooks, pens). In poorer communities they are also exchanged for *food*; recyclables worth 1 peso are traded for food worth 2 pesos.

This programme is an *example of a local initiative* that reduces municipal waste, saves natural resources through recycling, and contributes to improving children's awareness and well-being. The quantity of recyclable waste collected increased from 33 000 tonnes in 1995 to 72 000 tonnes in 2002. It is expected that all the Tepatitlan's schools will take part in this programme by 2010.

# 8

## SECTORAL INTEGRATION: AGRICULTURE AND RURAL DEVELOPMENT\*

### Features

- Structural and policy features of Mexican agriculture
- Irrigation water management in Mexico
- Land tenure reform and deforestation
- Agricultural policy reform: producer support and environmental impacts
- Rural development and the environment

\* The present chapter reviews progress in the last ten years, and more particularly since the previous OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “decoupling environmental pressures from economic growth” of the 2001 OECD Environmental Strategy. It takes into account the 1997 OECD Review of Agricultural Policies in Mexico and subsequent annual monitoring.

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- Create *synergies among agriculture, rural development, environment and natural resource management*, particularly by reinforcing institutional integration between SAGARPA and SEMARNAT and their respective agencies at the Federal and state levels and by developing a national agri-environmental strategy with quantified objectives.
- Pursue efforts towards *water pricing reform in agriculture*, particularly by progressively eliminating environmentally harmful irrigation subsidies.
- Contribute to the *development of profitable forestry* in the context of agricultural policy reform; in particular, further reduce incentives to intensify agricultural production and compensate populations engaged in forest management for otherwise unremunerated though environmentally beneficial public services, possibly through PROCAMPO.
- Promote consolidation of forest units on ejido land into viable larger-scale forest units in the context of *land tenure reform*, and introduce more flexibility to allow contracting out of forest management.
- Explore use of *economic incentives* to increase the revenues of rural populations; in particular, evaluate the potential for further promoting eco-tourism in protected areas.
- Assess the environmental effects of *PROCAMPO* support payments, as well as the anticipated environmental effects of NAFTA.

## Conclusions

*Fertiliser and pesticide* use in Mexico is low by OECD standards. Over the last ten years, while farmland area has increased, per hectare use of nitrogenous fertilisers has fallen; this is partly because direct subsidisation of agricultural inputs has been eliminated and payments based on input use have decreased considerably. There have also been efforts to improve pesticide regulations and harmonise registration procedures with those in other OECD countries. Many harmful pesticides, including chlordane and DDT (two persistent organic pollutants), have been withdrawn from the market. *Soil and water conservation infrastructure* is being rehabilitated in rainfed areas to retain rainwater and curb surface water runoff and soil erosion. The ambitious 1992 *water pricing reform* has resulted in water user associations currently covering 80% of operational and maintenance costs in irrigation districts, compared with 20% in the early 1990s. The 1992 *land tenure reform* gave many Mexican farmers titles to property, thereby providing incentives to increase productivity in agricultural and



forestry activities and to consolidate small plots into viable farms. The major agricultural policy reform process aims at improving the *market orientation of agricultural production*. The overall level of agricultural support in Mexico is low by OECD standards (Producer Support Estimate of 22%). The share of incentives aimed at intensifying agricultural production is falling significantly, while that of support more decoupled from agricultural production is increasing. Payments have been introduced to prevent use of fires as a farming practice. *Eco-certification* of forest management and of shade-grown coffee plantations is being developed. Further policy reforms give greater emphasis to creation of *new income sources in rural areas*. A new Law on Sustainable Rural Development was enacted in 2001. Rural development measures have been regrouped in a comprehensive national programme (the Concurrent Special Programme). More staff and a larger budget in the Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA) are being devoted to rural development policy.

However, commercial farmers tend to *overuse water and chemicals* on high-potential irrigated land. Agricultural water use has increased over the last 10 years; intensity of water use was already high, to the extent that water has become a significant constraint on sustainable development in many agriculture areas. Every year new areas are brought under irrigation, largely due to public investment in water infrastructure and government transfers to support on-farm irrigation, including recently increased subsidies for groundwater pumping. Consumption of methyl bromide (bromomethane), an ozone layer depleting fungicide, has dramatically increased. Traditional and subsistence farming also contributes to environmental degradation, as it tends to encroach on forests and fragile land to sustain agricultural production. *Deforestation* continues at alarming rates in tropical forests, mainly due to forest conversion to farmland or grassland. On-going agricultural policy reforms could provide new incentives for development of profitable forestry, provided the otherwise unremunerated but environmentally beneficial public services associated with forests are compensated. In fact, the link between agricultural policy and forest management has remained weak. Though decoupled from production, the Programme of Direct Payments to the Countryside (PROCAMPO), introduced in 1994, has not led to significant changes in agricultural production. The option of green PROCAMPO payments for environmental purposes has scarcely been used, partly reflecting limited institutional integration between SAGARPA and SEMARNAT. The *environmental effects of PROCAMPO*, including changes in pressures on marginal farmland, have not yet been evaluated. Neither have the anticipated *environmental effects of NAFTA* (from 2003, free trade applies to all agricultural commodities except maize, beans, sugar and powdered milk). *Rural development policy* has supported poor populations, but with little attention to land use patterns. In

some cases land reform has led to fragmentation of forestland or its conversion to farmland. A limited amount of ejido land has actually been sold; no attempts have been made to contract out management of large-scale forests on ejido land. Few rural development activities have combined environmental and poverty alleviation objectives. Use of economic instruments to increase local people's revenues should be further explored, as well as the potential for carbon sequestration and eco-tourism.



## 1. Agricultural and Rural Development Policy Objectives

Agriculture in Mexico is characterised by its *dual structure*: “commercial farms” on one hand and traditional farms on the other (some poor, but with commercial potential, and others very poor with only subsistence potential) (Box 8.1). Agricultural price support policy clearly impacts on commercial farms and, to some extent, on traditional farms with commercial potential; concerns related to subsistence farming are addressed by rural development policy.

Between 1989 and 1994 Mexico developed an ambitious programme of *agricultural policy reform*, aimed at modernising agriculture, enhancing the role of market mechanisms and improving the welfare of rural populations. The main objectives were to increase efficiency of resource use while also increasing competitiveness with cheaper imports, thus restraining price increases. Implementation of these reforms led to fundamental structural changes (e.g. privatisation of State-owned enterprises involved in the agricultural marketing and processing sectors). This reform, still underway, is underpinned by Mexico's increasing integration in the global and (through NAFTA) regional economy.

These *objectives of agricultural policy were reaffirmed* in the Countryside Alliance (Alianza para el Campo) programme for 1995-2000, which had the following aims: restoring profitability of the agricultural sector; increasing agricultural growth rate; alleviating poverty; reducing the agricultural trade balance deficit; and supplying food to the population at low prices. As part of the Agricultural Sectoral Programme (PSA) for 2001-06, a new Plan of Action to Strengthen the Agricultural Sector (the “Farming Shield”) was released at the end of 2002. This plan includes additional policy measures to mitigate the effects on Mexican agricultural production of eliminating tariffs on 17 agricultural products under NAFTA by the end of 2002. All these agricultural objectives have been established without much attention being given to their environmental implications.

The 2001 Sustainable Rural Development Law includes key *rural development policy objectives*. The main objectives of this law are to promote social and economic welfare through providing new sources of employment in agricultural and non-agricultural

## Box 8.1 Structural and policy features of Mexican agriculture

### *Structural features*

Mexico has a *dual agricultural structure*. A small number of large-scale (over 50 hectares) commercially oriented farm holdings account for a large share of agricultural output. Many small-scale holdings produce only enough for own consumption, and some must even supplement their production through purchases of maize (corn). Commercial farms in the northern part of the country are capital intensive, relying heavily on irrigation and purchased inputs.

Three types of *property rights* are recognised: ejido, private and communal property. The ejido is a form of land tenure in which the beneficiaries (ejidatarios) as a group, but not as individuals, have the usufruct. Until 1992, ejido land belonged to the State and could not be sold. Private properties are limited in size, according to type of agricultural activity (e.g. a maximum of 100 hectares in the case of irrigated land). Communal properties (comunidades) belong to indigenous communities (comuneros) which maintain their traditional property rights. Over half (52%) of Mexican territory belongs to ejidos and indigenous communities, 38% is private property and the remaining 10% includes Federal land and other forms of land tenure (e.g. national parks, military zones).

The average *size of a farm holding* on private land is about 25 hectares (with 60% of farms occupying less than five hectares). The average is 2 500 hectares for ejidos and properties belonging to indigenous communities; there are 27 203 ejidos and 2 478 communal properties. Ejido land (nucleo agrario) typically includes land for common use (generally permanent grassland, wooded areas and hills), individual family plots (commonly used for farming) and residential plots for houses (solares urbanos).

### *Policy features*

*Support to Mexican agricultural producers*, as measured by the Producer Support Estimate, increased from USD 4 to 5 billion in the early 1990s (before steep devaluation of the peso in 1995) to USD 8 billion in 2002 (Table 8.1). As a share of farm receipts, the level of support has fluctuated widely over the last two decades, mainly reflecting exchange rate volatility. For example, peaks at 30% in 1981 and 1992-93 were followed by dips associated with steep devaluation of the peso in 1983 and 1995. Since 1995 the percentage PSE has been rising again. At 22% of the value of production in 2002, the support level was quite similar to that in the United States.

*Agriculture's share in GDP* fell from 6.2% in 1990 to 5.7% in 2002, while its share in employment fell from 26.8% to 20.2%. Around 8.7 million people are currently employed in agriculture compared with 9.8 million in 1990, of which 3.4 million are producers (mainly landowners, ejidatarios and comuneros) and 5.3 million are workers (mainly jornaleros, peones and workers without pay). The share of agricultural exports in total exports fell from 5.3% to 2.5%, while for

### Box 8.1 Structural and policy features of Mexican agriculture (*cont.*)

agricultural imports the share fell from 5% to 2.9%. The cultivated area is mainly devoted to cereals (particularly maize), forage crops and pulses (beans). Mexico's main agro-food exports (in value terms) are fruits and vegetables, coffee, beverages and live cattle. Its main agro-food imports consist of processed foods, oilseed and cereals.

The *North American Free Trade Agreement* is the first regional trade agreement signed between advanced industrialised countries and a developing country in which all agricultural and agro-food trade was included. Since it entered into force in 1994, there has been an increase in agricultural production in Mexico and a significant increase in agricultural trade in the region. Between 1990-93 and 1999-2002, grain production in Mexico increased by 15% compared with an equivalent 39% increase in net imports. The pattern of changes in production and trade has been different for sugar and meat. Sugar production has increased by 34%; Mexico, which used to be a net sugar importer, has become a net exporter. Production of beef, pigmeat and poultrymeat has increased by 50% compared with an equivalent 18% increase in imports.

*All agricultural and agro-food trade between Canada, Mexico and the US will be duty-free by 2008*, as agreed under NAFTA. The transition period for elimination of Mexican tariffs on many agricultural products expired at the end of 2002; in some cases the impact will be marginal, as tariffs were already low, but in others tariff reduction in 2003 is more significant and may require considerable adjustments. This could be the situation with respect to pigmeat and poultrymeat, whose producers must pay a high price for feed maize, which is still highly protected by border measures (most imported maize is yellow maize for animal feed). NAFTA's greatest impact on Mexican agriculture will occur in the next five years, as border protection is progressively reduced for the most sensitive products (maize, sugar, milk powder and dry beans) until trade liberalisation is achieved in 2008. Maize is Mexico's main agricultural product and staple food. Small producers marketing part of their crops may have to adjust, which could require accompanying social measures, especially in poor areas. Sugar cane production is highly concentrated and is many small producers' only source of income; restructuring of Mexico's sugar industry is vital for these producers. Dry beans are a main staple, whereas milk powder is a main imported commodity.

Mexico recently signed an agreement with the Mercosur countries that will allow *regional free trade* among Latin America's three largest economies (Mexico, Brazil and Argentina) as well as other Mercosur members. The final treaty is expected to be signed in the second half of 2003.

sectors; to foster regional development through differentiated attention to low-income regions; and to support biodiversity conservation and natural resource management. As of 2003, rural development policy is being implemented through the Concurrent Special Programme (PEC) as part of the PSA.

Table 8.1 **Composition of Mexican agricultural support<sup>a</sup>**

Measures <sup>b</sup>	1980		1990		2000		2002 <sup>c</sup>		OECD <sup>d</sup>
	USD million	(%)	USD million	(%)	USD million	(%)	USD million	(%)	(%)
Market price support	700	24	2 153	46	5 643	74	5 314	66	63
Payments based on output	0	0	17	0	7	0	282	3	4
Payments based on input use	2 191	76	2 544	54	742	10	660	8	9
Payments based on area planted/animal numbers	0	0	2	0	56	1	383	5	14
Payments based on historical entitlements	0	0	0	0	1 098	14	1 286	16	5
Payments based on overall farm income	0	0	0	0	58	1	155	2	2
Payments based on input constraints	0	0	0	0	0	0	0	0	3
Total Producer Support Estimate (PSE)	2 891	100	4 716	100	7 604	100	8 080	100	100
Total PSE/gross farm receipts (%)	13		17		24		22		31

a) Monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm-gate level, arising from policy measures that support agriculture.

b) Ranked according to their relative impact on the environment (from higher to lower impact).

c) Provisional.

d) 2002 provisional data.

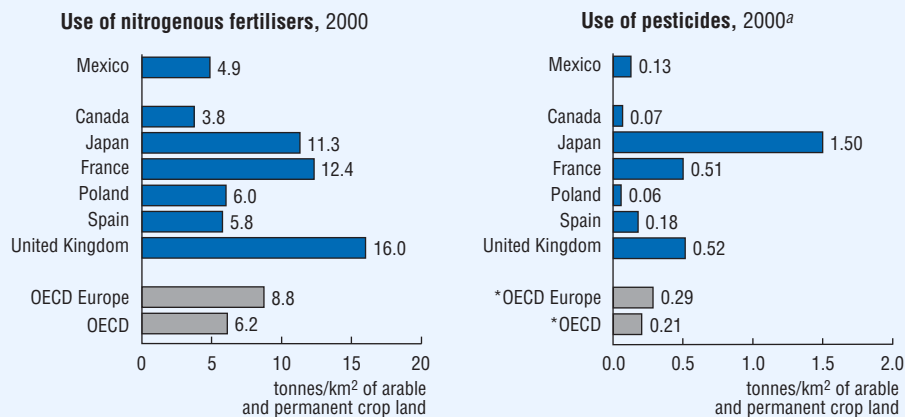
Source: OECD.

## 2. Environmental Impact of Agriculture

### 2.1 Agrochemicals: fertiliser and pesticide use

Use of nitrogenous fertilisers by farmers in Mexico per hectare is below the OECD average (Figure 8.1); water pollution by nutrients does not appear to be widespread (Box 3.1). The country-wide soil surface nitrogen balance, low by OECD standards, decreased between the late 1980s and late 1990s (from 28 to 20 kilograms per hectare). Pesticide use by farmers per hectare is also below the OECD average (Figure 8.1). This is partly because many farmers are in subsistence mode and are too poor to afford commercial fertilisers and pesticides. However, *local contamination* of surface water and aquifers by nitrates, phosphates and pesticides occurs in irrigated areas, where most *farm input use* is concentrated.

Direct subsidisation of farm inputs was eliminated through the privatisation or liquidation of State-owned agencies involved in providing subsidised inputs to agricultural producers, such as the Mexican Fertiliser Company (FERTIMEX)

Figure 8.1 **Agricultural inputs**

a) Or latest available year.  
Source: FAO; OECD.

in 1992. To offset the resulting increases in *farm input prices*, import barriers for most of these inputs have been progressively reduced. In 1994, under NAFTA, import tariffs for fertilisers and agricultural chemicals were removed. Since 1996 the Countryside Alliance, recently renamed Alliance with You (*Alianza Contigo*), has supported purchases of farm inputs by producers. Overall, however, *payments based on input use have significantly decreased* over the last decade (Table 8.1).

The Inter-ministerial Commission for the Control of Processing and Use of Pesticides, Fertilisers and Toxic Substances (CICOPLAFEST) is responsible for establishing procedures for pesticide approval. A catalogue of approved pesticides was published in 1994. In 1995 Mexico began to participate in the OECD programme for harmonised review of pesticides, with the intention of revising its regulatory framework. US/Canada bilateral efforts concerned with *pesticide regulatory harmonisation* were expanded in 1996 to include Mexico through the NAFTA Technical Working Group (TWG) on Pesticides: addressing national differences in maximum residue limits (MRLs), developing a better understanding of each regulatory agency's assessment practices, working to harmonise the three countries' procedures and requirements, and encouraging pesticide registrants (product owners) to make co-ordinated data submissions to the NAFTA countries.

In 1997, taking the lead among Latin American countries, Mexico decided to phase out two *persistent organic pollutants* used in agriculture: chlordane (by 1998) and DDT (by 2002). Both targets were met. In the context of a North American Regional Action Plan (NARAP), Mexico replaced chlordane with registered insecticides and termiticides and stopped using DDT by 2000, two years before the target date. Until then DDT had been used to prevent malaria transmission by the *Anopheles* mosquito; but amounts used for malaria control were a small fraction of those used for agricultural purposes. Mexican expertise in controlling malaria without DDT is being shared with other Latin American countries.

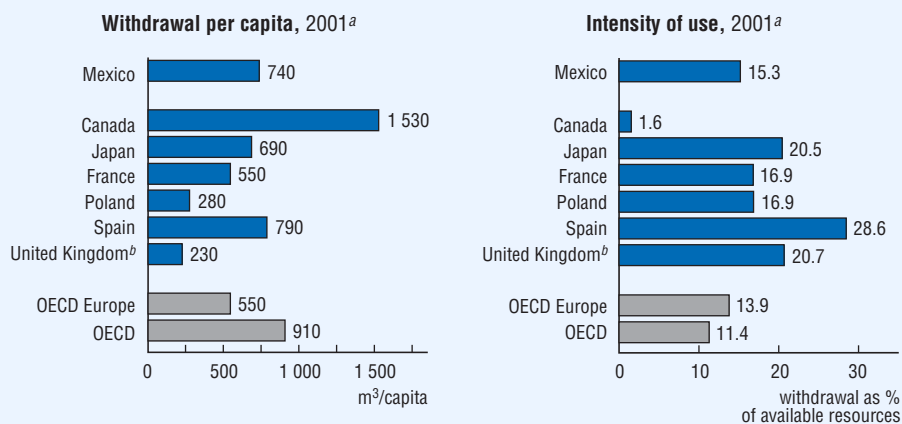
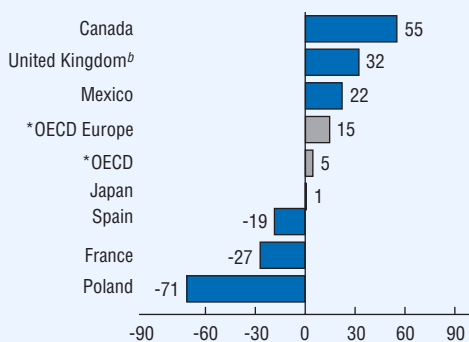
*Methyl bromide* (bromomethane), an ozone layer depleting fungicide, is used by Mexican farmers as a soil fumigant and, to a lesser extent, to treat stored crops and bulk deliveries prior to export. It is mainly used by vegetable growers (e.g. on tomatoes, peppers, eggplants). Under the Montreal Protocol for protection of the ozone layer (and its amendments) Mexico is classified as a developing country; its use of methyl bromide was to be reduced to 1995-98 levels in 2002 and then eliminated in 2015, except for limited purposes such as quarantines. In response to this commitment, Mexico aggressively increased its consumption until 1998, bumping up the baseline. The increase has been dramatic (305% between 1991 and 1998, equivalent to 1 207 tonnes of ozone depletion potential in 1998). Mexico is the only OECD country (besides Turkey) whose methyl bromide use increased in the 1990s.

Organic farms are being established in Mexico to respond to developing domestic demand for organic food as well as to provide export for the large and expanding (with trade liberalisation) Canadian and US organic food markets. Standards for *organic farming* practices should be developed in order to better inform and protect consumers of organic farm products. Such standards should be commonly agreed among NAFTA partners to prevent their use as trade barriers.

## 2.2 *Water use: large-scale irrigation, water pricing reform*

Overall intensity of water use is high in Mexico (Figure 8.2). Around 15% of Mexican aquifers are overexploited, and agriculture accounts for two-thirds of groundwater abstraction (Chapter 3). The share of irrigation in total freshwater abstraction (83%) is the second highest among OECD countries. Mexico's irrigated area is second to that of the United States among OECD countries (6.3 million hectares), extending over 24% of crop land (around 65% for wheat). *Agricultural water use* has increased by 22% since 1980, above the OECD average (Figure 8.2). This is partly due to a 30% increase in irrigated area over the period, though new areas brought under irrigation annually have decreased markedly – from around 200 000 hectares (early 1980s) to 40 000 (1990) to 6 000 (2002). Between 1995

Figure 8.2 Freshwater use

% change in irrigation withdrawals, 1980-2001<sup>a</sup>

a) Or latest available year.

b) England and Wales only.

Source: OECD.



and 2000 a total of 40 700 new hectares was brought under irrigation, below the target of 104 000 hectares (Chapter 3). Irrigated agriculture accounts for 50% of Mexico's agricultural production and 70% of its agricultural exports.

Irrigation is necessary for production of agricultural commodities in many regions. It has generally tended to absorb a significant share of public investment in agriculture. Mexico's *reform of water pricing policies* seeks to improve water management at the irrigation district level, and to make wholesale and retail water allocation systems less vulnerable to cyclical shortfalls in Federal budgets. One motivating factor was the general recognition that lack of revenue available to cover operational and maintenance costs had rendered huge areas of irrigated land virtually useless. Large irrigation units, which had proven too large to be adequately managed, were therefore broken up into smaller districts and given more administrative independence to collect charges, maintain collective assets and manage their water resources. These reforms have partially enabled many irrigation districts to collect, through farmers' charges, enough funds to sustainably keep their assets in operation.

*Public investment in irrigation and water conservation infrastructure* increased from USD 250-300 million a year (early 1990s) to USD 400-450 million (recent years), with a dip of USD 50-100 million (mid-1990s) following the 1995 economic crisis (Table 8.2). The purpose of this investment is to irrigate new areas and to rehabilitate and modernise existing irrigated land, at an annual rate of 100 000 to 200 000 hectares. The National Water Commission (CNA) also provides technical assistance to help improve irrigation methods and reduce water distribution losses (Chapter 3). Recently CNA has supported investment in soil and water conservation in rainfed areas. Surface water runoff and soil erosion measured in northeastern Mexico were respectively 10 and 40 times higher on agricultural land than in undisturbed native scrub forest. Recent estimates based on the universal soil loss equation have confirmed these figures. Up to 2002, soil and water conservation infrastructure rehabilitation covered 1.6 million hectares; 33 000 hectares of new areas was also covered (12 000 hectares through extension of existing works and 21 000 hectares through application of soil and water conservation where it had not previously existed).

The Mexican government has traditionally contributed to the *cost of operating and maintaining irrigation schemes*. Under the 1992 Water Law this responsibility was progressively transferred to organised producers, entailing dramatic changes: water user associations currently cover 80% of operational and maintenance costs in Irrigation Districts (DRs), against 20% in the early 1990s (Box 8.2). However, as most DRs still require substantial rehabilitation and modernisation, government budgetary transfers to support on-farm irrigation have continued at an annual rate of USD 50-100 million, including *subsidies for groundwater pumping* (Table 8.3). To

Table 8.2 **Public investment in infrastructure for water use in the agriculture sector**

(USD million)

	1991	1995	2000	2002
Irrigated areas	254	49	365	332
Major irrigation infrastructure	90	12	180	83
Minor irrigation infrastructure	69	7	57	83
Rehabilitation works	95	30	128	166
Rainfed areas <sup>a</sup>	..	..	56	41
Land preparation for water conservation	..	..	16	18
Supplementary water infrastructure	..	..	15	9
Maintenance and rehabilitation works	..	..	25	14
Operation and maintenance of reservoirs	6	8	18	24
Protection of productive areas	7	4	20	30
Total	267	61	459	427

a) Public investment in rainfed areas was initiated in 1998.

Source: CNA.

Table 8.3 **Main agricultural policy programmes<sup>a</sup>**

Programme	1997		2000		2002 <sup>b</sup>	
	USD million	Beneficiaries ('000)	USD million	Beneficiaries ('000)	USD million	Beneficiaries ('000)
Alliance with you <sup>c</sup>	652	3 546	919	4 439	1 221	4 324
of which:						
Rural development	138	1 937	283	2 312	578	2 301
Water <sup>d</sup>	46	96	112	91	52	46
PROCAMPO <sup>e</sup>	951	2 850	1 098	2 681	1 286	2 800
Marketing payments <sup>f</sup>	261		310		335	
Total	1 864		2 327		2 842	

a) Includes budgetary transfers to producers and for general services; excludes interest concessions and budgetary transfers to consumers.

b) Provisional.

c) From its inception in 1996 until 2002, Alliance with You was called the Countryside Alliance.

d) Operated by CNA; includes subsidies for electric pumping of groundwater.

e) Programme of Direct Payments to the Countryside (launched in 1994 and operated by ASERCA).

f) Operated by the Support Services for Agricultural Marketing Agency (ASERCA).

Source: SAGARPA.

## Box 8.2 Irrigation water management in Mexico

Around 60% of irrigated area is within *Irrigation Districts* (DRs), which include irrigation systems of over 3 000 hectares; around 30% is within *Irrigation Units* (URs), which include smaller-scale irrigation schemes. The remaining 10% belongs to small-scale schemes developed by the private sector. In the past, DRs were a part of the national land redistribution programme. In many instances landless peasants were brought in to populate an area purchased or expropriated by the government. In these DRs the government built dams and canals for irrigation without cost to farmers. These CNA-managed facilities remained the property of the Federal government. In contrast, farmers in Irrigation Units (URs) had to contribute about 40% of construction costs, mainly in the form of labour. Upon completion, they became the owners of these facilities and were responsible for operation and maintenance. Farmers in both DRs and URs were allowed to supplement their allocations of surface water with groundwater at no charge. They further benefited from subsidised prices for electricity used to pump water.

Since 1992 Mexico's water policy has undergone a major change. Confronted with limited supply and increasing demand, the government established a new regulatory framework to increase water use efficiency. One of the main features of the 1992 Water Law is the creation of CNA's Public Register of Water Rights (REPDA) and promotion of a market for *water concession rights* (*derecho de aguas*). Under Mexico's 1917 Constitution, all water resources are public property and are to be controlled by the Federal government. According to the Water Law, CNA may grant 50-year tradable water concession rights (in volumetric terms) to individuals, groups of individuals (e.g. Water User Associations, DRs), Federal, state or municipal departments or agencies. Most requests have been accepted by CNA based on historical uses and overall water supply and demand in the Irrigation District (DR). Sale of water concession rights to users outside the DR must be approved by two-thirds of users within the DR and by CNA; revenue from sales is to be returned to the DR rather than to individual holders of rights. Much progress has been made in implementing the REPDA (Chapter 3).

Another main factor leading to reform has been the steady decline in the quality of irrigation facilities, resulting from the failure to raise adequate revenue to pay for operation and maintenance. By the end of the 1980s about 800 000 hectares of irrigated land had been taken out of production or was being used less intensively due to severe deterioration of irrigation facilities. The Water Law allows responsibility for operating and maintaining irrigation works to be transferred to producers' associations. Within DRs, agricultural producers may form *Water User Associations* (OUAs) and operate the irrigation systems. The National Programme for the Decentralisation of Irrigation Districts, launched in 1989, created "irrigation modules" of 5 000 to 50 000 hectares operated by OUAs. By 2001, 3.3 million hectares (98% of DRs) had been transferred to joint management. The second stage of this reform involves the creation of Limited Responsibility Societies (LRSs) made up of irrigation modules, which will assume responsibility for wholesale water supplies. Seven LRSs, comprising about 705 000 hectares, have been created.

improve water use efficiency in areas irrigated by groundwater (one-third of total irrigated area) in the mid-1990s, it was decided to increase the electricity tariff for irrigation groundwater pumping. Agricultural subsidies for electric pumping therefore fell substantially, from USD 200-300 million per year (until the mid-1990s) to USD 10-20 million per year in recent years. However, the Agricultural Sectoral Programme (PSA) prescribes a standard subsidised rate for electric pumping for agricultural purposes of USD 0.03/kWh (eliminating increasing block schedules). This would involve government budgetary transfers of USD 150 million per year on average between 2003 and 2006. The decision process did not include environmental considerations.

### 2.3 *Land reform, deforestation and biodiversity loss*

*Deforestation* (i.e. forest clearance followed by land use change) affects 770 000 hectares a year in Mexico (1.2% of total wooded area), one of the highest rates in the world (Chapter 5). Of this total, 66% takes place in tropical forests, including in areas of high biodiversity value which often overlap with areas on which there are indigenous settlements (Box 7.2). Conversion of forests to farmland or grassland results from demographic changes (the rural population increased by 1.8 million in the last ten years) and the growing poverty of the rural population. Over 12 million people live in forest areas, most of them in poverty.

Some 80% of Mexican forests is on ejidos. The ejido system of collective land use was introduced at the end of the colonial period; under this system, land continued to belong to the nation. *Land tenure reform* in 1992 provided for registration of titles to all ejido land (Box 8.3).

So far, the 3.2 million new “rightholders” have shown *limited interest in the land reform process*, arguing that the old system already served their interests. They continue to prioritise agricultural production, as they have a strong interest in receiving PROCAMPO payments, farm inputs and technical support. There has been little change in land use. In some cases land reform has actually led to fragmentation of forestland or its conversion to farmland (Chapter 5). Only a limited amount of ejido land has been sold to the private sector. This can partly be attributed to the attachment of ejidatarios and comuneros to their land and to traditional activities; in addition, investors are reluctant to deal with ejido assemblies and government authorities (ejido communities must notify the Agrarian Attorney General’s Office and municipal and state governments before they privatise, sell or form a joint venture). Introducing more flexibility in contracting out management of large-scale forests on ejido land could constitute a step towards sustainable forest management, provided contractors are certified skilled (public or private) professionals, good silvicultural practices are

### Box 8.3 Land tenure reform: ejido, private and communal property

At the end of the colonial period, land ownership in Mexico was concentrated among a few people in the form of latifundios, or large land holdings. The Mexican Revolution in 1910 eventually brought about the Agrarian Law of 1915, which initiated *land redistribution to the peasantry*. The Agrarian Law established maximum limits for use of land under private ownership (e.g. 100 hectares for irrigated crop land, 800 hectares for forestland). It also established the ejido system of collective land use, under which land remained the property of the nation and beneficiaries (ejidatarios) had, as a group, the usufruct. Communal properties belong to indigenous communities with their traditional property rights. However, the property rights in ejido and communal systems were poorly defined and excessive restrictions were imposed on land mobility and on agreement of contracts for agricultural production.

In 1992 land redistribution was declared to have ended. Individuals within ejidos were awarded increased rights to their land, and commercial farmers' associations were allowed to possess up to 25 times more land than the maximum limits under private ownership (e.g. 2 500 hectares of irrigated crop land, 20 000 hectares of forestland). The *1992 land tenure reform* constitutes a new legal framework for property rights, authorising ejidatarios to sell (if authorised by the ejido assembly), rent or mortgage plots of land. Under certain legal provisions, ejido land can be sold outside the ejido community. The usufruct on part or all of ejido land may be transferred to third parties for up to 30 years, with the possibility of renewal, provided the usufruct is valued above a minimum (reference) amount set by the government.

This reform also provides for registration of titles to all ejido land. In 1993 the Secretariat of Agrarian Reform (SRA) launched the Programme for the Certification of Ejido Property Rights (PROCEDE) to *grant individual titles of property rights to ejido members* (ejidatarios). SAGARPA has a general co-ordinating and monitoring role. The National Institute for Statistics, Geography and Information (INEGI) is responsible for the field survey of ejido land and preparation of a register, to be kept by the National Agrarian Registry (RAN). The decision to receive a title, the titling process itself, and the decision to open up land sales to outsiders all require at least a majority vote in the ejido assembly. The Agrarian Attorney General's Office (PA) is responsible for assisting ejidos to carry out the land titling programme. It also arbitrates ejido land disputes, relying as appropriate on Agrarian Courts.

Following the reform, 61.5 million hectares (or 78% of ejidos and indigenous communal land) has received full titling involving 3.2 million ejidatarios and comuneros, half of whom are employed in agriculture (sujetos agropecuarios). The aim has been to provide *incentives to farmers to improve productivity* through establishing property rights and encouraging investment in agricultural and forestry activities. By giving farmers better access to credit, the reform also contributes to consolidation of small plots into viable farms, though there are still provisions concerning the maximum size of private properties. Apart from structural gains, this reform can also facilitate creation of a property register for entitlement to area-based payments, particularly through PROCAMPO (Box 8.1).

prescribed in the contract (e.g. management plan, reforestation, biodiversity conservation) and economic benefits are shared equitably among contracting parties.

Land reform in itself will not end deforestation unless *demographic and poverty pressures on ecosystems* are also addressed. Demographic changes and persistent poverty have created the need for more land to be cultivated, often in remote areas and for self-subsistence only. Rural development programmes have been implemented over the last two decades to support poor populations, but with little success as regards land use patterns. Most farm income in small production units (predios) is derived from non-agricultural sources (e.g. 70 to 80% of the income of farmers with predios of less than five hectares). Additional sources of income are clearly needed to prevent ejido and indigenous community populations from converting forests to other land use or from migrating massively to large cities. Tropical deforestation has not been addressed in rural development programmes; more generally, links between agriculture policy and forest management have remained weak.

### 3. Environmental Impact of Agricultural and Rural Development Policy

#### 3.1 Agricultural policy and the environment

##### *Towards agricultural policy reform*

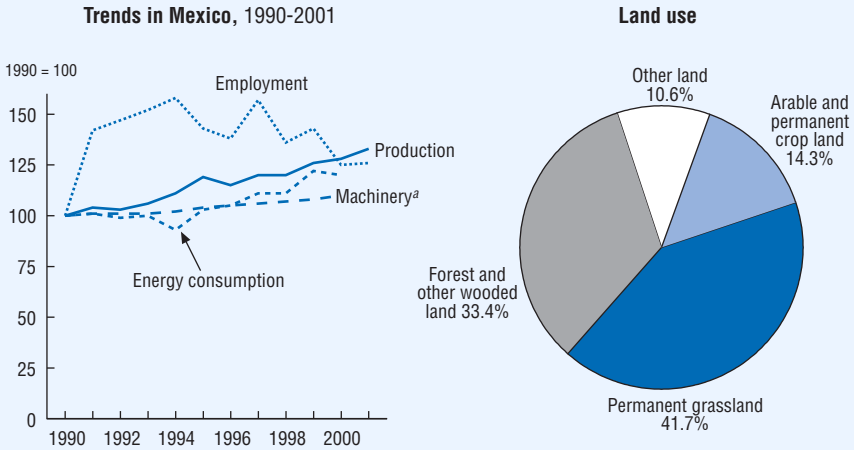
In 1994, following the major policy shift towards *improving the market orientation of agricultural production*, and coinciding with the entry into force of NAFTA, a major programme of budgetary payments to farmers was initiated (Programme of Direct Payments to the Countryside, or PROCAMPO). With PROCAMPO Mexico embarked on far-reaching policy reform. PROCAMPO payments (USD 1.2 billion in 2002) account for 16% of total producer support compared with an OECD average of 5% for this type of support. Around one-third of those employed in agriculture receive PROCAMPO payments. Payments are granted on condition that farmers with over five hectares use their land for agricultural or livestock production or for an environmental programme (since 1996 PROCAMPO payments can be made to farmers who undertake forestry activities). The “Green PROCAMPO” option has barely been used, however, partly due to limited institutional integration between the Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA) and the Ministry of Environment and Natural Resources (SEMARNAT), and partly due to limited interest by eligible farmers. Rules permitting capitalisation of PROCAMPO payments (cesion de derechos) were approved in July 2002. An agreement with certain banks allows farmers to receive the total amount of payments due up to 2008, subject to developing an investment project in agro-food, forestry or fishing.

Decoupled from production, PROCAMPO was established for a 15-year period to progressively replace consumer-financed price support policies for grain, beans and oilseed. *Implementation of PROCAMPO* has not seemingly led to significant changes in agricultural production or to reduced pressures on marginal farmland; the extent and composition of the area cultivated have remained virtually unchanged, with no major shift towards market oriented production (e.g. fruits and vegetables). The livestock population and the extent of grassland have also remained fairly stable (Figure 8.3). A study was recently launched, with support from the Inter-American Development Bank, to evaluate the environmental impacts of PROCAMPO, with a focus on soil quality (erosion) and land use changes (including forest land). The outcome is expected by 2005.

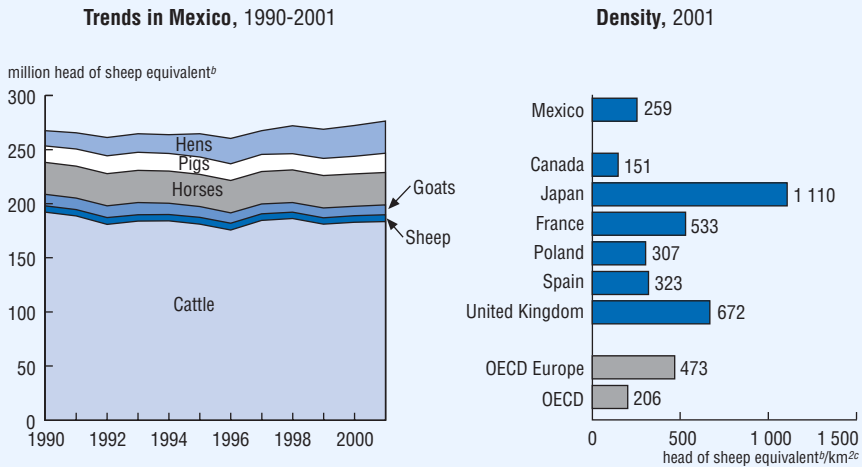
Other measures have subsequently been introduced to *increase productivity and competitiveness* in the agriculture sector. Since 1996, producers may become part of the Alliance with You (previously the Countryside Alliance), a set of programmes to improve their production base and encourage technological development through reducing the cost of inputs and equipment (e.g. ferti-irrigation, tractors, improved seed) and technical assistance. The Alliance's overall budget is currently USD 1.2 billion, similar to that of PROCAMPO (Table 8.3). Around half the people employed in agriculture benefit from support provided by the Alliance. The number of programmes under the Alliance was reduced in 2002 by regrouping them under common headings. Most payments consist of subsidies for inputs (mainly investment) or on-farm services. They also include payments to avoid use of fire as a farming practice (i.e. slash and burn); in 2002 these payments amounted to USD 7 million and covered 268 000 hectares (54% of the land subject to this practice).

A package of new measures, the Farming Shield, was announced in November 2002; most of these measures may not be implemented until 2004. The Farming Shield includes new legal and regulatory provisions to facilitate government *actions against "unfair" competition* and to reinforce controls on food safety for imports. It also aims at facilitating farmers' access to credit. Measures proposed under the Farming Shield include payments based on output (a new counter-cyclical payment for crops, paid per tonne on the basis of target prices, which will replace current marketing payments) as well as payments based on input use (a new standard subsidised price for electricity used in agricultural production). They also include payments based on animal numbers (a new payment per cow conditional on extending livestock production). *Trade liberalisation* provides increasing opportunities to diversify agricultural production. For instance, since the lifting in 1997 of restrictions first imposed in 1913, export of Mexican avocados to the United States has expanded. Avocado exports are now allowed to 31 US states and to Washington DC. (Mexico is the world's leading avocado producer.)

Figure 8.3 Agriculture



**Livestock**



a) Tractors and combined harvester-threshers in use.  
 b) Based on equivalent coefficients in terms of manure: 1 horse = 4.8 sheep; 1 pig = 1 goat = 1 sheep; 1 hen = 0.1 sheep; 1 cow = 6 sheep.  
 c) Of arable, permanent crop land and permanent grassland.  
 Source: FAO; OECD.



### *The environmental impacts of agricultural policy measures*

Overall, *producer support* has remained at 10 to 30% of farm receipts over the last ten years, except for a dip in 1995 due to steep devaluation of the Mexican peso (Box 8.1). Analysing the components of support can help identify their relative impacts on the environment, as some measures provide a greater incentive for sustainable farming than others (Table 8.1).

First, the share of *incentives to intensify agricultural production* (market price support, payments based on output or on input use) within total producer support significantly decreased, from 100% in 1990 to 77% in 2002, and is now comparable to the OECD average (Table 8.1). Both market price support (transfers from consumers and taxpayers, to cover the gap between domestic and border prices) and payments based on output (marketing payments provided to grain and oilseed producers on a per tonne basis, to cover the gap between market prices and “consensus” prices agreed between producers and buyers) increase the price producers receive for a specific commodity; payments based on input use (various Alliance with You and CNA measures to subsidise farm inputs) reduce the cost of inputs used by producers. Thus the lower these types of support, the less incentive there is to use farm inputs and/or use environmentally sensitive land.

Second, the share of *measures more decoupled from agricultural production* (payments based on historical entitlements or on overall farm income) increased from 0% of total producer support in 1990 to 18% in 2002. This indicates a positive trend towards market orientation and reduction of environmental pressures. Payments based on historical entitlement (e.g. PROCAMPO payments based on area planted at an historical base period) and those based on overall farming income under the Temporary Employment Programme (PET) also have the potential to keep environmentally sensitive areas under production. However, since producers are not obliged to plant, own animals or produce any particular commodities to receive these payments, the payments allow individual choices concerning environmentally friendly production techniques and do not encourage production intensification and/or monoculture.

Third, some 5% of total producer support (compared with an OECD average of 14%) takes the form of *payments based on area planted/animal numbers* (mainly under the Alliance with You). As producers must plant a specific crop or own specific animals, these payments encourage monoculture and provide an incentive to keep environmentally sensitive land under production. However, as producers are not encouraged to increase yields, environmental impacts are potentially lower than those of incentives to intensify production. There are *no payments based on input constraints* (i.e. paid on condition that farmers reduce, replace or withdraw use of farm inputs). Environmental cross-compliance (support conditional on farmers

undertaking environmental activities) has not been introduced, though it would attenuate the environmental impact of support measures.

Though they have differentiated impacts on the environment, the various types of support measures have not been assessed for their environmental impacts or been the subject of much debate on these impacts. This suggests that there is *considerable scope for much better integration* of environmental concerns in agricultural policies (both institutional and market-based integration).

### 3.2 Rural development policy and the environment

Much of the agriculture sector still confronts major structural problems. Commercial farms in northern Mexico can probably adapt to the growing influence of international markets, but there is still a lack of basic infrastructure, marketing channels, research, training and extension services in many parts of the country where traditional and subsistence farms are located. *Support for rural development* has long been provided in Mexico, mainly consisting of road building, electrification, water supply and sanitation, promoting social welfare and influencing farming conditions. It has taken on increasing importance in the Alliance with You (Table 8.3). Recent initiatives such as the 2001 Law on Sustainable Rural Development, the steady increase in the number of SAGARPA staff directly involved in rural development, and the regrouping of rural development support measures under the Concurrent Special Programme (PEC) indicate that this trend will continue and even intensify. USD 10.6 billion was allocated to rural development under the PEC in 2003 (Table 8.4). The lion's share is devoted to social (housing, health, education) and productive (mainly farming) activities, primarily for target groups (women, indigenous communities, the young, the elderly) and in economically marginal areas.

Very few rural development activities have yet *combined environmental and poverty alleviation objectives*. Under the PEC, USD 400 million will be spent on environmental protection (mainly biodiversity conservation) as there is the intention to compensate forest owners or tenants for providing environmental services. In 2002 SAGARPA launched a new programme on *watershed management* in small catchments as part of its rural development activities. The aim was to curb conversion of forestland to farmland and reduce soil erosion, while increasing population income. SAGARPA has also started to support use of electricity from *renewable energy resources* in agriculture; there are currently 250 photovoltaic and wind energy water-pumping projects in 14 states.

Mexico ranks fourth in the world in forest species diversity. However it is estimated that 95% of its tropical humid forests have already been lost (Chapter 5).

The first best policy approach to establishing sustainable and *efficient use of land for forestry and for agriculture* is to reduce assistance to agricultural production. On-going reform of agricultural policy could provide new incentives for development of profitable forestry. However, it is unlikely that reform on its own would be sufficient, given that many forestry activities in Mexico are not viable under market conditions. This is partly because the forestry industry mainly consists of small-scale sawmills with low efficiency (representing 74% of total raw material production) and partly because the steps from harvesting, processing and manufacturing to distribution and sales are poorly co-ordinated (reflecting lack of a proper chain-of-custody for timber products). The low profitability of forestry activities is also due to the many environmental benefits of forests that are not captured by the market. Any policy response should be aimed at compensating populations engaged in forestry for their otherwise unremunerated but environmentally beneficial public services.

Opportunities for poor farmers to *earn income from carbon credits* by sequestering or conserving carbon through forest management, restoration of degraded forests and rehabilitation of grazing lands are being explored. This would meet the goals of reducing GHG levels in the atmosphere while reversing land degradation, conserving biodiversity and improving the livelihood of local communities. Assuming carbon credits are worth USD 10 each, the cumulative potential undiscounted value of carbon offset credits for Mexican land use, land-use change and the forestry sector between 1990 and 2030 would be in the range of USD 23 million to USD 51 million.

Table 8.4 **Rural development policy measures, 2003<sup>a</sup>**

Measures <sup>b</sup>	USD million	(%)
Social welfare	4 783	45
Productive activities	3 939	37
Basic and productive infrastructure	863	8
Environment	393	4
Employment	366	3
Agriculture	273	3
Total	10 617	100

a) Planned expenditure.

b) Operated by 13 ministries and consisting of 57 specific programmes under the umbrella of the Concurrent Special Programme (PEC).

Source: ASERCA.

*Use of economic instruments* to increase local people's revenues should be further explored. Revenues from *user fees* that are progressively being applied to all marine reserves (e.g. for whale watching or diving) are used for reserve administration and tourism infrastructure. A similar fee could be applied to inland protected areas (e.g. for watching wildlife or eco-tourism), but it should partly be returned to local communities. *Tradable hunting permits* that could be sold on the international market (as envisaged in the case of the wild big-horned sheep) could provide a sustainable income source provided hunting is kept at a sustainable level. *Eco-tourism* is expanding in Mexico and could become a major source of income for indigenous communities living in forests (Chapter 6).

In Mexico coffee has been an important crop for centuries. Unlike growers in some other coffee regions, Mexican growers have traditionally used a plantation system that maintains a forest canopy of valuable tropical tree species. However, due to the volatility of coffee prices, in recent years some farmers have converted their *shade-grown coffee* plantations to cultivation of staple food crops, neglected maintenance in order to find work off-farm, or abandoned their plantations altogether. Certified shade-grown coffee is sold at a premium, and projects that further promote such *eco-certification* could increase rural income and discourage conversion from shade-grown coffee production. Since forest certification was launched in Mexico in 1995, 36 Forest Stewardship Council (FSC) certificates have been granted for an area of 614 000 hectares (less than 1% of Mexico's total wooded area) in five states (Chihuahua, Durango, Michoacán, Oaxaca, Quintana Roo). Certificates were provided to ejidos (22), indigenous communities (nine) and private forest owners (five). FSC certification has only been made possible through external funding, as the additional revenue from selling certified forest products does not yet fully cover the costs of acquiring certification.

# 9

## INTERNATIONAL CO-OPERATION\*

### Features

- Climate
- Ozone depleting substances
- Marine resources and coastal areas
- Environmental co-operation between Mexico and the United States
- NACEC
- The northern border
- Protection of fauna: whales, dolphins, turtles
- Trade and the environment

\* The present chapter reviews progress in the last ten years, and particularly since the OECD Environmental Performance Review of 1998. It also reviews progress with respect to the objective “global environmental interdependence” of the 2001 OECD Environmental Strategy. Selected international commitments are discussed in other chapters: water management (Chapter 3), nature and biodiversity management (Chapter 5).

## Recommendations

The following recommendations are part of the overall conclusions and recommendations of the environmental performance review of Mexico:

- continue to emphasise the use of *indicators and quantified targets* in developing result-oriented international environmental strategies;
- address the negative environmental impacts of growing *international trade and investment* in northern Mexico;
- strengthen both the institutions to enhance bilateral co-operation and the mechanisms that encourage international commitments, consistent with *environmental management decentralisation*;
- develop *like-minded countries* positions on international issues, such as biodiversity conservation, response to climate change, and international law, and assume leadership as appropriate;
- develop a national strategy to reduce the rate of growth of *GHG emissions*, with specific objectives and precise measures to be taken over the next few years, including under the proposed Clean Development Mechanism;
- seek the development of *integrated management of international water basins*, with special emphasis on efficient use of water;
- improve institutional mechanisms to provide better protection of the environment in *marine waters*, coastal waters and coastal zones, and increase involvement by SEMARNAT in this regard;
- continue to develop institutions and measures to combat marine *pollution from ships* and to respond rapidly to *oil emergencies*.

## Conclusions

Mexico has greatly improved the manner in which its international environmental agenda is being addressed. To a great extent it has acted in line with other OECD countries, though it has not always been obliged to do so. It has assumed *responsibilities beyond its legal obligations* under the Climate Change Convention and the Montreal Protocol. Mexico ratified the Kyoto Protocol in 2000. CO<sub>2</sub> inventories have been carried out and effective measures have been taken to reduce GHG emissions. CO<sub>2</sub> emissions have been decoupled from GDP growth. Consumption of ozone-depleting substances has been much reduced, in advance of mandatory requirements. Mexico has important responsibilities relating to *its rich biodiversity*, but resources with which to protect the environment and conserve natural resources are limited. It has made considerable *progress towards protection of whales, sea turtles and dolphins*

and has created the world's largest whale sanctuary. It promotes co-operation with like-minded countries that are also rich in biodiversity, with a view to creating an equitable system of natural resource use. *Bilateral environmental co-operation* has been strengthened, and *regional environmental co-operation* with other Latin American countries has increased. Mexico has provided technical assistance to support sustainable development in a number of Latin American countries. Tripartite environmental co-operation within North America is increasing and has led to concrete results; improvements were made recently in waste water treatment near the northern border.

However, Mexico is experiencing difficulties *implementing its legal regime*, as well as adequately *funding* projects, in order to meet its international commitments. Law and order in the environmental protection area could be improved, especially in an open economy like that of Mexico. *Air pollution* in the twin cities along the northern border has worsened, largely due to increasing international lorry traffic. Cross-border difficulties have arisen over *water use* in northern Mexico. Current plans concerning access to drinking water and basic sanitation are not consistent with undertakings under the UN Millennium Declaration or the objectives agreed at the Johannesburg Summit. Additional financial resources should be made available to ensure consistency. Regarding climate change, economic instruments are still not used as incentives for behavioural change or to finance subsidies encouraging use of cleaner energy. Activities to protect the *marine environment* and coastal ecosystems from land-based activities and pollution sources, and from pollution from ships, could be given greater attention and be better co-ordinated.



## 1. Overall Performance

Mexico is a *key player in international environmental negotiations*, reflecting its geographic location, the wealth of its biodiversity, and its dual diplomatic and economic position. It is a member of the OECD and of NAFTA, in addition to its close links with the other Latin American and Caribbean countries. It maintains good relations with both industrialised and developing countries; relations with the United States are particularly close, though a number of bilateral environmental problems exist.

Mexico supports international environmental policies based on the *principles of equity, common but differentiated responsibilities, and precaution*. It considers it essential to promote international actions that channel scientific, technical and financial resources to support sustainable development, particularly in regions that are unlikely to profit greatly from globalisation. At national level, Mexico seeks to implement

measures that are efficient, effective and equitable; it considers it important to enhance transparency and accountability. Mexico also seeks to *increase its environmental responsibility without compromising economic growth*. It has made commitments relating to a range of international environmental issues in many global, regional and bilateral agreements.

Mexico is a *party to over 100 international agreements* that concern the environment. It is implementing OECD Decisions and Recommendations. The new law on freedom of information is in line with the OECD Recommendation on environmental information, and the new register of toxics with the OECD Recommendation on the implementation of Pollutant Release and Transfer Registers (PRTRs). A bill on chemicals and hazardous waste seeks to incorporate the main elements of OECD legal acts in these areas. Mexico has been very active in international fora focusing on natural resources (*e.g.* CITES, CBD, Convention to Combat Desertification) (Box 5.1). However, Mexico is not yet a party to the following agreements:

- Convention on the Prevention of Major Industrial Accidents (ILO, Geneva, 1993);
- Protocol to the London Convention on Prevention of Marine Pollution by Dumping Waste and other Matter (London, 1996);
- Annexes III (Harmful Substances in Packaged Form) and IV (Sewage from Ships) of the Protocol on Prevention of Pollution by Ships MARPOL (London, 1978);
- Agreement on Conservation and Management of Straddling Fish Stocks and Highly Migrating Fish Stocks (New York, 1995);
- Revised Agreement on Tropical Timber (New York, 1994);
- Protocol on Specially Protected Areas and Wildlife (Kingston, 1990);
- Montreal (1997) and Beijing (1999) Amendments to the Montreal Protocol;
- Protocol related to Marine Pollution from Land-Based Activities in the Great Caribbean Region (Oranjestad, 1999).

Mexico is one of the few OECD countries to have *developed an international strategy for the period 2001-06* addressing international environmental issues in a timely, efficient and effective manner. This strategy aims to promote sustainable development nationally and internationally. It sets out a mission, a vision, and the main objectives and goals of Mexico's international environmental agenda. It also emphasises indicators of results and follow-up activities. So far, however, Mexico's international efforts appear to have been spread thin on many different activities, with few quantified targets relating to these activities actually adopted.

Much progress has been made with respect to international co-operation since the *1998 OECD Environmental Performance Review of Mexico*. Nevertheless, the



following summary assessment shows that some of its recommendations are still valid and need to be addressed, and that overall Mexico finds it *difficult to finance activities* relating to its international environmental agenda and to carry out its international responsibilities (Table 9.1).

## 2. Multilateral Environmental Co-operation

### 2.1 Climate change

Mexico ratified the UN Framework Convention on Climate Change (UNFCCC) in 1993 and undertook to fulfil the commitments agreed by developing countries. It was the *first NAFTA member to ratify the Kyoto Protocol* (in 2000). Canada, an Annex 1 country, ratified the Protocol in 2002. Mexico submitted its second National Communication to the UNFCCC Conference of the Parties in 2001; the first was submitted in 1997. Mexico is well aware of its vulnerability to climate change. It considers that all countries should ratify the Kyoto Protocol.

An *Inter-ministerial Committee on Climate Change* was created in 1997. A national climate change strategy issued in 2000 was not implemented. This strategy would have aimed at reducing the rate of increase in GHG emissions without affecting economic growth, with various options being proposed. Along the same lines, a new climate change strategy is under preparation.

Mexico is *the world's ninth greatest GHG emitter*. It is responsible for 3% of the world's total GHG emissions. In 2000 its contribution of CO<sub>2</sub> emissions was 370 million tonnes (3.8 tonnes per person), far below the OECD average of 11.2 tonnes per person and less than the world average (4.02 tonnes per person) (Figure 2.1). In terms of CO<sub>2</sub> intensity, Mexico emits 0.45 tonnes per USD 1 000 GDP, below the OECD average of 0.51 tonnes per USD 1 000. In the period 1990-2000 its CO<sub>2</sub> emissions increased by 24%, below the rate of increase in several other OECD countries (e.g. Korea, New Zealand, Ireland, Portugal, Spain and Turkey). This increase is linked to increased energy consumption (24%) and growth in GDP (40%). CO<sub>2</sub> emissions from electricity production grew by 51% between 1990 and 1998 (despite the fuel switch to natural gas), reflecting rapid growth in demand. CO<sub>2</sub> emissions from industry increased by 11%, and those from transport by 20%. In the energy sector Mexico was the first non-industrialised country to create an inventory of its GHG emissions. This inventory is being updated.

Mexico's *major greenhouse gases* are CO<sub>2</sub> (68%), CH<sub>4</sub> (29%) and N<sub>2</sub>O (3%) (Table 9.2). The main CO<sub>2</sub> emission sources are energy combustion (89%) and

Table 9.1 Follow-up on 1998 OECD Recommendations

Recommendation	Response
1. Continue to develop a more <i>proactive position</i> , reflecting OECD membership, on <i>global environmental issues</i> .	Mexico has participated in all activities related to climate change, searching for pragmatic alternatives and promoting better understanding of the issues, to find solutions acceptable among parties. It has been very active on fishery issues and actively participates in several international fora to strengthen co-operation initiatives on sustainable development and natural resource issues.
2. Seek <i>additional resources</i> to make it possible to pursue international co-operation on environmental protection and nature conservation.	At the national level, a reduction of financial resources for international co-operation prevented implementation of a number of co-operative activities. The number of staff at SEMARNAT devoted to international activities has remained stable over the last ten years despite rapid development of international activities. At the international level, Mexico obtained external credits to support 12 projects on biodiversity, climate change and international waters totalling USD 17.6 million. USD 18.2 million from GEF was used for other regional programmes. The North American Development Bank (NADB) recently agreed to loan Mexico USD 40 million for activities related to water conservation. Additional external financial support for international co-operative activities has been provided by the Inter-American Development Bank, the North American Wetland Conservation Center, the US Agency for International Aid and the US Environmental Protection Agency (USEPA), as well as development agencies in Germany, Japan and Spain. Special support has been given biodiversity, climate change and ODS initiatives. The assistance provided by external sources is highly appreciated and has had measurable effects. However, as stated by SEMARNAT, it is "modest in relation to the magnitude of the problems to be solved."
3. Further develop institutional capacity and <i>inter-ministerial co-operation in border areas</i> to solve transboundary environmental problems caused by economic development.	The development of a plan for sustainable development of the northern border and the creation of an inter-ministerial commission for the border regions are significant steps forward. Mexico has actively participated in various co-operative systems in place at Federal and state levels. Several projects have been aimed at institutional strengthening. Better communication has been established, but overall many bilateral problems have not been solved.
4. Establish <i>long-term financing plans</i> with state and local authorities to address water management issues arising along the northern border.	Progress on the preparation of financing plans has taken place, as there is now a line in the Federal budget for the northern border (USD 6 million). However, Mexico faces difficulties providing long-term commitments to finance environmental infrastructure: an integrated plan outlining the financial commitments of each ministry, agency and state in relation to the northern border is not yet available; projections and calculations without firm commitments are available.
5. Seek additional international funding to protect the country's rich <i>biodiversity</i> .	Mexico has received international support for this activity. The World Bank has granted USD 40 million to fund five years of the Forest Resources Conservation and Sustainable Management Project in Mexico and six years of the Aquaculture Development Project in Mexico. Negotiations have also been initiated with GEF to fund projects on forestry policy and a conservation strategy. This fund has contributed USD 10 million to finance the action plan to protect the Mesoamerican reef system. Further international support would be needed to address biodiversity issues with no direct economic implications.

Table 9.1 Follow-up on 1998 OECD Recommendations (*cont.*)

Recommendation	Response
6. Implement a national strategy to <i>combat climate change</i> , including clear targets, and select effective regulatory and economic measures to reduce growth in CO <sub>2</sub> emissions.	A national strategy on climate change was developed by the Inter-ministerial Committee on Climate Change in 1998-99. The public was consulted in 1999. The strategy was published in 2000 but not implemented by the new government. Objectives are not quantified (e.g. "to reduce the growth rate of GHG emissions") and there are few economic measures to reduce CO <sub>2</sub> emissions. A new strategy is forthcoming. Use of economic instruments beyond subsidies is not foreseen.
7. Integrate more closely the activities of various ministries concerning marine environmental issues, so as to better protect coastal areas and the <i>marine environment</i> while developing economic activities linked to the sea (tourism, fisheries, offshore oil industry, maritime transport).	No evidence was provided that this recommendation has been acted upon. Competence for fisheries was transferred from the ministry responsible for environment to the ministry responsible for agriculture.
8. Invest in <i>port reception facilities</i> in order to ratify the related MARPOL Annex V (garbage from ships).	Mexico ratified this Annex in July 1998.

Source: OECD.

industrial processes (11%). CO<sub>2</sub> emissions from fuel combustion mainly originate from energy production and transport (Table 9.3). The main sources of emissions of methane are fugitive emissions in the oil industry (32%), agriculture (26%) and waste (42%). Nitrous oxide emissions are mainly from agriculture (76%) and transport (19%).

Under the Kyoto Protocol, Mexico (which is not an Annex 1 country) *is not obligated to reduce its GHG emissions* according to a specific target or timeframe. However, exceeding its international obligations, it has adopted various measures to reduce increases in those emissions. In the energy sector itself, energy savings amount to a reduction of 6 million tonnes of CO<sub>2</sub> per year; in the energy end-use sectors, energy efficiency gains have been equivalent to a reduction of 7 million tonnes of CO<sub>2</sub>. Other initiatives that have produced important energy savings are implementation of daylight

Table 9.2 Emissions of greenhouse gases, 1998

(kt of CO<sub>2</sub> equivalent)

Sector	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total GHG
Energy	350 400	55 100	3 550	409 100
Combustion				
Transport	104 600	500	2 800	107 900
Industry	62 400	60	210	62 700
Energy industry	47 300	20	40	47 400
Electric generation	101 400	20	180	101 600
Residential use	22 600	1 090	310	24 000
Commercial use	6 400	0	0	6 400
Agricultural use	5 700	0	10	5 700
Fugitive emissions (oil industry)	0	53 400	0	53 400
Industrial process	44 300	100	0	44 400
Agriculture	0	43 100	11 400	54 500
Waste	0	70 600	0	70 600
Total	394 700	168 900	15 000	578 600

Source: SEMARNAT.

Table 9.3 CO<sub>2</sub> emissions<sup>a</sup> from fuel combustion, 1990-2000

(% of total emissions)

Mexico	Oil		Natural Gas		Coal and coal products		Total <sup>a</sup>		Change (%)
	1990	2000	1990	2000	1990	2000	1990	2000	
Total <sup>a</sup>	77.8	71.2	17.8	21.3	4.4	7.5	100.0	100.0	23.1
Energy production and transformation	33.8	38.6	40.2	69.0	42.8	77.4	35.3	48.0	67.4
of which: public electricity and heat production	22.7	29.3	15.4	24.3	41.4	63.7	22.2	30.8	70.6
Manufacturing industries and construction	16.6	10.9	56.2	28.9	57.2	22.6	25.4	15.6	-24.4
Transport	38.0	39.2	-	-	-	-	29.5	27.9	16.3
of which: road transport	37.1	38.5	-	-	-	-	28.8	27.4	17.1
Residential	7.6	7.2	3.6	2.1	-	-	6.6	5.6	4.1
Other	4.0	4.1	-	-	-	-	3.1	2.9	14.8

a) Total CO<sub>2</sub> emissions for Mexico reached 292 Mt of CO<sub>2</sub> in 1990, 359 Mt of CO<sub>2</sub> in 2000.

Source: IEA-OECD.

saving, the programme of energy saving in public buildings, and PEMEX's energy saving programme. In the domestic sector new home insulation standards have been adopted, use of more energy-efficient light bulbs is encouraged, and air conditioners and refrigerators have been improved. Areas for further progress include fuel substitution by natural gas, cogeneration and use of renewable energy.

The major *result of the energy saving programme* is a reduction of 18 million tonnes of CO<sub>2</sub> emissions (11 through technical standards, 4.3 from energy saving in industry and 2.5 from daylight saving) out of 350 million tonnes of total CO<sub>2</sub> emissions linked to combustion (Table 9.2). CO<sub>2</sub> sinks could be enhanced through conserving forest ecosystems (e.g. avoiding fires and deforestation, promoting reforestation). In the period 1997-2000 such actions permitted the capture of 3.3 million tonnes of carbon. However, overall benefits cannot be achieved because total forested area is decreasing and the tropical forest is at risk.

Mexico has the potential to *develop renewable energy*. Already 3.1% of electricity is generated by geothermal sources. Biomass and hydroelectric sources provide 7% of total energy. Use of solar and wind sources (e.g. wind farms) has not yet been widely developed.

A number of *mitigation measures* would be cost-effective. However, such measures often require sizeable initial capital investment and take time to be implemented. By 2010 it would be possible, theoretically, to reduce GHG emissions by 262 million tonnes in the forest sector and by 131 million tonnes in the energy sector.

In carrying out its climate change programme, Mexico has benefited *from external assistance* (e.g. from the USEPA, World Bank, UNDP, GEF). Joint implementation activities have been carried out with Norway (more energy-efficient light bulbs), the United States (renewable energy network) and the United Kingdom (carbon sinks in tropical forests). Mexico has supported the creation of a prototype carbon fund. Other joint activities could be foreseen with countries that provide needed capital investment.

Mexico *does not yet have a national strategy to reduce GHG emissions* with measurable targets such as limiting CO<sub>2</sub> emission increases to a specific share of growth in energy use or in GDP. Significant measures to limit transport sector growth are lacking, and cost-effective measures have not been implemented. Steps could be taken to "sell" carbon sequestration schemes to other OECD countries. A new programme on energy and the environment should be presented in 2003. A government climate change agency will soon be in operation.

## 2.2 Ozone depleting substances

Mexico ratified the *Montreal Protocol* in 1989. It adopted the London (1990) and Copenhagen (1992) amendments. Adoption of the Montreal (1997) and Beijing (1999) amendments is still under consideration.

Mexico was the *first non-industrialised country to present an accelerated schedule for phasing out ozone depleting substances* (many years before other developing countries), reaching 82% reduction in 2001. In 1998 it implemented a manufacturing standard for household and commercial refrigerators. Today 100% of household refrigeration equipment, 95% of commercial refrigeration equipment, 80% of solvents and 75% of polyurethane foam manufactured in Mexico are CFC free. Import of refrigeration equipment using CFCs is prohibited. Mexico has introduced voluntary reconversion agreements with industries that use ODS, strict control measures on trade in ODS, and training programmes and subsidies to ease conversion. External assistance has been provided by UNDP, UNIDO, USEPA and the World Bank (52 projects totalling USD 28.9 million).

In 1998 Mexican consumption of CFCs and halons was 34% and 30%, respectively, of the amounts consumed in 1989 (Table 9.4). Consumption of methyl chloroform, however, is increasing considerably. CFC production has fallen but is still significant. In 2000 *Mexico was the world's fifth largest CFC producer*.

As a result of price increases in prohibited CFCs, *illegal trade* has developed in these substances (as well as halons) for sale to industrialised countries. Measures are being taken to strengthen enforcement of measures in Mexico and other Latin American countries against illegal trade. Implementing the Montreal amendment would require Mexico to establish a licensing system for ODS imports and exports. In 1995 a North American CFC Enforcement Initiative was initiated to combat illegal exports of ODS to the United States. Illegal trade in CFCs produced for use in developing countries often involves re-exporting these substances to developed countries labelled as recycled CFCs.

## 2.3 Pollution control agreements

Mexico favours the creation of a *single international regime for integrated control of chemicals and of hazardous waste life cycles* (i.e. integration of the Basel, Stockholm and Rotterdam Conventions). In the framework of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Mexico has participated actively in the design of a Strategic Plan for the next ten years as well as an analysis of the Protocol on Liability and Compensation. To promote integrated hazardous waste management, a bill to regulate generation,

management and disposal of all types of wastes was approved by the House of Representatives in 2002; it is under examination by the Senate.

Mexico has signed the *Stockholm Convention on Persistent Organic Pollutants* (POPs). Approval by the Senate is required before this convention can be ratified. An Inter-ministerial Committee will co-ordinate elaboration of a National Action Plan. The first activities to be developed will be supported by GEF (with at least USD 500 000); an implementing agency will be chosen to fulfil commitments derived from the POPs Convention. In 2001 Mexico announced its intention to ratify the Rotterdam Convention on the Prior Informed Consent Procedure (PIC) for Certain Hazardous Chemicals and Pesticides in International Trade.

Table 9.4 Ozone depleting substances

Substance	National voluntary target	Target date	Consumption (tonnes)			International target
			1989	At target date	1998	
CFC11	Freeze at 1989 level	1993	2 933	2 874	752	} 50% reduction in 2005 from 1999 level
CFC12	20% reduction	1994	6 001	5 340	2 704	
CFC113	60% reduction	1995	1 249	634	13	
CFC114	70% reduction	1997	4	2	0	
CFC115	80% reduction	1998	160	27.5	27.5	
Total CFCs			10 347		3 496.5	
Halon 1211	90% reduction	2000	203.6	–	67.6	} 50% reduction in 2005 from 2002 level
Halon 1301	90% reduction	2000	28.2	–	1.0	
Total halons			231.8		68.6	
Carbon tetrachloride	90% reduction	2000	3 898	–	0	100% reduction in 2010
Methyl chloroform	90% reduction	2000	13.5	–	763.8	30% reduction in 2005/2003
Methyl bromide	Freeze at 1996-98 level (1 713 t)	2002	–	–	2 012	20% reduction in 2005/2002

Source: INEGI.

## 2.4 Marine resources and coastal areas

### Fisheries

Mexico has a very long coastline (11 500 kilometres) and a large *Exclusive Economic Zone* (3 million km<sup>2</sup>). Tropical and subtropical marine currents favour the

development of a variety of mammals and fishery resources (Box 9.1). Lagoons and coastal waters (1.6 million hectares) are highly suitable for aquaculture. Total *fishery production* at the end of the 1990s was around 1.2 million tonnes, of which some 160 000 tonnes from aquaculture (oysters, shrimp, two-banded bream). This is below the level reached in the 1980s (1.4 million tonnes). The *trade balance of the fishery sector* is positive (USD 516 million). Difficulties have arisen over exports to the United States, as fishing practices may conflict with measures to protect dolphins, marine turtles, whales and other animals. The shrimp industry faces serious difficulties: the length of shrimp fishing moratoria is increasing, having reached six months per year. The Mexican Navy has intervened to halt excessive trawling in the Sea of Cortez (Gulf of California), which threatens the vaquita porpoise. Fewer than 600 vaquitas may be left. Other species at risk include abalone, sea urchin, grouper, sea cucumber and whelk.

In 1999 *key regulations on fishing* were published to encourage sustainable development of aquatic fauna and flora. In December 2000 fisheries management was transferred from the ministry responsible for the environment to the ministry responsible for agriculture. However, SEMARNAT retained competence for elaborating fishing equipment standards to protect natural resources. Mexico *co-operates on fisheries* within the auspices of APEC, FAO, OECD, the Latin American Organisation for Fisheries Development, the Inter-American Tropical Tuna Commission and the International Commission for the Conservation of Atlantic Tunas. It has supported adoption of the 1995 FAO Code of Conduct for Responsible Fisheries and the 1995 UN Convention on straddling fish stocks, but has not yet ratified the latter.

### *Coastal areas*

Mexico co-operates with the United States on programmes for *protecting marine ecosystems* in California and on conservation of the fishery resource in the Pacific Ocean and Gulf of Mexico. It supports actions carried out with the Association of Caribbean States to obtain international recognition of the Caribbean Sea as a Special Area in the context of sustainable development of Caribbean countries.

Within the framework of the environmental programme of the Caribbean countries, Mexico is reviewing activities under the Protocol concerning *Specially Protected Areas and Wildlife* (SPAW) in the Wider Caribbean Region. It participated in negotiating the Protocol concerning Prevention of Marine Pollution from Land-based Sources (Oranjestad, 1999). Mexico is not yet a party to these agreements; it is considering whether to sign the Convention for Co-operation in the Protection and Sustainable Development of the Marine and Coastal Environment of the North-East Pacific (Antigua, 2002). Under Mexico's General Law on Wildlife, 26 natural areas containing valuable marine resources are protected. Work has been



## Box 9.1 Protection of fauna: whales, dolphins, turtles

### *Whaling*

In 2002 Mexico created the *world's largest whale sanctuary*, protecting 21 different cetaceous species (three million square kilometres in the Pacific and Atlantic Oceans and the Caribbean Sea). In 2001 and 2002 the government organised the First and Second National Fora on Whale Protection, in which a clear consensus emerged concerning Mexico's position within the International Whaling Commission (IWC).

*At the international level* Mexico has supported the creation of two other marine sanctuaries: the South Pacific Sanctuary (originally proposed by Australia and supported by Mexico, New Zealand, the United Kingdom and the United States) and the South Atlantic Sanctuary (a Brazilian proposal also supported by these countries). The sanctuaries will come into existence once the proposal is approved with a minimum of 75% of the vote.

Mexico has succeeded in having the small cetaceans included on the IWC list of endangered species. They include the *Gulf of California porpoise* (vaquita), which lives in the Sea of Cortes (930 000 hectare reserve). It has voted against changing the designation of some mammal species from Annex 1 to Annex 2 of the CITES Convention. Mexico opposes commercial whaling, as well as scientific whaling research (SWR) if translated into commercial whaling. Mexico considers that SWR should be firmly based on final scientific knowledge and restricted to the lowest numbers. Mexico also opposes a Revised Management Scheme (RMS) unless it includes a clear and open whale management process, genetic registries and qualified personnel aboard whaling ships.

### *Protection of the whale reproduction area*

The El Vizcaino Biosphere Reserve in the state of Baja California is protected under the World Heritage Convention. It is a reproduction area for *grey whales*, which live mainly in the Bering and Beaufort Seas and risked becoming extinct in the mid 20th century. In the El Vizcaino reserve the grey whale population increased from 17 674 in 1992-93 to 26 635 in 1997-98. In 1999 a UNESCO mission of experts investigated risks associated with the development of salt works at San Ignaciaco in the reserve. The government endorsed their findings and in March 2000 decided not to proceed with this project.

### *Protection of dolphins*

In the past, Mexican tuna fishing practices have been very harmful to dolphins. Following a change in fishing practices, the total number of dolphins killed fell from 9 562 in 1992 to 946 in 1998. The incidental dolphin catch with the United States led to a change in the US Marine Mammal Protection Act in 1997 and publication in 2000 of regulations for implementing this Act. A nine-year *embargo on imports of*

### Box 9.1 Protection of fauna: whales, dolphins, turtles (*cont.*)

*Mexican tuna was lifted* in 2000 after Mexico demonstrated that its fishing practices (large nets) did not cause dolphin deaths and allowed observers aboard its tuna fishing boats (the only case in the world of this being allowed). The Mexican government is implementing the International Programme Agreement for Dolphin Conservation (1998), which entered into force in 1999, and has joined the Inter-American Tropical Tuna Commission.

In April 2002 an Appeals Court in the US refused to allow tuna imported from Mexico to be labelled “dolphin safe”, making it nearly impossible for Mexican tuna to enter the US market. The Court found that the US government had not carried out scientific studies showing whether *dolphins were stressed* or otherwise harmed by being repeatedly captured and released. Recently a scientific report was released in the US; as a result of bilateral discussions on this topic, Mexican tuna exports to the US have resumed. In the EU the prohibition on setting nets on dolphins was abrogated in 1999, following implementation of the International Dolphin Conservation Programme (1998).

#### *Marine turtles*

Seven of the world’s eight species of sea turtles are found in *high numbers and densities in Mexico*. There are 80 research stations along the Mexican coast to protect females, eggs and hatchlings. A ban is in effect on all turtle products. Protection of nesting beaches has improved. The number of eggs increased from 144 000 in 1992 to 487 000 in 1998, and the number of young turtles from 178 000 to 362 000.

Turtles, which migrate extensively, are threatened by shrimp fishing. Use of *turtle excluder devices (TED)* has been obligatory in Mexico since 1996 in the Pacific Ocean, and since 1997 in the Atlantic. The Interamerican Convention of the Protection and Conservation of Marine Turtles was ratified in 1999 by Mexico, the United States and seven other countries. Three more countries signed the Convention, which establishes standards for conservation of these endangered animals and their habitats. The Convention came into force in May 2001. It addresses conservation of sea turtle habitats, protection of nesting beaches, limits on intentional and accidental capture, and prohibition of international trade in sea turtles and their products. Under the Convention, each member party agrees to require the shrimp industry to use turtle excluder devices to allow sea turtles to escape shrimp nets and thus avoid drowning in them.

undertaken to reduce marine pollution from land-based sources (e.g. to reduce pollution from hotel sewage in coastal zones, increase recycling and water purification, and improve waste disposal systems).

Mexico does not have an inter-ministerial commission or other administrative body to *ensure proper co-ordination and integration of marine related activities* by ministries responsible for economic sectors (e.g. maritime transport, fisheries, tourism) or those with special marine related competences (e.g. environment, health, waste water disposal, emergency response). Protection of marine resources and coastal zones from land-based and sea-based pollution, as well as unsustainable development of tourism, would be better co-ordinated through an inter-ministerial presidential commission and independently of the economic actors that threaten marine resources. There are plans to better organise distribution of marine related competences; progress in this regard is particularly desirable in view of the importance to Mexico's economy of integrated management of coastal zones. Conflict has occurred between large-scale tourism development and the need to protect coastal areas (e.g. in Baja California, Quintana Roo in the area of Sian Ka'an). Many beaches are littered with waste from ships. Coastal areas are also affected by oil releases from ships and PEMEX activities.

## 2.5 *World Summit on Sustainable Development (WSSD)*

Mexico supports addressing financial, trade and social concerns horizontally, within a sustainable development policy framework. It played a leading role at the Monterrey Summit and in the preparation of the Monterrey Declaration, which preceded the Johannesburg Declaration. Mexico succeeded in having a Latin American Initiative on Sustainable Development undertaken by leaders of the region (building on the 2001 Platform of Action) taken into account in the WSSD Plan of Implementation. It also succeeded in the adoption of a mandate to negotiate an international regime on access and benefit-sharing arising from use of genetic resources.

Mexico supported adoption of the UN *Millennium Declaration* (2000) and of the *Johannesburg Declaration*, under which the proportion of people in the world without *access to safe water and to basic sanitation* should be halved by 2015. Meeting this commitment will require considerable progress to be made in rural areas. However, Mexico's current water resources strategy does not take these new goals into consideration. Unless significant financing is provided for water supply and basic sanitation (i.e. connection to sewerage or septic tanks, improved latrines), Mexico will probably be unable to meet the targets agreed at Johannesburg (Chapter 3). A greater financial contribution from municipalities and users, rather

than the Federal government, may be needed. In this case the price of drinking water is likely to increase substantially.

### 3. Bilateral and Regional Environmental Co-operation

#### 3.1 *Environmental co-operation between Mexico and the United States*

At least seven applicable international environmental agreements and seven bilateral co-operative arrangements are in force in Mexico. Most recent agreements concern protected border areas (1997), migrating birds (1997), forestry (1998), biodiversity and protected areas (2000), water supply and waste water treatment (2000) and electronic data exchange (2001). Official *institutional mechanisms concerning the northern border* include at least 13 international commissions and organisations such as the Border Environmental Co-operation Commission (BECC), the North American Commission for Environmental Co-operation, and the International Boundary and Water Commission. The latter contributes to implementing the agreement to share the waters of the Colorado River and the Rio Bravo/Rio Grande (Box 3.3).

Authorities from the ten states along the border have met periodically to exchange information and adopt co-operative agreements.

#### *The northern border*

Border XXI is a major bilateral instrument designed to help solve border issues (Box 9.2). An *action programme* is prepared mainly by USEPA and SEMARNAT. The previous programme (1996-2000) was more a framework for co-operation than a legislative programme or even an agreed set of actions. It had no appropriated funds or funded staff in the United States; activities were supported with resources available in various budgets. A new programme for the period 2002-12 is under preparation.

Co-operation in solving border issues has produced *significant results*. Access to drinking water on the Mexican side increased from 88% of the population in 1995 to 93% in 2000, access to sewerage from 69 to 75% and access to waste water treatment from 34 to 81%. Six “sister city” joint contingency plans for chemical emergency response have been developed (one in 1997, two in 1998, three in 2000). Discrepancies between hazardous waste tracking in the US and in Mexico have been resolved. Agreement has been reached on a consultative mechanism for exchanging information on potential siting of hazardous or radioactive waste disposal sites near the border. Emission inventories have been carried out in the Mexican cities of Ciudad Juárez, Mexicali and Tijuana. Public information and participation have greatly improved.

## Box 9.2 The northern border

### *Present conditions and trends*

Mexico's northern border extends for 3 153 kilometres, of which 2 019 kilometres along the Rio Bravo/Rio Grande. Some *11.8 million people* inhabit this region (6.3 million in the United States and 5.5 million in Mexico); 90% live in 14 paired but independent "sister cities." The population in 2020 is estimated at 19.4 million. Water shortage is increasing and serious water constraints are likely within a few years. About *80% of Mexican maquiladoras* are located along the border. There were approximately 1 700 in 1990 and 3 800 in 2001 (2 700 in border states). The maquiladoras in the region employ 800 000 people. Most trade between Mexico and the United States involves transport by truck; this traffic doubled between 1994 and 1999.

*Socio-economic conditions* on the US side of the border are characterised by higher population growth, higher unemployment, a greater proportion of poor persons and lower household income compared with the average in the south-western states. There are colonies (slums) with inadequate infrastructure (e.g. poor roads, drainage and water services) and many other signs of economically disadvantaged areas (e.g. environmental injustice, low educational level, poor public health). Along the border there are three times as many cases of hepatitis per 100 000 people as in the rest of the United States, as well as twice as many typhoid fever cases. The situation *on the Mexican side* is even worse, as average household income is about one-quarter that on the US side. Typhoid fever is nearly 100 times more frequent and amebiasis 600 times more frequent than on the US side.

The *Mexican and US governments take a very different view of environmental issues along the border*. In the US this is a relatively poor region, subject to many of the negative environmental impacts of growing international trade. Thus special measures are required to address its environmental problems. However, the northern border is one of Mexico's most dynamic regions. It is experiencing rapid demographic and industrial growth; it also has relatively high wages, relatively low unemployment, and better infrastructure than much of the rest of the country. Socio-economic problems are no worse in this region than in other regions to the south.

### *Financing environmental protection*

To finance environmental protection in the border region, the United States sees a need to provide extra funds to address socio-economic and health problems. In Mexico, by contrast, this region's environmental issues are not substantially different from those elsewhere. Both countries recognise that they have common but differentiated responsibilities related to the environment. They seek common solutions using differentiated financing. So far, *financing levels have been very different in the two countries*. Overall Mexican expenditure on solving bilateral environmental problems was USD 34 million per year in the period 1997-2000. It was much lower in 2002

### Box 9.2 The northern border (*cont.*)

(USD 6 million). On the US side, the USEPA provided USD 150 million per year in the period 1995-97; funding of border activities fell to USD 50 million in 1999. Total investment in 31 water or waste projects, when completed, will amount to USD 958 million, mainly coming from the USEPA. *The US Congress voted an average of USD 75 million per year to support investment in the region* (USD 550 million in 1995-2001). Major investment was made in the South Bay International Waste Water Treatment Plant, which became operational in 1998. This large plant treats half Tijuana's effluent to advanced primary standards. Delays have occurred in treating Tijuana's sewage to meet the US Clean Water Act's secondary treatment requirements. Waste water treatment plants in Ciudad Juárez have been built with financial support from the USEPA.

Up to now, *funding has been somewhat unpredictable*; overall there has been a reduction in available funds. The issue of financing needs to be addressed more clearly. The Environmental Infrastructure Funding Projections for 2001-05 are USD 1 032 million (Mexico) and USD 881 million (US). NADB loans may amount to USD 283 million and grants to USD 20 million. The US government would finance USD 623 million and the Mexican government USD 320 million; state and local governments would provide USD 667 million.

Past experience indicates that there is a *need to assign a budget* to Mexico's northern border environmental programme. To be successful, this programme should become a priority for SEMARNAT. In the future it is anticipated that many Mexican projects currently being financed by the Federal government could be managed and financed by state governments. However, such *devolution* would not necessarily facilitate international co-operation, as it would introduce additional actors in the relations between Federal governments.

Local governments are becoming more closely involved in bilateral activities. To achieve such results, nine bilateral working groups have met regularly.

However, *air pollution in the twin cities is worsening* and water is becoming scarce. Many health related problems and waste management issues have not been adequately addressed. According to an assessment by the Advisory Council for Sustainable Development, "the majority of programme activities have been more directed at containing damage to environmental and natural resources than to achieving sustainability."

Under the *North American Agreement on Environmental Co-operation* (NAAEC), the bilateral Border Environmental Co-operation Commission (BECC)

evaluates projects for financing through the North American Development Bank (NADB). NADB projects so far have been in the areas of waste water treatment, drinking water and solid waste management facilities. Such support could be extended to tyre recycling and hazardous waste management, as well as water conservation. Most NADB funding has been in the form of USEPA grants. Allocation of funds from the two countries' finance ministries has been very limited. The NADB loan portfolio is small (USD 11 million). The BECC technical support programme's annual budget is USD 10 million. SEMARNAT's strategy for 2001-06 includes assessment of existing international mechanisms for the border area (e.g. increasing the scope of competence, streamlining operations, decreasing paperwork and delays, increasing funding levels). Use could be made of the large sums accumulated in the NADB (USD 450 million). This might be facilitated by the USD 5 million fund for financing loan applications to the NADB following BECC certification.

SEMARNAT has formulated an Institutional Programme for the Northern Border incorporating concrete activities intended to increase sustainability in the region, especially with respect to water issues, biodiversity and ecosystem conservation, pollution with impacts on human health and ecosystems, and cross-cutting environmental justice, public participation and environmental education issues. In September 2002 a *new Border 2012 Programme* was submitted to the public in response to "grave environmental and public health problems". The programme has five goals (related to water, air, soil contamination, pesticides and accidental chemical releases). The goals for reducing water contamination include precise objectives such as increasing by 1.5 million the number of people connected to potable water and waste water collection and treatment systems. When adopted, the programme will aim to achieve concrete, measurable results to be monitored using environmental and public health indicators. The newly created Mexican Inter-ministerial Commission for Northern Border Affairs and the new 2001-06 Development Programme for the Northern Border will help obtain adequate financing. The President of Mexico has nominated a Special Envoy for the Northern Border to oversee programme development.

As a number of important issues remain to be adequately addressed, there is a need to develop and implement the *new Border 2012 programme*. The long-term programme should include precise targets and financing mechanisms to provide reasonably assured financial resources on both sides. Progress could also be made using decentralised approaches involving states, municipalities and citizens to a greater extent than heretofore.

### *Air pollution in the twin cities*

Along the northern border *air pollution is severe* in Ciudad Juárez, Mexicali and Tijuana, (Table 2.3). A monitoring programme partly financed by USEPA was carried out in the period 1995-2000.

High levels of CO, NO<sub>x</sub> and HC are *essentially caused by road transport*. PM<sub>10</sub> levels are high in Mexicali and Tijuana due to energy use, and in Mexicali and Ciudad Juárez due to unpaved roads. Between 1997 and 1999, CO and NO<sub>2</sub> levels increased in all three cities and ozone levels increased in Ciudad Juárez. In Mexicali in 1999, the average CO level was the same as that in Mexico City.

*Action programmes* have been adopted for Ciudad Juárez (1998-2002) and Mexicali and Tijuana (2000-05). They are aimed at meeting Mexican air quality standards in Ciudad Juárez and decreasing the number of days of exceedance by 75% in Tijuana and 50% in Mexicali. The measures contemplated are reducing all emissions from old vehicles, better vehicle inspection, better control of imported vehicles, reducing VOC emissions at service stations, use of oxygenated petrol, use of LPG in public transport, paving of roads, limiting fires in agricultural and garbage disposal, training of technicians, and public education. Special attention is being given to reducing truck waiting times at the border (and thus CO, NO<sub>x</sub> and HC emissions).

## 3.2 NACEC

The *North American Commission for Environmental Co-operation* (NACEC) was created in 1994 following the entry into force of the North American Agreement on Environmental Co-operation (NAAEC), which accompanied the North American Free Trade Agreement (NAFTA). The NACEC addresses regional environmental concerns, helps avoid potential trade and environment conflicts, and promotes effective enforcement of environmental law. Its operation and effectiveness between 1994 and 1997 were reviewed in 1998 by an Independent Review Committee, which concluded that it had already taken significant steps towards achieving its aims. In some important areas (e.g. management of chemicals, understanding continental air pollution pathways) NACEC leadership has catalysed on-the-ground action by the three NAFTA countries. In some other areas significant progress has also been made (e.g. management of transfrontier movements of hazardous waste, climate change, protection of marine ecosystems in Baja California, citizen access to mutually compatible pollutant release and transfer registers). Four North American action plans (for chlordane, DDT, mercury and PCBs) have been developed and are at various stages of implementation; two more are under development (Box 9.3).



### Box 9.3 Trade and the environment

Within the framework of the NACEC, studies have been carried out on the environmental effects of increased trade in North America. The *overall results are not conclusive*, as it is difficult to separate the impact of NAFTA from other factors. However, it is possible to identify an increase in air pollution as a result of use of trucks to carry goods across the border (which doubled over a period of ten years) as well as an increase in the propagation of exotic species outside their normal habitats. Hazardous waste imports and exports have increased. NAFTA's indirect effects on Mexican agriculture may include a shift to cultivation of a limited number of crops, more extensive use of GMOs and greater consumption of pesticides and fertilisers. New thermal power stations being built in northern Mexico to provide electricity across the border are a source of air pollution in both countries. The maquiladoras, which have proliferated since NAFTA entered into force, are a source of air pollution and soil contamination. However, many of these problems might exist even were it not for NAFTA.

#### *Transfrontier movement of hazardous waste*

*Mexico is a net importer of hazardous waste from the United States.* Waste imports increased from 158 kt in 1995 to 265 kt in 1999, mainly reflecting recycling of metals and batteries. Export of waste also takes place because the maquiladoras must return their waste to the US. The flow of waste increased from 73 kt in 1996 to over 98 kt in 1999, mostly from the states of Baja California, Chihuahua and Tamaulipas. Certain types of hazardous waste are exported because treatment facilities are not available in Mexico. Export of this waste increased from 5.7 kt in 1995 to 21.8 kt in 1998.

*Import of hazardous waste into Mexico for final disposal is very restricted since there are few facilities (one exists in Monterey).* Import of domestic waste for disposal in sanitary landfills is hampered by the small number of such landfills in Mexico (five, compared with 27 in the US). There are many cases of illegal dumping of hazardous waste in the Mexican border region due to the general lack of hazardous waste facilities in Mexico and to illegal disposal of domestic waste.

As a result of co-operation with US authorities, Mexico is using a *hazardous waste tracking system (SIRREP)* to better control waste movements across the border. This system operates in conjunction with the HAZTRACK system developed in the US by USEPA. There have not yet been any reports of illegal movements of hazardous waste across the northern border.

#### *Protection of international investment*

*Chapter 11 of NAFTA is designed to protect investors against "expropriations" by foreign governments.* In recent years Mexico had been involved in two significant decisions concerning whether environmental protection had been invoked as a form of unlawful expropriation. In the Azinian case a US national's concession contract for a waste disposal operation was cancelled by Mexican authorities to protect the environment.

### Box 9.3 Trade and the environment (*cont.*)

The contract holder's claim, for over USD 10 million, was dismissed. In the Metalclad case a hazardous waste disposal facility was denied an operating permit by the state of San Luis Potosi and the city of Guadalcázar, which declared that this facility would contaminate groundwater supply and affect an ecological zone. The Mexican government was obliged by a tribunal to pay USD 16.6 million in compensation to Metalclad. SEMARNAT now systematically consults municipalities before granting permits.

No progress has been made with respect to the legally binding *agreement on transboundary environmental impact assessment* recommended to the three countries in 1998 by the NACEC Council of Ministers. At issue is the scope of the agreement, i.e. whether it would cover projects under the competence of state authorities in the United States.

In June 2001 the NACEC Council established a *long-term strategic framework* for its work, reaffirming the commitment to regional environmental co-operation in the context of closer economic, environmental and social linkages. In 2002 the Council requested that working relations with the International Joint Commission and the International Boundary and Water Commission be strengthened.

The NACEC continues to operate with the same annual *budget* (USD 9 million) it had in 1994. The main areas of expenditure in 2002 were pollution and health (46%), environment, economics and trade (22%), biodiversity (18%), and law and policy (14%). In addition, a small North American Fund for Environmental Co-operation supporting various community projects related to the NAAEC financed 142 projects at up to USD 25 000 each, for a total of USD 5.4 million, between 1995 and 2000 (Box 9.3).

The NAAEC includes a mechanism for *citizen submissions* when it appears that a government has failed to enforce its own environmental laws. Citizens have submitted a number of claims against the Mexican government as well as those of the United States and Canada. Factual records of findings have already been issued by the NACEC on the Cozumel (1997) and the Metales y sus Derivados (2002) cases. On the Caribbean island of Cozumel a proposed development was allowed to go ahead, as risks to coral reefs were not considered serious. Concerning the Metales y sus Derivados maquiladora (battery recycling plant and lead smelter), complaints centred on the

return to the US of 6 000 tonnes of hazardous waste generated at an abandoned lead smelter. Factual records are likely to be issued on several other cases: Aquanova (mangrove destruction by shrimp farming), Cytrar II and Molymex II (improper disposal of hazardous waste), Rio Magdalena (municipal waste water discharge to the Magdalena River) and Tarahumara (human rights in indigenous communities).

While this *procedure* can help the countries concerned improve their environmental management, it is not the same thing as a court investigation. Parties are free to decide on follow-up once the factual record has been published. Citizen submissions are particularly useful, in that Mexican citizens would otherwise have very limited access to the courts for the purpose of defending a public interest.

### 3.3 Other bilateral and regional environmental co-operation

#### *Bilateral co-operation*

Co-operation with *Guatemala* was strengthened with the signing of a general agreement on environmental protection and biodiversity conservation in 1997. A joint work programme on air, biodiversity, ecotourism and water was adopted in 2002. Twenty-four bilateral co-operation projects were implemented over five years, including study tours, training courses, seminars and information exchange. A bilateral working group on natural resources has been established. An agreement was signed with *Belize* in 1998 to construct, operate and maintain hydrological measurement stations on the Rio Hondo, the river separating the two countries.

Mexico carries out a large co-operative programme with *other Central American countries*, particularly Costa Rica, Cuba, Nicaragua (over 20 projects in five years), El Salvador, Honduras and Panama. General agreements on environmental co-operation were signed with Cuba in 1997 and Costa Rica in 2000. An agreement on environmental administration was signed with Panama in 2000. Mexico has also undertaken co-operative actions with *South American countries* including Bolivia, Brazil, Chile, Colombia, Ecuador, Peru and Venezuela.

Bilateral activities are also carried out *with OECD countries* other than the United States. Activities with *Canada* agreed upon in 1999 and 2001 covered issues such as climate change, water (Lake Chapala) and forest fires. Mexico agreed in 2001 to co-operate on reef protection with *Queensland* (Australia). *Japan* is Mexico's largest environmental donor: 13 co-operative projects are concerned with air pollution, integrated coastal management and forestry issues. *Germany* is the second largest donor: 24 projects have been carried out, and a new programme will focus on sustainable use of natural resources (including water pricing and waste management) and institutional capacity-building for comprehensive environmental management

(decentralisation). Mexico has also signed agreements with *France* (1998, 2002) to co-operate on hazardous waste and river basin management, and with *Spain* (1999) on conservation of grey whales. Co-operative activities have been carried out with Denmark, the Netherlands, Norway and the United Kingdom.

### *Multilateral co-operation*

In 1998 *Belize, Guatemala, Honduras and Mexico* agreed an action plan on conservation of the Mesoamerican reef system. Work was formally undertaken in 2001, with a contribution (USD 10.5 million) from GEF aimed at implementing the Tulum Declaration (1997). Mexico participates in a project carried out by the *Central American Commission for Environment and Development (CACED)* on the creation of a Mesoamerican biological corridor linking focal sites in protected natural areas of south-east Mexico and Central America. In 2001 it signed a memorandum of understanding with CACED on issues related to biodiversity use and requested inclusion as a Party. GEF Funding (USD 15 million over eight years) is expected. Mexico, together with *Colombia and Venezuela*, seeks to collect and disseminate educational materials concerned with environmental and natural resource issues.

Mexico participates in the *Ibero-American Forum of Environmental Ministers*, created in 2001, which adopted an Ibero-American Action Plan for the Sustainable Management of Water Resource Protection. It will host the Forum's 2003 session. As an active member of the *OECD*, Mexico has determined to promote effective implementation of the policy recommendations in the Environmental Strategy for the First Decade of the 21st Century and in the 2001 Ministerial Communiqué, "Towards Sustainable Development". It has hosted many OECD meetings, seminars and workshops. In 1997 Mexico signed an agreement on economic association with the *European Union*; this agreement could help strengthen co-operation between Mexico and the EU on environmental protection and fisheries, particularly concerning biosafety and food safety. Mexico will continue strengthening its linkages within the *Asian Pacific Economic Co-operation forum (APEC)* on sustainable development and natural resources issues. It contributed to the preparation of the Seven Principles on Sustainable Development and developed the California Aquarium for Endemic Species of the Sea of Cortes. In 2002 Mexico chaired APEC and hosted several ministerial and high-level meetings. It participates in a range of UN activities related to environmental protection, most notably *UN ECLAC* (Economic Commission for Latin America and the Caribbean), UNEP projects and UNCSD meetings.

### 3.4 Aid

#### *Donor country*

Mexico does not have an official aid programme, but it *provides assistance to many other Latin American countries* (e.g. through visits, seminars) as part of bilateral co-operation.

#### *Recipient country*

Reflecting its economic strength, Mexico receives *little official development* assistance. ODA, which was USD 390 million in 1995, fell to USD 15 million in 1998. It was USD 35 million in 1999. The main donors in the period 1998-99 were Germany (USD 15 million), France (USD 12 million) and the United States (USD 10 million); 45% of donor assistance is for education, health and other social purposes. On a per capita basis, ODA provided to Mexico is insignificant.

*Environmental assistance* from bilateral or multilateral sources represents only *a small part of total donor assistance*. However, numerous scientists and other experts from various countries support environmental activities in Mexico. Along the northern border, environmental assistance also takes the form of gifts of scientific equipment.

Mexico has succeeded in channelling significant World Bank and GEF funds for biodiversity conservation. *Foreign direct investment* increased very rapidly following the peso crisis, reaching USD 8.9 billion in 1997 and USD 13.8 billion in 1999. Further increases are likely, reflecting the new economic policy adopted by the Mexican government in 2001.

## **REFERENCES**

- I.A Selected environmental data
- I.B Selected economic data
- I.C Selected social data
- II.A Selected multilateral agreements (worldwide)
- II.B Selected multilateral agreements (regional)
- III. Abbreviations
- IV. Physical context
- V. Selected environmental events (1992-2002)
- VI. Selected environmental Web sites

## I.A: SELECTED ENVIRONMENTAL DATA (1)

	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	
<b>LAND</b>													
Total area (1000 km <sup>2</sup> )		9971	<b>1958</b>	9364	378	99	7713	270	84	31	79	43	338
Major protected areas (% of total area)	2	9.6	<b>8.2</b>	21.2	6.8	6.9	7.7	23.5	29.2	2.8	16.2	32.0	8.4
Nitrogenous fertiliser use (t/km <sup>2</sup> of arable land)		3.8	<b>4.9</b>	5.7	11.3	21.9	1.9	59.0	7.9	17.0	7.1	10.3	7.1
Pesticide use (t/km <sup>2</sup> of arable land)		0.07	<b>0.13</b>	0.20	1.50	1.29	0.06	0.82	0.24	1.15	0.13	0.12	0.05
<b>FOREST</b>													
Forest area (% of land area)		45.3	<b>33.4</b>	32.6	66.8	65.2	19.4	29.5	47.6	22.2	34.1	10.5	75.5
Use of forest resources (harvest/growth)		0.4	<b>0.2</b>	0.6	0.3	0.1	0.6	0.6	0.7	0.9	0.7	0.6	0.8
Tropical wood imports (USD/cap.)	3	1.6	<b>0.2</b>	2.2	10.7	6.1	4.0	3.4	0.4	24.2	0.3	3.8	1.4
<b>THREATENED SPECIES</b>													
Mammals (% of species known)		32.6	<b>33.2</b>	10.5	24.0	17.0	23.2	15.2	26.2	31.6	33.3	22.0	11.9
Birds (% of species known)		13.1	<b>16.9</b>	7.2	12.9	14.1	12.1	25.3	26.0	27.5	55.9	13.2	13.3
Fish (% of species known)		7.5	<b>5.7</b>	2.4	24.0	1.3	0.7	0.8	41.7	54.3	29.2	15.8	11.8
<b>WATER</b>													
Water withdrawal (% of gross annual availability)		1.6	<b>15.3</b>	19.0	20.5	33.9	6.2	0.6	4.2	45.1	11.5	12.3	2.1
Public waste water treatment (% of population served)		72	<b>24</b>	71	64	70	..	80	86	38	64	89	81
Fish catches (% of world catches)		1.0	<b>1.4</b>	5.0	5.3	1.9	0.2	0.6	-	-	-	1.6	0.2
<b>AIR</b>													
Emissions of sulphur oxides (kg/cap.)		82.3	<b>12.2</b>	62.7	6.9	24.7	95.8	11.6	5.0	20.1	25.8	5.2	14.6
(kg/1000 USD GDP)	4	3.1	<b>1.6</b>	2.0	0.3	2.1	4.1	0.7	0.2	0.9	2.0	0.2	0.6
% change (1990-late 1990s)		-22	..	-20	-3	-29	-4	20	-55	-37	-86	-85	-71
Emissions of nitrogen oxides (kg/cap.)		66.9	<b>12.0</b>	84.4	13.1	23.3	135.2	53.4	22.6	35.7	38.6	38.9	45.6
(kg/1000 USD GDP)	4	2.5	<b>1.6</b>	2.7	0.5	2.0	5.7	3.1	0.9	1.5	3.0	1.5	1.9
% change (1990-late 1990s)		-2	<b>18</b>	5	-	17	17	18	-9	16	-47	-25	-21
Emissions of carbon dioxide (t./cap.)	5	16.7	<b>3.8</b>	20.8	9.3	9.5	17.2	8.4	7.7	11.8	11.9	9.4	10.8
(t./1000 USD GDP)	4	0.62	<b>0.45</b>	0.63	0.38	0.68	0.71	0.45	0.32	0.48	0.91	0.37	0.45
% change (1990-2000)		22	<b>24</b>	18	13	88	26	38	9	14	-19	2	5
<b>WASTE GENERATED</b>													
Industrial waste (kg/1000 USD GDP)	4, 6	..	<b>50</b>	..	40	60	110	30	80	60	70	20	150
Municipal waste (kg/cap.)	7	350	<b>320</b>	760	410	360	690	380	560	550	330	660	460
Nuclear waste (t./Mtoe of TPES)	8	4.7	<b>0.1</b>	0.9	1.7	3.5	-	-	-	2.2	1.0	-	2.2
<b>PAC EXPENDITURE</b> (% of GDP)	9	1.1	<b>0.8</b>	1.6	1.4	1.7	0.8	..	1.7	0.9	2.0	0.9	1.1

.. not available. - nil or negligible. x data included under Belgium.

1) Data refer to the latest available year. They include provisional figures and Secretariat estimates.

Partial totals are underlined. Varying definitions can limit comparability across countries.

2) Data refer to IUCN categories I to VI; AUS, HUN, ITA, LUX, NOR, POL, TUR: national data.

3) Total imports of cork and wood from non-OECD tropical countries.

4) GDP at 1995 prices and purchasing power parities.

Source: OECD Environmental Data Compendium.

## OECD EPR / SECOND CYCLE

FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD*	OECD*
549	357	132	93	103	70	301	3	42	324	313	92	49	506	450	41	779	245	34777
10.1	26.9	2.6	9.1	9.5	0.9	9.1	6.5	11.6	7.6	9.7	6.6	21.6	8.4	8.1	18.0	3.8	20.4	12.4
12.4	15.3	7.3	6.4	9.8	43.1	7.6	x	30.5	11.4	6.0	3.9	4.5	5.8	6.9	11.8	5.1	16.0	6.2
0.51	0.26	0.29	0.10	-	0.25	0.44	0.63	0.98	0.04	0.06	0.50	0.21	0.18	0.06	0.33	0.13	0.52	<u>0.21</u>
31.4	30.1	22.8	18.9	1.3	8.8	23.3	34.4	9.2	39.2	29.7	37.9	42.2	32.3	73.5	31.7	26.9	10.5	33.9
0.7	0.4	0.6	0.6	-	0.6	0.3	0.5	0.6	0.5	0.6	0.8	0.5	0.5	0.7	0.5	0.4	0.7	<u>0.5</u>
6.8	1.8	2.8	0.1	2.8	11.2	7.1	-	15.6	3.6	0.3	17.9	0.1	6.2	2.2	0.6	0.5	2.7	4.0
19.7	36.7	37.9	71.1	-	6.5	40.7	51.6	15.6	3.4	14.6	17.3	22.2	21.2	23.1	34.2	22.2	21.9	..
14.3	29.2	13.0	18.8	34.7	21.8	18.4	50.0	27.1	7.7	14.7	13.7	14.4	14.1	19.2	42.6	6.7	6.4	..
7.5	68.2	24.3	32.1	-	33.3	31.8	27.9	82.1	-	9.6	18.6	23.8	29.4	7.9	44.7	9.9	11.1	..
16.9	22.3	12.1	4.7	0.1	2.3	32.1	3.7	5.2	0.7	16.9	15.1	1.4	28.6	1.5	4.8	17.0	20.7	11.4
77	91	56	32	33	73	63	95	98	73	55	46	49	48	86	96	17	95	<u>64</u>
0.6	0.2	0.1	-	2.1	0.3	0.3	-	0.5	2.9	0.2	0.2	-	1.0	0.4	-	0.5	0.8	27.4
14.2	10.1	51.4	58.5	33.4	42.2	16.0	7.1	5.7	6.4	39.1	37.6	33.2	40.4	8.0	3.9	33.0	19.9	32.7
0.7	0.4	3.7	5.7	1.3	1.7	0.8	0.2	0.2	0.2	4.3	2.4	3.3	2.4	0.4	0.1	5.3	1.0	1.5
-34	-84	7	-41	14	-14	-46	-79	-55	-46	-53	4	-67	-25	-48	-35	..	-68	-33
28.1	19.9	36.4	22.0	91.7	32.2	25.8	38.8	26.6	53.7	21.7	37.0	24.1	33.0	30.2	14.8	14.1	26.9	40.3
1.3	0.9	2.6	2.1	3.5	1.4	1.2	0.9	1.1	2.1	2.4	2.4	2.4	2.0	1.4	0.6	2.3	1.3	1.9
-12	-40	17	-7	-2	3	-24	-27	-27	6	-35	17	-43	6	-23	-32	48	-42	-4
6.0	10.0	8.0	5.5	7.7	11.0	7.4	18.4	10.9	7.7	7.7	6.0	6.6	7.2	5.3	5.6	3.1	9.2	11.2
0.26	0.43	0.54	0.49	0.29	0.40	0.34	0.43	0.44	0.29	0.85	0.36	0.63	0.40	0.23	0.20	0.49	0.44	0.51
-3	-15	23	-18	8	29	8	-23	11	21	-16	49	-36	35	-2	-5	49	-3	13
80	30	50	20	1	60	20	140	30	30	160	80	80	40	110	10	30	40	70
510	540	430	450	700	560	500	640	610	620	290	450	320	660	450	650	390	560	540
4.4	1.2	-	1.8	-	-	-	-	0.2	-	-	-	2.5	1.4	4.6	2.4	-	3.4	1.5
1.4	1.5	0.8	0.7	..	0.6	0.9	..	1.8	1.2	1.1	0.9	1.5	0.8	1.2	1.6	..	1.0	..

UKD: pesticides and threatened species: Great Britain; water withdrawal and public waste water treatment plants: England and Wales.

5) CO<sub>2</sub> from energy use only; international marine and aviation bunkers are excluded.

6) Waste from manufacturing industries.

7) CAN, NZL: household waste only.

8) Waste from spent fuel arising in nuclear power plants, in tonnes of heavy metal, per million tonnes of oil equivalent of total primary energy supply.

9) Household expenditure excluded; HUN, POL: investments only.



**I.B: SELECTED ECONOMIC DATA (1)**

	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK
<b>GROSS DOMESTIC PRODUCT</b>											
GDP, 2001 (billion USD at 1995 prices and PPPs)	842	<b>812</b>	9156	3131	674	474	72	198	258	139	138
% change (1990-2001)	33.4	<b>40.7</b>	39.1	14.6	87.1	44.0	32.6	27.0	24.6	3.8	26.9
per capita, 2001 (1000 USD/cap.)	27.1	<b>8.2</b>	32.1	24.6	14.2	24.5	18.7	24.4	25.1	13.6	25.8
Exports, 2001 (% of GDP)	43.3	<b>27.5</b>	10.3	10.4	42.9	22.4	36.6	52.2	86.8	71.4	45.3
<b>INDUSTRY</b> <span style="float: right;">2</span>											
Value added in industry (% of GDP)	31	<b>28</b>	25	32	44	26	27	33	28	41	27
Industrial production: % change (1990-2001)	36.0	<b>42.6</b>	41.6	-5.3	135.8	28.2	19.1	45.4	15.2	-18.6	41.9
<b>AGRICULTURE</b>											
Value added in agriculture (% of GDP)	3	<b>4</b>	2	1	5	4	8	2	1	4	3
Agricultural production: % change (1990-2001)	13.9	<b>33.4</b>	20.3	-9.2	26.2	28.0	29.0	4.3	17.2	..	2.3
Livestock population, 2001 (million head of sheep eq.)	103	<b>276</b>	786	55	27	295	102	18	30	14	25
<b>ENERGY</b>											
Total supply, 2000 (Mtoe)	251	<b>154</b>	2300	525	194	110	19	29	59	40	19
% change (1990-2000)	20.0	<b>23.8</b>	19.3	19.6	109.1	25.9	32.9	13.3	22.3	-14.8	7.7
Energy intensity, 2000 (toe/1000 USD GDP)	0.30	<b>0.19</b>	0.25	0.17	0.30	0.24	0.26	0.15	0.23	0.30	0.14
% change (1990-2000)	-8.7	<b>-12.2</b>	-13.2	3.9	15.1	-10.5	2.1	-9.8	-0.8	-15.0	-14.4
Structure of energy supply, 2000 (%)	4										
Solid fuels	12.0	<b>4.6</b>	23.6	17.9	21.7	43.1	5.4	12.5	14.2	52.2	20.7
Oil	34.7	<b>61.8</b>	38.7	50.5	53.6	33.2	33.9	41.1	40.4	19.1	45.0
Gas	29.4	<b>21.7</b>	23.7	12.3	8.8	17.5	27.1	22.7	22.7	18.2	22.9
Nuclear	7.5	<b>1.4</b>	9.1	16.0	14.7	..	..	..	21.3	8.6	..
Hydro, etc.	16.5	<b>10.4</b>	5.0	3.3	1.3	6.3	33.5	23.7	1.3	1.9	11.3
<b>ROAD TRANSPORT</b> <span style="float: right;">5</span>											
Road traffic volumes per capita, 1999 (1000 veh.-km/cap.)	9.4	<b>0.6</b>	15.8	6.0	1.8	9.3	8.0	7.8	8.7	3.1	8.4
Road vehicle stock, 1999 (10 000 vehicles)	1784	<b>1459</b>	21533	7003	1116	1199	231	485	512	373	223
% change (1990-1999)	7.8	<b>47.7</b>	14.1	24.0	228.9	22.7	25.2	31.3	20.2	43.7	17.9
per capita (veh./100 inh.)	59	<b>15</b>	79	55	24	63	61	60	50	36	42

.. not available. - nil or negligible. x data included under Belgium.

1) Data may include provisional figures and Secretariat estimates. Partial totals are underlined.

2) Value added: includes mining and quarrying, manufacturing, gas, electricity and water and construction;  
production: excludes construction.

Source: OECD Environmental Data Compendium.

## OECD EPR / SECOND CYCLE

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
124	1393	1921	165	117	8	112	1288	20	398	120	352	167	58	739	206	200	391	1293	24965
24.6	22.0	19.0	31.2	12.2	31.8	115.0	19.0	86.5	34.4	41.9	44.6	33.7	14.9	33.5	20.6	10.3	31.6	28.3	30.6
23.9	23.5	23.3	15.5	11.5	26.8	29.1	22.2	44.5	24.9	26.5	9.1	16.6	10.8	18.4	23.2	27.7	5.7	21.6	22.0
40.4	28.2	35.0	24.5	60.6	39.8	94.5	28.3	153.6	65.8	46.2	29.8	31.5	75.9	29.9	46.5	43.8	35.0	27.1	21.6
34	25	30	21	34	29	41	29	21	27	43	35	31	35	30	28	30	30	28	28
63.2	19.0	14.0	14.1	54.0	..	256.6	14.2	28.9	20.7	41.1	64.3	24.7	0.2	21.7	40.0	26.1	38.2	10.0	23.6
4	3	1	8	4	11	4	3	1	3	2	4	4	5	4	2	2	15	1	2
-13.7	2.0	-2.9	16.9	-13.0	9.1	10.3	7.2	x	-0.6	-15.2	-16.2	0.5	..	12.8	-9.3	-7.0	7.8	-11.2	..
9	164	124	21	13	1	54	71	x	46	9	57	19	7	96	13	12	117	117	2682
33	257	340	28	25	3	15	172	4	76	26	90	25	17	125	47	27	77	233	5317
15.0	13.8	-4.5	27.9	-12.9	63.5	39.8	13.1	3.1	14.0	19.4	-9.9	43.4	-19.5	37.9	1.7	6.1	46.4	9.5	17.8
0.27	0.19	0.18	0.18	0.22	0.46	0.14	0.14	0.20	0.19	0.22	0.26	0.15	0.31	0.17	0.23	0.13	0.18	0.18	0.22
-7.0	-4.8	-19.3	1.5	-19.4	27.8	-30.7	-3.2	-41.9	-14.2	-14.6	-37.0	9.3	-27.6	6.2	-14.6	-2.5	3.0	-12.7	-8.9
15.7	5.7	23.7	32.5	16.2	2.9	18.2	7.5	3.9	10.8	3.9	62.2	15.5	24.1	16.8	5.5	0.9	30.5	15.5	20.4
30.4	33.2	38.8	56.1	28.0	24.5	56.5	52.6	73.3	38.5	33.1	22.1	63.4	16.2	52.1	28.6	46.8	40.5	35.9	40.8
10.6	13.4	21.2	6.1	39.3	..	23.5	34.5	21.0	46.8	13.3	11.0	8.3	32.6	12.2	1.5	8.9	16.4	37.8	21.6
18.2	41.1	13.0	..	14.9	..	..	..	..	1.4	..	..	..	24.3	13.0	32.0	25.4	..	9.6	11.0
24.9	6.6	3.3	5.3	1.6	72.6	1.8	5.4	1.8	2.6	49.6	4.7	12.8	2.7	5.9	32.4	17.9	12.6	1.2	6.2
8.9	8.4	7.4	7.3	3.5	6.5	8.3	8.0	8.9	7.0	7.2	4.5	5.8	2.2	4.2	8.4	7.2	0.8	7.8	8.0
240	3309	4503	389	271	17	148	3545	31	675	225	1104	461	141	2048	424	376	548	2909	57281
7.6	16.3	20.7	54.1	12.7	27.3	55.8	15.9	40.2	17.7	16.0	72.6	109.5	..	41.8	7.9	13.9	132.1	15.4	21.7
46	56	55	37	27	62	39	61	71	43	51	29	46	26	52	48	53	8	49	51

3) Agriculture, forestry, hunting, fishery, etc.

4) Breakdown excludes electricity trade.

5) Refers to motor vehicles with four or more wheels, except for Italy, which include three-wheeled goods vehicles.

**I.C: SELECTED SOCIAL DATA (1)**

	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK	
<b>POPULATION</b>												
Total population, 2001 (100 000 inh.)	311	<b>991</b>	2850	1273	473	194	39	81	103	102	54	
% change (1990-2001)	12.2	<b>22.0</b>	14.0	3.0	10.4	13.6	14.5	5.3	3.2	-1.3	4.2	
Population density, 2001 (inh./km <sup>2</sup> )	3.1	<b>50.6</b>	30.4	336.9	476.7	2.5	14.3	96.9	336.9	129.6	124.4	
Ageing index, 2001 (over 64/under 15)	67.1	<b>17.0</b>	58.4	125.1	36.3	61.0	52.4	92.5	94.5	84.4	79.3	
<b>HEALTH</b>												
Women life expectancy at birth, 2000 (years)	81.7	<b>77.9</b>	79.4	84.6	79.2	82.0	80.8	81.2	80.8	78.5	79.0	
Infant mortality, 2000 (deaths /1 000 live births)	5.3	<b>24.9</b>	7.1	3.2	7.7	5.2	5.4	4.8	5.2	4.0	5.3	
Expenditure, 2000 (% of GDP)	9.3	<b>5.4</b>	13.0	7.8	5.9	8.3	8.2	8.0	8.7	7.2	8.4	
<b>INCOME AND POVERTY</b>												
GDP per capita, 2001 (1000 USD/cap.)	27.1	<b>8.2</b>	32.1	24.6	14.2	24.5	18.7	24.4	25.1	13.6	25.8	
Poverty (% pop. < 50% median income)	10.3	<b>21.9</b>	17.0	8.1	..	9.3	..	7.4	7.8	..	5.0	
Inequality (Gini levels)	2	28.5	<b>52.6</b>	34.4	26.0	..	30.5	25.6	26.1	27.2	..	21.7
Minimum to median wages, 2000	3	42.5	<b>21.1</b>	36.4	32.9	23.8	57.9	46.3	x	49.2	30.4	x
<b>EMPLOYMENT</b>												
Unemployment rate, 2001 (% of total labour force)	7.2	<b>2.5</b>	4.8	5.0	3.7	6.8	5.3	4.9	6.6	8.2	4.3	
Labour force participation rate, 2001 (% 15-64 year-olds)	77.5	<b>55.7</b>	66.9	78.2	65.3	75.4	66.0	76.9	64.0	71.5	80.1	
Employment in agriculture, 2001 (%)	4	2.9	<b>17.6</b>	2.4	4.9	10.3	4.9	9.1	5.7	2.2	4.8	3.3
<b>EDUCATION</b>												
Education, 2001 (% 25-64 year-olds)	5	81.9	<b>21.6</b>	87.7	83.1	68.0	58.9	75.7	75.7	58.5	86.2	80.2
Expenditure, 1999 (% of GDP)	6	6.6	<b>5.2</b>	6.5	4.7	6.8	5.8	..	6.3	5.5	4.7	6.7
<b>OFFICIAL DEVELOPMENT ASSISTANCE</b>												
ODA, 2001 (% of GNI)	7	0.22	..	0.11	0.23	..	0.25	0.25	0.29	0.37	..	1.03
ODA, 2001 (USD/cap.)	49	..	40	77	..	45	29	66	85	..	305	

.. not available. - nil or negligible. x not applicable.

1) Data may include provisional figures and Secretariat estimates. Partial totals are underlined.

2) Ranging from 0 (equal) to 100 (inequal) income distribution; figures relate to total disposable income (including all incomes, taxes and benefits) for the entire population.

3) Minimum wage as a percentage of median earnings including overtime pay and bonuses.

Source: OECD.

## OECD EPR / SECOND CYCLE

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
52	592	823	106	102	3	38	579	4	160	45	386	101	54	403	89	72	686	600	11367
4.2	4.4	3.7	5.3	-1.7	11.9	9.6	2.1	14.8	7.0	6.4	1.4	1.9	1.5	3.6	3.9	7.7	22.1	4.2	9.1
15.4	107.8	230.6	80.5	109.5	2.8	54.6	192.3	170.6	385.0	13.9	123.6	109.4	109.7	79.6	19.8	175.1	88.0	245.0	32.7
84.4	86.2	116.3	111.9	92.4	50.0	52.2	124.9	74.6	73.0	75.0	67.0	90.7	60.2	116.3	100.1	95.6	18.4	82.3	65.9
81.0	82.5	80.7	80.6	75.6	81.4	79.1	81.6	81.2	80.6	81.4	78.0	79.1	77.2	82.4	82.1	82.5	71.0	79.8	..
3.8	4.5	4.4	6.1	9.2	3.0	5.9	5.1	5.1	5.1	3.8	8.1	5.5	8.6	4.6	3.4	4.9	38.7	5.6	..
6.6	9.5	10.6	8.3	6.8	8.9	6.7	8.1	6.0	8.1	7.5	6.2	8.2	5.9	7.7	7.9	10.7	4.8	7.3	..
23.9	23.5	23.3	15.5	11.5	26.8	29.1	22.2	44.5	24.9	26.5	9.1	16.6	10.8	18.4	23.2	27.7	5.7	21.6	22.0
4.9	7.5	9.4	13.8	7.3	..	11.0	14.2	..	6.3	10.0	..	..	..	..	6.4	6.2	16.2	10.9	..
22.8	27.8	28.2	33.6	28.3	..	32.4	34.5	..	25.5	25.6	..	..	..	..	23.0	26.9	49.1	32.4	..
x	60.8	x	51.3	35.6	x	x	x	48.9	46.7	x	35.5	38.2	..	31.8	x	x	..	x	..
9.1	8.7	7.4	10.4	5.7	1.5	3.9	9.6	2.6	2.2	3.6	18.2	4.1	19.3	10.5	4.0	1.9	8.4	5.1	6.4
74.8	69.7	75.1	63.0	58.0	76.8	70.4	60.8	65.3	67.0	80.7	65.1	75.7	69.5	69.3	77.0	81.8	51.5	75.9	68.5
5.7	3.7	2.6	16.0	6.3	7.8	7.0	5.3	1.4	2.9	3.9	19.1	12.7	6.1	6.4	2.3	4.2	32.6	1.4	6.6
73.8	63.9	82.6	51.4	70.2	56.9	57.6	43.3	52.7	65.0	85.2	45.9	19.9	85.1	40.0	80.6	87.4	24.3	63.0	64.2
5.8	6.2	5.6	3.9	5.2	..	4.6	4.8	..	4.7	6.6	5.3	5.7	4.4	5.3	6.7	5.9	3.9	5.2	5.5
0.32	0.32	0.27	0.17	..	..	0.33	0.15	0.82	0.82	0.80	..	0.25	..	0.30	0.77	0.34	..	0.32	0.22
75	71	61	19	..	..	75	28	318	198	298	..	26	..	43	187	126	..	76	61

4) Civil employment in agriculture, forestry and fishing.

5) Upper secondary or higher education; OECD: average of rates.

6) Public and private expenditure on educational institutions; OECD: average of rates.

7) Official Development Assistance by Member countries of the OECD Development Assistance Committee.

## II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA	JPN
1946	Washington	Conv. - Regulation of whaling	Y	D	R	R R
1956	Washington	Protocol	Y	R	R	R R
1949	Geneva	Conv. - Road traffic	Y	R	R	R R
1954	London	Conv. - Prevention of pollution of the sea by oil	Y	R	R	R R
1971	London	Amendments to convention (protection of the Great Barrier Reef)		R		
1957	Brussels	Conv. - Limitation of the liability of owners of sea-going ships	Y	S		D
1979	Brussels	Protocol	Y			
1958	Geneva	Conv. - Fishing and conservation of the living resources of the high seas	Y	S	R	R
1960	Geneva	Conv. - Protection of workers against ionising radiations (ILO 115)	Y		R	R
1962	Brussels	Conv. - Liability of operators of nuclear ships				
1963	Vienna	Conv. - Civil liability for nuclear damage	Y		R	
1988	Vienna	Joint protocol relating to the application of the Vienna Convention and the Paris Convention	Y			
1997	Vienna	Protocol to amend the Vienna convention				
1963	Moscow	Treaty - Banning nuclear weapon tests in the atmosphere, in outer space and under water	Y	R	R	R R
1964	Copenhagen	Conv. - International council for the exploration of the sea	Y	R		R
1970	Copenhagen	Protocol	Y	R		R
1969	Brussels	Conv. - Intervention on the high seas in cases of oil pollution casualties (INTERVENTION)	Y		R	R R
1973	London	Protocol (pollution by substances other than oil)	Y		R	R
1969	Brussels	Conv. - Civil liability for oil pollution damage (CLC)	Y	R	D	S D
1976	London	Protocol	Y	R	R	R
1992	London	Protocol	Y	R	R	R
1971	Brussels	Conv. - International fund for compensation for oil pollution damage (FUND)	Y	D	D	S D
1976	London	Protocol	Y	R	R	R
1992	London	Protocol	Y	R	R	R
1971	Brussels	Conv. - Civil liability in maritime carriage of nuclear material	Y			
1971	London, Moscow, Washington	Conv. - Prohib. emplacement of nuclear and mass destruct. weapons on sea-bed, ocean floor and subsoil	Y	R	R	R R
1971	Ramsar	Conv. - Wetlands of international importance especially as waterfowl habitat	Y	R	R	R R
1982	Paris	Protocol	Y	R	R	R R
1987	Regina	Regina amendment	Y	R	R	R
1971	Geneva	Conv. - Protection against hazards of poisoning arising from benzene (ILO 136)	Y			
1972	London, Mexico, Moscow, Washington	Conv. - Prevention of marine pollution by dumping of wastes and other matter (LC)	Y	R	R	R R
1978		Amendments to Annexes (incineration at sea)	Y	R	R	R R
1978		Amendments to convention (settlement of disputes)		R		R R
1980		Amendments to Annexes (list of substances)	Y	R	R	R R
1996	London	Protocol to the Conv. - Prevention of marine poll. by dumping of wastes and other matter		R		S
1972	Geneva	Conv. - Protection of new varieties of plants (revised)	Y	R	R	R R
1978	Geneva	Amendments	Y	R	R	R R
1991	Geneva	Amendments	Y		R	R
1972	Geneva	Conv. - Safe container (CSC)	Y	R	R	R R
1972	London, Moscow, Washington	Conv. - International liability for damage caused by space objects	Y	R	R	R R
1972	Paris	Conv. - Protection of the world cultural and natural heritage	Y	R	R	R R
1973	Washington	Conv. - International trade in endangered species of wild fauna and flora (CITES)	Y	R	R	R R
1974	Geneva	Conv. - Prev. and control of occup. hazards caused by carcinog. subst. and agents (ILO 139)	Y			R
1976	London	Conv. - Limitation of liability for maritime claims (LLMC)	Y		R	R
1996	London	Amendment to convention		S		
1977	Geneva	Conv. - Protection of workers against occupational hazards in the working environment due to air pollution, noise and vibration (ILO 148)	Y			
1978	London	Protocol - Prevention of pollution from ships (MARPOL PROT)	Y	R	R	R R



## II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA	JPN
1978 London	Annex III	Y		R	R	
1978 London	Annex IV					R
1978 London	Annex V	Y	R	R	R	
1997 London	Annex VI					
1979 Bonn	Conv. - Conservation of migratory species of wild animals	Y				
1982 Montego Bay	Conv. - Law of the sea	Y	S	R		R
1994 New York	Agreem. - relating to the implementation of part XI of the convention	Y	S		S	R
1995 New York	Agreem. - Implementation of the provisions of the convention relating to the conservation and management of straddling fish stocks and highly migratory fish stocks	Y	R		R	S
1983 Geneva	Agreem. - Tropical timber	Y	R		R	R
1994 New York	Revised agreem. - Tropical timber	Y	R		R	R
1985 Vienna	Conv. - Protection of the ozone layer	Y	R	R	R	R
1987 Montreal	Protocol (substances that deplete the ozone layer)	Y	R	R	R	R
1990 London	Amendment to protocol	Y	R	R	R	R
1992 Copenhagen	Amendment to protocol	Y	R	R	R	R
1997 Montreal	Amendment to protocol	Y	R			
1999 Beijing	Amendment to protocol		R			
1986 Vienna	Conv. - Early notification of a nuclear accident	Y	R	R	R	R
1986 Vienna	Conv. - Assistance in the case of a nuclear accident or radiological emergency	Y	S	R	R	R
1989 Basel	Conv. - Control of transboundary movements of hazardous wastes and their disposal	Y	R	R	S	R
1995 Geneva	Amendment					
1999 Basel	Prot. - Liability and compensation for damage					
1989 London	Conv. - Salvage	Y	R	R	R	
1990 Geneva	Conv. - Safety in the use of chemicals at work (ILO 170)	Y		R		
1990 London	Conv. - Oil pollution preparedness, response and co-operation (OPRC)	Y	R	R	R	R
1992 Rio de Janeiro	Conv. - Biological diversity	Y	R	R	S	R
2000 Montreal	Prot. - Biosafety			S	S	
1992 New York	Conv. - Framework convention on climate change	Y	R	R	R	R
1997 Kyoto	Protocol			S	R	S
1993 Paris	Conv. - Prohibition of the development, production, stockpiling and use of chemical weapons and their destruction	Y	R	R	S	R
1993 Geneva	Conv. - Prevention of major industrial accidents (ILO 174)	Y				
1993	Agreem. - Promote compliance with international conservation and management measures by fishing vessels on the high seas		R	R	R	R
1994 Vienna	Conv. - Nuclear safety	Y	R	R	R	R
1994 Paris	Conv. - Combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa	Y	R	R	R	R
1995 Rome	Code of conduct on responsible fishing					
1996 London	Conv. - Liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea		S			
1997 Vienna	Conv. - Supplementary compensation for nuclear damage					S
1997 Vienna	Conv. - Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Y	R		S	
1997 New York	Conv. - Law of the non-navigational uses of international watercourses					
1998 Rotterdam	Conv. - Prior informed consent procedure for hazardous chemicals and pesticides (PIC)				S	S
2001 London	Conv. - Civil liability for bunker oil pollution damage					
2001 Stockholm	Conv. - Persistent organic pollutants		R	S	S	

Source: IUCN; OECD.

OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	EU
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
			R	R	R	R	R	R	R	R	R			R	R			R	R	R	R	R	R	R		R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
																S							S			
R				R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R
R	R	R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	R	R
S	R	R	S	S		S	S	S	S	S		R	S	S	S	S	R		S		S	S			R	S
R	R	R	R	R		R	R	R	R	R			R	R	R	R	R		R		R	R	R	R	R	R
R	R	R	R	R		R	R	R	R	R			R	R	R	R	R		R		R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
	R			R		R								R		R									R	
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	S	R	R	R	R	R	S	R	R	R	R	S	R	S	R	S	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
			R		R	R	R								R	R	R		R	R	R	R	R	R	R	R
						S	S	S			S				S							S	S		S	
R					R	S	R	R	R			R	R		R	R	S				S	R	R	R	R	R
R	R	R			R	R	R	R	R		R	R	R		R	R	S			R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
S		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
S	R	R	R	R	R	R	R	R	R	R	R	S	R	R	S	R	R	R	R	S	R	R	R	S	S	S
						S										R					R					
						S	S		S							S	S					S			S	
						S																				
S	S		R	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
						R	S		R						S	R	R		S			R				
S	S	S	S	S	R	S	S	S	R	S	R			S	S	R	R	S	S		S	S	R	S	S	S
S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S	S	S	S	S	S	S	S



**II.B: SELECTED MULTILATERAL AGREEMENTS (REGIONAL)**

Y = in force S = signed R = ratified D = denounced

			CAN	MEX	USA	JPN
1940	Washington	Conv. - Nature protection and wild life preservation in the Western Hemisphere	Y	R	R	
1949	Washington	Conv. - Establishment of an inter-American tropical tuna commission	Y	D	R	R
1992	Moscow	Conv. - Conservation of anadromous stocks (North Pacific Ocean)	Y	R	R	R
1959	Washington	Treaty - Antarctic	Y	R	R	R
1991	Madrid	Protocol to the Antarctic treaty (environmental protection)	Y	S	R	R
1966	Rio de Janeiro	Conv. - International convention for the conservation of Atlantic tunas (ICCAT)	Y	R	R	R
1972	London	Conv. - Conservation of Antarctic seals	Y	R	R	R
1973	Oslo	Agreem. - Conservation of polar bears	Y	R	R	
1980	Canberra	Conv. - Conservation of Antarctic marine living resources	Y	R	R	R
1983	Cartagena	Conv. - Protection and development of the marine environment of the wider Caribbean region	Y	R	R	
1983	Cartagena	Protocol (oil spills)	Y	R	R	
1990	Kingston	Protocol (specially protected areas and wildlife)	Y	S	S	
1999	Oranjestat	Protocol (pollution from land based sources)				S
1988		Agreem. - Conservation of wetlands and their migratory birds		R	R	R
1992	Viña del Mar	Memorandum of understanding on port state control in Latin America			R	
1993		North American agreement on environmental co-operation	Y	R	R	R
1996		Memorandum of understanding to establish trilateral committee for wildlife, plants and ecosystem management		R	R	R

Source: IUCN; OECD.

**OECD EPR / SECOND CYCLE**

Y = in force S = signed R = ratified D = denounced

KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	EU

## Reference III

### ABBREVIATIONS

AAMA	American Automobile Manufacturers Association
ANSI	American National Standards Institute
AOS	Annual Operation Schedule
APEC	Asian Pacific Economic Co-operation forum
ASERCA	Support Services for Agricultural Marketing Agency
BANOBRAS	National Bank for Public Works and Services
BECC	Border Environmental Co-operation Commission
BOD	Biochemical oxygen demand
CACED	Central American Commission for Environment and Development
CBD	Convention on Biological Diversity
CECADESU	Centre of Education and Training for Sustainable Development
CENICA	National Environmental Research and Training Centre
CENSA	National Centre of Environmental Health
CFCs	Chlorofluorocarbons
CFE	Federal Electricity Commission
CIBIOGEM	Inter-ministerial Commission on Biosafety and Genetically Modified Organisms
CICAVS	Integrated Centres for Conservation, Management and Sustainable Use of Wildlife
CICOPLAFEST	Inter-ministerial Commission on the Control of Processing and Use of Pesticides, Fertilisers and Toxic Substances
CIDE	Centre on Research and Teaching in Economics
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNA	National Water Commission
CNDS	National Consultative Council for Sustainable Development
CONABIO	National Biodiversity Commission
CONAE	National Commission on Energy Conservation
CONAFOR	National Forestry Commission
CONANP	National Commission for Protected Natural Areas
CONAPO	National Population Council

CSD	Commission on Sustainable Development (UN)
DR	Irrigation District
ECMT	European Conference of Ministers of Transport
EIA	Environmental impact assessment
EPR	Environmental Performance Review (OECD)
FANP	Fund for Protected Natural Areas
FAO	Food and Agriculture Organisation of the United Nations
FDI	Foreign direct investment
FERRONALES	Mexican National Railways
FERTIMEX	Mexican Fertiliser Company
FINFRA	Infrastructure Investment Fund
GEF	Global Environment Facility
GHG	Greenhouse gas(es)
GMOs	Genetically modified organisms
HC	Hydrocarbons
IBRD	International Bank for Reconstruction and Development
IBWC	International Boundary and Water Commission
ICA	Practical water quality index
IMECA	Air Quality Metropolitan Index
INE	National Institute of Ecology
INEGI	National Institute for Statistics, Geography and Information
IRF	International Road Federation
ISO	International Organisation for Standardisation
ISR	Income tax
IUCN	World Conservation Union
IVA	Value-added tax
IWC	International Whaling Commission
LAN	Act on National Waters
LAU	Single Environmental Licence
LGEEPA	General Law on Ecological Balance and Environmental Protection
LFC	Central Light and Power Company
MARPOL	International Convention for the Prevention of Pollution from Ships
NAAEC	North American Agreement on Environmental Co-operation
NABCI	North American Bird Conservation Initiative
NACEC	North American Commission for Environmental Co-operation
NADB	North American Development Bank
NAFTA	North American Free Trade Agreement

NARAP	North American Regional Action Plan
NGO	Non-governmental organisation
NOM	Official Mexican Standard
ODA	Official development assistance
ODS	Ozone depleting substance
OLDEPESCA	Latin American Fishing Development Organisation
PAC	Pollution abatement and control
PAMS	Projects in Areas of Sustainable Wildlife Management
PCBs	Polychlorinated biphenyls
PDS	Programme to Promote Sustainable Development in the Federal Government
PEC	Concurrent Special Programme
PEMEX	Petróles Mexicanos (state-owned oil company)
PET	Polyethylene terephthalate
PET	Temporary Employment Programme
PIC	Prior informed consent
PICCA	Comprehensive Programme to Combat Atmospheric Pollution
PM <sub>10</sub>	Particulate matter < 10 microns in diameter
PND	National Development Plan
PNH	National Water Plan
PNMA	National Environment and Natural Resources Programme
POPs	Persistent organic pollutants
PREP	Projects for Conservation and Recovery of Priority Species
PROAIRE	Air Quality Improvement Programme
PROCAMPO	Programme of Direct Payments to the Countryside
PRODEFOR	Forestry Development Programme
PRODEPLAN	Programme for the Development of Commercial Forestry Plantations
PRODER	Regional Sustainable Development Programme
PROFEPA	Federal Attorney for Environmental Protection
PROMAGUA	Programme for the Modernisation of Water Utilities
PRONARE	National Reforestation Programme
PRTR	Pollutant Release and Transfer Register
PSA	Agricultural Sectoral Programme
PSE	Producer Support Estimate
REMEXMAR	Mexican Network of Environmental Waste Management
REPDA	CNA's Public Register of Water Rights
RMS	Revised Management Scheme

SAGARPA	Ministry of Agriculture, Rural Development, Fisheries and Food
SECTUR	Ministry of Tourism
SEDESOL	Ministry of Social Development
SEDUE	Ministry of Urban Development and Ecology (until 1992)
SEMARNAP	Ministry of Environment, Natural Resources and Fisheries (became SEMARNAT in 2000)
SEMARNAT	Ministry of Environment and Natural Resources
SIMEBIO	Indo-American Information System on Biodiversity
SINAICA	National Air Quality Information System
SINAP	National System of Protected Natural Areas
SIRREP	System for Tracking Hazardous Waste
SMEs	Small and medium-sized enterprises
SPAW	Specially Protected Areas and Wildlife in the Wider Caribbean Region
SRA	Secretariat of Agrarian Reform
SUMA	System of Units for the Conservation, Management and Sustainable Use of Wildlife
TED	Turtle excluder device
toe	tonne of oil equivalent
TRIPS	WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights
TSS	Total suspended solids
UIA	Ibero-American University
UMA	Wildlife Conservation Management Units
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UN ECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
USD	United States dollar
USEPA	United States Environmental Protection Agency
VAT	Value added tax
VOCs	Volatile organic compounds
WIPO	World Intellectual Property Organisation
WSSD	World Summit on Sustainable Development
WTO	World Trade Organisation
ZMVM	Valley of Mexico Metropolitan Area

## Reference IV

### PHYSICAL CONTEXT

Mexico covers an area of almost 200 million hectares (including around 5 000 km<sup>2</sup> of islands) in North America. It has a 3 152 kilometre border with the United States and a 1 149 kilometre border with Guatemala and Belize. Its extensive coastline (over 10 000 kilometres, excluding islands) runs along the Pacific Ocean and Gulf of California on the west and the Gulf of Mexico and Caribbean Sea on the east. Mexico has a 3 149 920 km<sup>2</sup> Exclusive Economic Zone.

The western and eastern Sierra Madre define the *topography* of northern Mexico. Between these two ranges lies the Mexican high plateau (altiplano), averaging 1 100 metres above sea level in the north and 2 000 metres in the south. On the southern altiplano numerous valleys have been formed by ancient lakes. Several of Mexico's most important cities including Mexico City and Guadalajara are in these valleys. The southern Sierra Madre, the Sierra Madre of Oaxaca and the Sierra Madre and central plateau of Chiapas dominate the landscape of southern Mexico. Mexico's highest mountains are volcanoes; the Orizaba peak is 5 700 metres. Western Mexico drains to the Pacific Ocean. The Balsas, Lerma-Santiago and Yaqui watersheds are the country's largest. Among eastern watersheds draining to the Gulf of Mexico, the Bravo, Grijalva-Usumancita and Pánuco are the largest. There are also a number of inland watersheds, of which the largest is the Nazas-Aguanaval.

Mexico's latitude and topography account for its highly varied *climatic range*. North of the Tropic of Cancer (half the national territory) warm, dry climates predominate except in temperate mountainous areas. In the other half of the country the climate is warm and humid in coastal and southern areas and temperate on the high plateaux. Average annual rainfall is 100 to 600 mm (warm and dry climates), 600 to 1 000 mm (temperate climates) and 1 000 to 2 000 mm, sometimes as much as 4 000 mm, in warm and humid climates.

Geophysical factors are reflected in a *wide range of vegetation types*. Northern Mexico is mostly covered by arid scrubland (matorral), except in mountainous areas where temperate (pine and oak) forests predominate. Part of the high plateau is covered by grassland (pastizal). In the south there are tropical rainforests and mangroves in coastal and southern areas; in mountainous areas temperate forests predominate. Dry forests are found in northern and southern Mexico, mainly in coastal areas. Almost

one-third of the territory is wooded (half temperate, half tropical). Mexico is one of the few countries in the world with *megabiodiversity*. Some 25 000 plant species have been registered in Mexico, about 10% of all species existing in the world.

Permanent grassland is the major (42%) *land use*, most of it in arid zones, followed by forests and wooded land (33%). Arable and permanent cropland covers 14% of the territory. The remaining 11% is open land (degraded forests and desert). In 2000 about 6.5 million hectares of arable and permanent cropland was irrigated.

Exploitation of *natural resources* – forests, soil, water and fisheries – has had a very important role in Mexico's economic development. Since 1993 the annual rate of deforestation has practically doubled, reaching 1.1 million hectares. Mexico ranks second in the world in annual forest loss, behind Brazil. Tropical forests in particular are at risk and would disappear in less than 60 years at the current deforestation rate. Over 60% of Mexican soil is being degraded, mainly by water erosion (37%), wind erosion (15%), biological factors (4%) and salinisation (3%, or more than 6 million hectares). Intensity of use of freshwater resources increased from 12% in 1980 to 16% in 1999. Contamination of water bodies is a serious concern in many parts of the country. Over the last 20 years the annual fish catch has remained stable, which could point to sustainable yields. Three-quarters of the fish catch comes from the Pacific Ocean and one-quarter from the Gulf of Mexico and Caribbean Sea. Mexico is vulnerable to a range of *natural hazards*: droughts, earthquakes, floods, hurricanes and volcanic eruptions.

Mexico is rich in *energy resources*. A major non-OPEC oil producer, it has the western hemisphere's second largest proven crude oil reserves after Venezuela (26.9 billion barrels). In 2001 Mexico produced about 3.6 million barrels of oil per day; 44% was exported, mainly to the United States. Mexico is the world's fifth largest oil producer (including crude, lease condensate, natural gas liquids and refinery gain), behind the United States, Saudi Arabia, Russia and Iran. It has proven natural gas reserves of 835 billion cubic metres, with production of about 37 billion cubic metres in 1999. While Mexico has the fourth largest natural gas reserves in the western hemisphere (after the United States, Venezuela and Canada), it did not emphasise natural gas exploration and development until recently. There are recoverable coal reserves of about 1.2 billion tonnes, 70% anthracite and bituminous and 30% lignite and sub-bituminous. Most of these reserves are in the state of Coahuila. Coal production has remained stable in the past few years. Coal is mainly used for steel production and electricity generation. A small volume of imports from the United States, Canada and Colombia augments domestic coal supplies.

Thermal (oil, gas and coal) sources account for nearly 80% of total *electricity generation*. Hydropower accounts for 16%, nuclear 4% and other renewable sources (wind, solar, biomass) 0.2%. Hydropower production is close to the economically



exploitable capacity; there are no plans to build more major hydro plants. Uranium exploration ended in 1983, when reasonably assured resources were 1 700 tonnes.

Mexico has been mined for centuries. It continues to produce significant amounts of valuable ores. *Mineral deposits* mainly result from volcanic activity and are widely distributed except along the Gulf of Mexico and in the Yucatán peninsula. At least 60 minerals were first discovered and described in Mexico. Mexican silver mines may have produced as much as one-third of the silver the world has ever used. Mexico remains the world's foremost silver producer, with annual output of around 2 800 tonnes (17% of global output). Other metals mined in Mexico include arsenic, copper, gold, iron, lead, manganese, molybdenum, tellurium and zinc. There are deposits of non-metallic minerals such as clay, gypsum, kaolin, magnesium, salt and sodium salts throughout the country.

## Reference V

### SELECTED ENVIRONMENTAL EVENTS (1992-2002)

#### 1992

- Creation of Ministry of Social Development (SEDESOL), which assumes responsibility for environmental management from Ministry of Urban Development and Ecology (SEDUE). A quarter of SEDESOL's budget (around USD 100 million a year) is devoted to environmental protection. SEDESOL is assisted by the National Institute of Ecology (INE), with normative and policy advice responsibilities, and the Federal Attorney for Environmental Protection (PROFEPA), which has enforcement powers.

#### 1994

- Creation of Ministry of Environment, Natural Resources and Fisheries (SEMARNAP) to i) contain deterioration of the environment and renewable natural resources, ii) introduce strict sustainability criteria for production based on natural resources, and iii) contribute to poverty alleviation, especially in rural areas. SEMARNAP's annual budget is USD 1.25 billion.
- Establishment of institutional and legal conditions to improve management of natural protected areas through increased financing and public participation.
- Creation of Programme of Direct Payments to the Countryside (PROCAMPO) to support farmers based on historical entitlements and enhance market orientation of agricultural production.

#### 1995

- National Development Plan (PND) 1995-2000 applies sustainability concept to environmental protection, social welfare and economic growth.
- First National Programme of Protected Natural Areas (1995-2000).
- Introduction of economic instruments (*e.g.* user and pollution charges, water and fuel taxes) for use with other instruments such as Mexican Official Standards, environmental planning and EIA.

- Hazardous waste management policy focuses on waste minimisation and recycling and development of waste treatment infrastructure.

### **1996**

- Amendment of General Law on Ecological Balance and Environmental Protection (LGEEPA) to introduce new air quality management concepts and provisions related to sustainable development.
- Creation of Fund for Protected Natural Areas (FANP). USD 16.5 million Global Environment Facility (GEF) grant for nature conservation in 10 protected areas.
- Launch of two new agricultural programmes, the Temporary Employment Programme (PET) to support farming income and the Countryside Alliance to enhance productivity and technology.

### **1997**

- Mexico's first National Communication to UN Framework Convention on Climate Change (UNFCCC, COP3).

### **1998**

- Two national constitutional amendments to promote citizens' right to a healthy environment and to establish that national development must be sustainable.
- Hazardous waste management provisions included in LGEEPA.
- Forest fire prevention programme initiated.
- Inventory and Diagnosis of Taxonomic Activity in Mexico, compilation of 193 scientific collections in 69 research institutes.
- Creation of Information System for Living Modified Organisms.

### **1999**

- Ratification of North American Bird Conservation Initiative (NABCI) by Canada, Mexico and United States.
- Creation of Inter-ministerial Commission on Biosecurity and Genetically Modified Organisms (CIBIOGEM) to co-ordinate policies for biosecurity and use of GMOs and their products.

**2000**

- SEMARNAP restructured into Ministry of Environment and Natural Resources (SEMARNAT). Creation of National Commission for Protected Natural Areas (CONANP).
- Mexico ratifies Kyoto Protocol.
- Mexico's Second National Communication to UNFCCC (COP7).
- Provisions for management of protected natural areas included in LGEEPA.
- Publication of National Biodiversity Strategy.
- Priority areas designated for biodiversity conservation and bird conservation.
- GEF grant for Biological Indo-American Corridor project.
- National Air Quality Information System (SINAICA) provides real time information on air quality in major cities.
- Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA) launches rural development programmes involving natural resource management.

**2001**

- Release of National Environmental and Natural Resources Programme (PNMA) 2001-06.
- LGEEPA amended to establish Pollutant Release and Transfer Registers.
- SEMARNAT and North American Commission for Environmental Co-operation (NACEC) publish guide for estimating pollutant emissions by industry.
- Memorandum of Understanding between CONABIO and Central American Commission for Environment and Development (CACED) to formalise CONABIO's participation in Indo-American Information System on Biodiversity (SIME-BIO).
- To address poverty alleviation in rural and indigenous communities, CONANP's scope extended to regions covered by Sustainable Regional Development Programme (PRODER).
- Second NABCI meeting in Querétaro.
- Law on Sustainable Rural Development.

**2002**

- Negotiation between Mexico and United States aimed at ensuring efficient and sustainable water use in Rio Bravo/Rio Grande basin to maintain supply to basin users pursuant to 1944 agreement.
- Mexico ratifies Cartagena Protocol on Biosafety.
- Publication of a national land use map, scale 1:250 000.
- Second GEF grant for use in 12 protected areas.
- World Bank support for Biological Indo-American Corridor project.
- Special Programme for Sustainable Rural Development (2001-06).

**Reference VI****SELECTED ENVIRONMENTAL WEB SITES**

<b>Web site</b>	<b>Host institution</b>
<i>www.semarnat.gob.mx</i>	Ministry of Environment and Natural Resources
<i>www.profepa.gob.mx</i>	Federal Attorney for Environmental Protection
<i>www.cna.gob.mx</i>	National Water Commission
<i>www.imta.mx</i>	Mexican Institute of Water Technology
<i>www.ine.gob.mx</i>	National Institute of Ecology
<i>www.conabio.gob.mx</i>	National Biodiversity Commission
<i>www.conanp.gob.mx</i>	National Commission for Protected Natural Areas
<i>www.conafor.gob.mx</i>	National Forestry Commission
<i>www.cec.org</i>	North American Commission for Environmental Co-operation
<i>http://informe.presidencia.gob.mx</i>	President's 2002 government report
<i>www.sre.gob.mx</i>	Ministry of Foreign Affairs

OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16  
PRINTED IN FRANCE  
(97 2003 11 1 P) ISBN 92-64-10499-2 – No. 53211 2003