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FOREWORD

The present report reviews Chile's environmental performance. It is the result of co-operation between the UN ECLAC and the OECD. It is a pilot review of a proposed work programme by UN ECLAC for Latin America and the Caribbean. It is also part of the OECD's Environmental Performance Reviews programme.

The OECD and the UN ECLAC are particularly *indebted to the Government of Chile* for its co-operation in expediting the provision of information and the organisation of the experts' mission to Chile, and in facilitating contacts with many individuals both inside and outside administrative and governmental structures. The OECD and the UN ECLAC extend their most sincere thanks to all those who helped in the course of this review, and especially to the examining countries (Canada, France, Mexico and the United States) and their experts. The present review benefited from grant support from Canada, Spain and the United States.

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 OECD member countries and 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 aim of the programme is to help *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 countries*, through a peer review process; and

– to stimulate *greater accountability* from countries' governments towards their public opinion, within developed countries and beyond.

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The OECD Working Party on Environmental Performance conducted the review of Chile at its meeting on 24-26 January 2005. Its conclusions and recommendations were approved by representatives of OECD member countries and Chile.

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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 (Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom).

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 (CLP).
In 2004, CLP 609.5 = USD 1.

Cut-off Date

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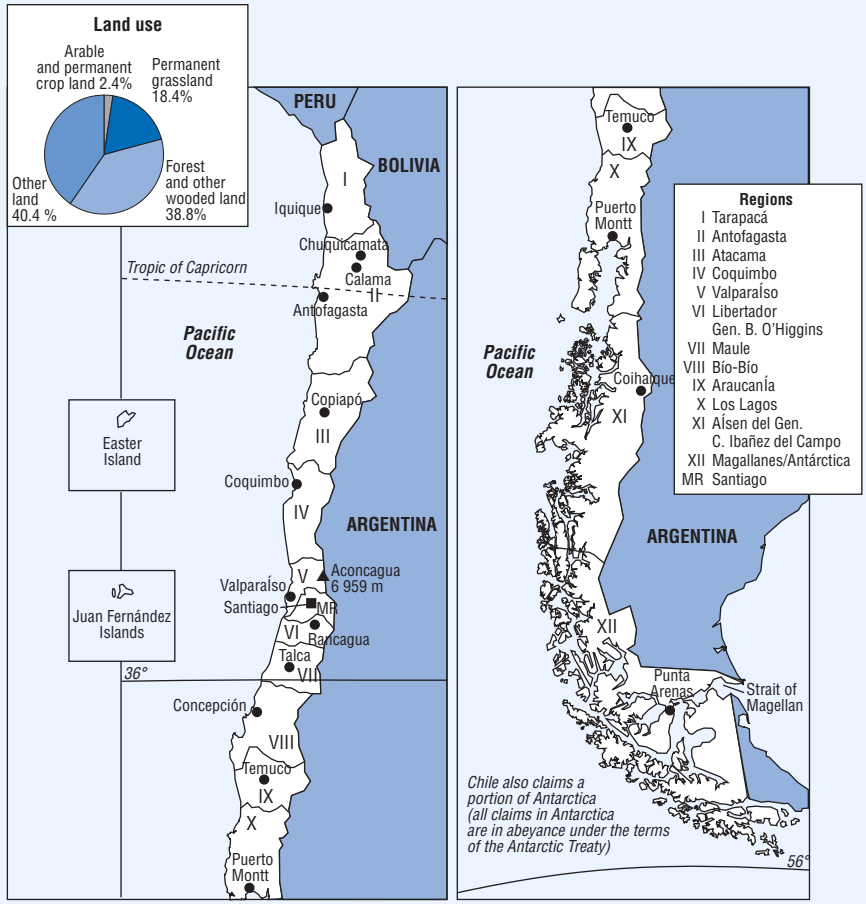
Map of Chile



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CONCLUSIONS AND RECOMMENDATIONS*

Since 1990, Chile has experienced *rapid, increasingly diversified, export-led economic growth*, with a 108% rise in GDP. This economic development was supported by sound macroeconomic and social policies and resulted in significant reductions in poverty. It also put *considerable pressure on some natural resources*, particularly in booming sectors such as mining, forestry and aquaculture. Environmental conditions in Chile should be understood in the context of its rapid pace of development.

Evidence of increasingly severe environmental degradation (e.g. in air quality in the Santiago Metropolitan Region and around copper smelters in northern Chile), together with the restoration of democratic institutions in 1990, led to greater emphasis on environmental protection. Environmental policy has been strongly influenced by concerns over *human health and international trade* (as Chile exports principally to OECD countries). Chile has strengthened its environmental institutions on the basis of a multisectoral environmental co-ordination model. It has also intensified its environmental actions concerning air, water, waste and biodiversity management, with innovative instruments (e.g. trading) and successful reforms (e.g. in water services). *Important challenges remain* in continuing with environmental management progress and integrating environmental concerns in sectoral policies (e.g. concerning agriculture, energy, transport, primary industry, tourism and taxation). Chile is aware of the gap regarding *convergence with environmental standards of OECD countries*, in particular in the context of free trade agreements and multilateral environmental agreements.

* The Environmental Performance Review of Chile was conducted jointly by the OECD and the UN ECLAC. The present Conclusions and Recommendations were reviewed and approved by the OECD Working Party on Environmental Performance (including the Delegations of OECD member countries and of Chile) at its meeting on 24 January 2005.

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To meet these challenges, it will be necessary for Chile to: i) thoroughly and efficiently implement its environmental policies; ii) further integrate environmental concerns into economic, social and sectoral decisions; and iii) strengthen its international environmental co-operation. This report examines progress made by Chile since 1990, and the extent to which the country's *domestic objectives and international commitments* are being met. Fifty-two recommendations are made that could help strengthen Chile's environmental progress in the context of sustainable development.

1. Environmental Management

Implementing environmental policies

During the review period (1990-2004) Chile strengthened its *environmental institutions*, most notably with the 1994 General Environmental Framework Law, which established the National Environment Commission (CONAMA), reporting directly to the President's office through the Ministry General Secretariat of the Presidency. CONAMA is a public body that operates as a decentralised service under a special regime, with a public legal personality and assets. It co-ordinates government environmental policies, prepares environmental regulations and fosters integration of environmental concerns in other policy. Much of Chile's environmental progress over the review period was driven by concerns about pollution's *health impacts* (and related effects on health expenditure and labour productivity) and the need for corporate environmental responsibility in *industries largely exporting to OECD countries*. Chile uses a *wide range of instruments* in connection with environmental policy: environmental impact assessment (EIA), other regulatory instruments, economic instruments (including trading mechanisms), voluntary approaches and planning and information instruments. It has put relatively low emphasis on regulation and information and, more recently, increased focus on land use planning and voluntary approaches. As a precautionary tool, the *EIA system* is well established and has proved active and influential. *Chile was a pioneer* in the use of *trading mechanisms* such as tradable particulate emission permits in Santiago, nationwide trading of water rights and individual transferable quotas for some fish species. These programmes have provided invaluable experience and are potential first steps towards wider or more active markets, but at their current scale the economic efficiency benefits are small. A major and successful *reform in water and sanitation service provision* to households led to the restructuring of the water sector, full-cost pricing and rapid infrastructure improvement. This reform reinforced Chile's progress towards fully applying the *polluter pays and*

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user pays principles. Efforts to ensure that at least half of municipal solid waste is deposited in sanitary landfills were reinforced in 2002, and the target appears to have been reached for the country as a whole. *Voluntary approaches* now involve many firms, accounting for about half of GDP, largely because their export markets are OECD countries where consumers, producers and financial institutions are used to high environmental standards. Total public and private environmental expenditure (including water supply) has reached about 1.25% of GDP in recent years. Most expenditure has gone to water-related infrastructure and reducing copper smelter emissions.

Looking ahead, health issues and export-oriented concerns will continue to drive environmental progress in Chile, including further reductions in air emissions (e.g. from industry, energy production and transport) and continued improvement in water-related infrastructure and domestic and industrial waste management. Nature and biodiversity should increasingly be protected as assets for the domestic and international recreation and tourism industries. As the *road*

Recommendations:

- develop and *strengthen the environmental institutions* at national and regional levels;
- further *develop and strengthen regulatory frameworks* (e.g. standards) to improve environmental health and to achieve Chile's international commitments; review ways to strengthen *compliance and enforcement* capacity, including through institutional reforms, for instance the establishment of an environmental inspectorate;
- review the scope for introducing *new economic instruments* (e.g. product charges on hazardous waste, air emission charges, water pollution charges) and improve trading mechanisms;
- further apply the *polluter pays and user pays principles* through appropriate charges (e.g. on waste management, for access to protected areas, for natural resources), with due regard to social constraints;
- further develop and strengthen *land use plans*: municipal and intermunicipal plans, regional urban development plans and coastline and watershed management plans; survey wetlands and assure their protection through regulations and incentives;
- develop a national set of *indicators* to measure environmental performance with respect to domestic objectives and international commitments.

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to environmental convergence with many *OECD countries* will remain long as regards several issues, it will be necessary to strengthen and expand environmental institutions considerably. In particular, stronger actions are needed concerning EIAs; quality and emission standards for air, water, waste and nature management; the use of economic instruments; territorial management policies; and national as well as regional plans and strategies. An *environmental enforcement policy* based on co-ordination of various sectoral enforcement bodies is not the most effective institutional arrangement to assure compliance. Integration of environmental concerns in regional and municipal *land use planning* is needed, and the coverage and implementation of spatial plans should be expanded and strengthened. Economic information and analysis affecting environmental decisions should be strengthened considerably.

Air

Changes in *fuel quality* have helped reduce the amount of sulphur from mobile and stationary sources and have eliminated lead from petrol. National *ambient air quality standards* have been made more stringent and, for some air pollutants such as particulate matter, include triggers for alerts, pre-emergencies and emergencies. *New vehicle standards* will be only five years behind the EU and US standards. *Plans for air pollution prevention and control in the Metropolitan Region* (1998 and 2004) have been, respectively, implemented and launched, allowing significant reductions in emissions of criteria pollutants and in the number of pre-emergencies. No emergency levels have been recorded since 2000. The transport plan of Santiago could significantly improve traffic management in the Metropolitan Region. An emission trading programme for particulates was established in 1992 for point sources. *Switching to natural gas* contributed to sizable reductions in PM_{10} and $PM_{2.5}$ levels. The elimination of coal subsidies was also environmentally beneficial. Sulphur, particulate and arsenic emissions from copper smelters have been considerably reduced.

Chile continues to face *major health and air pollution challenges* in the Metropolitan Region (which accounts for 40% of the country's population and 48% of GDP) and in the mining sector (with major sources of SO_x, particulates and arsenic). *General emission standards are lacking* for industrial processes and for emitters of toxic air contaminants (except arsenic from copper smelters). Air quality is monitored, and emission inventories have been developed, only for a few major cities and for areas surrounding copper smelters. Emissions of SO_x remain very high, mainly because of copper smelter emissions, and should be further reduced. The pollution prevention and control goals for

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NO_x emissions in the Metropolitan Region were not achieved, largely because of traffic growth; new, more stringent goals have been set for 2010. The national *energy efficiency* programme has been discontinued. Little effort has been made to diversify *energy sources* with a view to reducing emissions of air pollutants and greenhouse gases. Highly polluting solid fuels (e.g. coal and coke) are untaxed. Little attention has been given to the use of fiscal instruments to internalise environmental externalities in the transport and energy sectors.

Recommendations:

- make further progress with the implementation of *air quality programmes*, including those concerning the mining sector and those focusing on $PM_{2.5}$, PM_{10} and ozone; monitor progress and the programmes' impact on health through appropriate *indicators*;
- develop nationwide *emission standards* (e.g. for a range of industrial sources and for toxic air pollutants);
- develop *air monitoring* in all major cities and an integrated air data management system;
- develop *energy efficiency* measures for all aspects of energy consumption;
- review the future *energy supply mix* (including contingency plans), taking into account environmental concerns (such as emissions of air pollutants and greenhouse gases);
- implement air, traffic and transport management plans in the Metropolitan Region; develop and implement improved plans to reduce *emissions from transport* in all cities.

Water

Since the late 1990s Chile has *undertaken a major water reform* concerning the delivery of water supply and sanitation services. As a result, provision of *water infrastructure* has dramatically increased in line with the regionalisation and privatisation of water companies. Two-thirds of the urban population is now connected to waste water treatment, and plans call for urban sewage treatment to continue to increase. *Full cost recovery* pricing applies to public water supply and sewage treatment, in the context of price regulation at the regional level and subsidies to the poorest 18-20% of the population. Water prices increase in

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summer to reflect water scarcity. *Minimum river flow* is included in the 1994 General Environmental Framework Law and is broadly taken into account in the allocation of surface water rights; more specific legal provisions have been proposed for inclusion in the Water Code. A pioneering nationwide system of *tradable water rights* was introduced for surface water and groundwater with the 1981 Water Code, but active trading remains mainly confined to some irrigated areas. There is high compliance with the World Health Organization drinking water quality standards. *Effluent discharge standards* were recently introduced for industry, covering both direct discharges and discharges to sewers.

However, even though most Chilean water bodies are of acceptable quality, *water quality* is poor in some lakes, rivers and coastal waters, mainly due to untreated urban and industrial sewage discharges. There is also pressure from heavy metals from mining in the north, salmon farming inputs in the south and farm inputs in rural areas. A large share of freshwater species is endangered. There are no *water quality objectives* aimed at preserving ecosystems, though they are being discussed. Water quality monitoring and inspection are dispersed among various agencies. Only the Health Code provides authority for enforcement (sanctions), environmental standards having a lower legal status. *Irrigation subsidies* have contributed to water scarcity problems in the

Recommendations:

- continue to invest in *sewerage, waste water treatment and other sanitation infrastructure* in urban and rural areas;
- increase the effective treatment of *industrial effluents*, and strengthen water inspection and enforcement capacities;
- reduce the *effects of agriculture* (e.g. those related to irrigation, nutrients, pesticides and salinisation) on water quality and quantity;
- develop an *integrated watershed approach* to improve water and forest resource management and to provide environment-related services more efficiently;
- give greater weight in water management to protection of *aquatic ecosystems*; improve the integration of nature concerns in water management by setting up a *robust regime for minimum ecological flows and biological water quality standards*;
- improve the *information and knowledge base* for water management (e.g. monitoring of ambient water quality, registry of water rights, data on expenditure and financing).

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centre-north, though efforts are being made to increase cost recovery. *Flood management* has not received much attention in urban planning and there is a lack of storm water collectors. The concept of *river basin management* is only just being talked about.

Nature and biodiversity

Since 1990 Chile has enacted several laws with a nature protection dimension, and it adopted a *national biodiversity strategy* in late 2003. More detailed regional biodiversity strategies and a national biodiversity action plan are in preparation. Natural resource laws and regulations incorporate sustainable management provisions, as do the plans for tourism development. Chile has designated for *legal protection* almost one-fifth of its territory, including nine Ramsar sites and seven UNESCO biosphere reserves. In addition, private interests (NGOs, companies and individuals) manage almost 17 000 km^2 (equivalent to about 12% of state protected areas) for conservation purposes. Agencies operate recovery programmes for *threatened species* such as the Andean deer and the flamingo but not for freshwater species. Progress has been made in recent years in setting up and consolidating a knowledge base about nature and ecosystems.

Nevertheless, the protection of nature has so far not been given enough emphasis and resources to deal with long-term threats to Chile's highly endemic biodiversity. There is *no dedicated nature conservation law*, and *institutional and management structures* make conservation objectives secondary to the wider goals of relevant agencies. Despite improvements over the review period, nature and biodiversity protection and its enforcement are still *underfunded*. The country's species, their conservation status and the functioning of Chile's ecosystems remain *insufficiently known*. Government policies do not adequately acknowledge the value of *nature as a vital asset for the tourism industry* or make the most of tourism's potential to contribute to the financing of nature management. Despite the high overall protection ratio, many significant ecosystems and habitat types are under-represented, and the *target of protecting 10% of all significant ecosystems* by 2010 will not be met at the present rate of progress. The management of protected areas suffers from a lack of financing and investment. The absence of effective arrangements for spatial planning, other than sectoral planning mechanisms, leaves habitats outside of protected areas vulnerable to destruction. *Native forests* not in protected areas continue to suffer from fires of human origin and illegal cutting of valuable species. Only limited progress has been made so far in integrating biodiversity considerations in *water management*.

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Recommendations:

- complete, firmly implement and devote adequate resources to the national and regional biodiversity strategies and action plans;
- review *institutional and legislative arrangements* for the management of nature and biodiversity;
- develop a *strategic vision* of the complementary roles of state and private protected areas in order to achieve a *coherent network of core protected areas*, buffer zones and ecological corridors;
- step up *financial efforts* to meet the target of protecting 10% of all significant ecosystems in Chile (including coastal and marine areas) and boost *nature-related enforcement* activities;
- mount a co-ordinated effort by state agencies and academia to build the *scientific knowledge base* (including cataloguing of living species) required for nature management;
- speed up progress towards establishing an *effective land use planning* system capable of taking biodiversity values into account;
- identify and use further mechanisms, including economic instruments, for creating win-win opportunities in *tourism and nature policies*.

2. Towards Sustainable Development

Integration of environmental concerns in economic decisions

From 1990 to 2004 Chile experienced high, diversified, export-led growth supported by sound macroeconomic and social policies, resulting in significant reductions in poverty but also considerable pressure on some natural resources, though certain pressures (e.g. from SO_x) have been reduced. The 1994 General Environmental Framework Law incorporates the *notion of sustainable development* in recognising three clear objectives: i) sustaining equitable improvement in individuals' quality of life without compromising future generations' expectations; ii) ensuring that socio-economic development and environmental sustainability are complementary; and iii) improving social equity and eradicating poverty. Policy coherence for sustainable development is supported by the Sustainable Development Council, established in 1998 as an advisory body to the President. With few production-based or input subsidies, Chile does not have many potentially *environmentally harmful subsidies*; however, there are subsidies for irrigation water and for afforestation projects,

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mainly oriented towards small-scale farmers. Availability of *natural gas* from Argentina led to the relatively rapid spread of combined-cycle gas turbine generators beginning in 1998, displacing coal and fuel oil; this, together with retrofitting of home heating systems, led to substantial reductions in emissions of particulate matter from power generation along with lower CO_2 emissions. New public and private investment proposals are subject to EIA, ensuring that some attention is given to environmental considerations at project level. Desire to meet the demands of buyers in Chile's export markets, for instance for *agricultural products*, led to clean production agreements (e.g. with pig producers, winegrowers, fruit and vegetable exporters and cheese producers) and a national certification system for organic products. Implementation of environmental policies does not seem to have diminished the country's *international competitiveness*; in a number of sectors, rigorous compliance with demanding environmental standards is seen as necessary for the penetration of Chilean products on OECD countries' markets.

Overall, Chile has not achieved the strong decoupling between environmental pressures and growth seen in a number of OECD countries (except SO_x and PM_{10} emissions in the Metropolitan Region). A national investment system is responsible for standards, techniques and procedures to guide public sector investment approvals, but gives little attention to environmental issues. Quantitative *cost-benefit analyses* are carried out for the establishment of environmental standards and decontamination plans; they should be used more extensively to support decisions concerning projects and instruments affecting the environment. In the *annual budgeting process* at national level, most environmental expenditure originates with sectoral ministries, where environmental priorities compete with others. Although the sustainable growth of the *electric power* sector is an explicit goal of Chilean energy policy, little attention is given to environmental concerns as such. No strategic environmental assessment of national energy development and regional or national transport plans has yet been done. In *agriculture*, environmental concerns are only partially integrated through growing awareness regarding water quality, water quantity in several regions, and pesticide use. More analysis of the environmental significance of distorted market signals is needed in some sectors. Regarding *tax policy*, there is no explicit use of taxes for environmental purposes, and the environment-related taxes in the energy and transport sectors were designed with little attention to their environmental impact. Chile has no national sustainable development strategy. Overall, *integration of environmental concerns into economic and sectoral decision making* should be fostered to improve environmental performance and move towards sustainable development. Such integration is also needed to achieve cost-effective responses to environmental challenges. Economic forces and changes in such sectors

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as energy, transport, industry, tourism, agriculture and other primary sectors strongly influence environmental conditions and trends, and hence can enhance or diminish the benefits of environmental policies. With its export-led growth, Chile has a considerable chance to capture the economic and environmental benefits of win-win situations.

Recommendations:

- develop *economic analyses of environment-related policies*, expanding both economic information on the environment (e.g. on environmental expenditure, environment-related taxes, health risk assessment, water and energy prices) and cost-benefit analysis of projects and legislation relating to the environment;
- review ways and means of integrating environmental concerns in *fiscal instruments and policies*;
- undertake *strategic environmental assessments* concerning: i) Chile's *energy policy framework* and ii) long-term *transport* plans for the Santiago Metropolitan Region, for other urban areas and at national level;
- based on analysis of the social cost and benefits of *energy efficiency* and *non-conventional renewables*, consider providing a positive financial incentive to encourage faster uptake;
- ensure that successors to the *clean production agreements in the agriculture sector* include dated targets for pesticide and nutrient management, expressed as intensity of use, and annual audited progress reports;
- formalise *institutional integration mechanisms* relating to sustainable development.

Sectoral integration: mining, forestry, aquaculture

Mining

The mining sector accounts for *8.2% of GDP and 42% of export value*. Chile is the world's biggest copper producer. Mine output has increased by 265% since 1990. Copper production is capital-intensive and employs 1.2% of the total labour force. An environmental unit was created in the Ministry of Mining in 1991. Chile has reduced copper smelters' SO_x *emissions* by two-thirds, set

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standards for their arsenic emissions and improved their energy efficiency. Mining was an early user of *EIAs*. The country's 14 largest mining companies, including state-owned CODELCO (the world's largest single producer of copper), have ISO 14001 certification or apply their own systems of *corporate environmental management*. Large mining companies have engaged in a voluntary *clean production agreement*. Progress towards environmentally sustainable mining is well on its way.

Nevertheless, mining activities still cause the bulk of SO_x emissions in Chile and *arsenic emissions* in several regions. *Particulate emissions* need to be further reduced and water use efficiency increased in the sector. One-third of abandoned tailing dams are in unacceptable or deficient condition. Nearly half of mining sewage from large companies is not treated. *Small and medium-sized mining companies* often do not comply with regulations. Little is known about soil contamination by heavy metals and toxic contaminants generated by mining activities. Chile has no clean-up plans for *abandoned mines*. The environmental impact of transporting minerals has been evaluated only in the context of the EIA system. Progress towards sustainable mining will require an appropriate balance among its economic, environmental and social dimensions, including mechanisms to support investment in human and social capital, to apply the polluter pays principle and to capture resource rents associated with mineral exploitation.

Forestry

The forestry industry accounts for *3.5% of GDP and 12% of export value*. Chile is the world's third-largest exporter of wood chips and sixth-largest of pulp. Planting of trees, a renewable natural resource, has increased dramatically: at 2.2 million hectares, plantations make up 14% of forest cover. Harvest in plantation forests has increased by 180% since 1990, easing pressure for harvest in native forests, whose *cover has remained remarkably high* at 13.4 million hectares. Chile has adopted standards concerning deforestation, such as compulsory reforestation after forest harvesting, selective thinning on heavy slopes, and soil classification to avoid conversion to farming. Almost one-third of native forests are in *protected areas*. Since 1974, intensive tree planting (mainly Monterey pine) on coastal mountains has aided *restoration of eroded land* abandoned by farmers. A draft law on native forests seeks to introduce payments to farmers who own native forests and adopt sustainable forest management practices while diversifying their income. Progress towards *sustainable forest management* has begun. Pilot projects using sustainable management have been carried out in native forest since 1992. *Forest certification* has spread in recent years.

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However, little attention has been given to the environmental effects, both beneficial and harmful, of tree planting (e.g. as regards soil and water conservation, water quality and biodiversity). Any forest harvest of more than 500 hectares a year is supposed to undergo EIA, but owners avoid this by segmenting the area cut; nor is EIA required for new planting. Though timber harvesting in native forest decreased as the use of plantation timber spread, *harvesting for fuel continues*. Tree plantations have *little genetic* diversity, and the growing reliance on clonal eucalypt plantations for pulp production increases the risk of epidemics. *Tree planting subsidies* (USD 225 million since 1974) have created an incentive for conversion of some native forest, though not on a major scale; subsidisation has been redirected to small landowners and soil conservation objectives. Little effort has been made to protect wooded river banks despite legal provisions to this effect. More attention could also be given to grouping forest owners for economies of scale in moving towards sustainable management of native forests.

Aquaculture

The volume of aquaculture production has grown by 825% since 1990, and Chile has become the *world's second-largest producer and exporter of salmonids* (after Norway). Under current plans production will double, particularly in the southern Regions X and XI, where aquaculture has become a capital-intensive industry with direct and indirect benefits for employment. The 2001 *environmental regulation for aquaculture* led to measures to safeguard the environment at cultivation sites and make aquaculture more sustainable. *Preliminary site characterisation* of new fish farms has become compulsory. The first reports on the state of the environment in the aquaculture sector are being prepared. Of about 1 400 aquaculture projects that have undergone EIAs, 60% were approved. In addition, 48 salmon producers (accounting for 80% of salmon exports) have signed a *clean production agreement*.

However, progress towards sustainable aquaculture is recent. Both the government and the fish farming industry have recognised the challenge and started addressing it. *Water pollution* by excess food and faeces can contribute to eutrophication of lakes, fjords and coastal areas. Controlling water quality in aquaculture areas also involves policies for other sectors, such as forestry (since the potential for salmon raising is higher in lakes surrounded by forested watersheds), agriculture (whose nutrient run-off affects water quality) and water services (given the effects of urban and industrial sewage treatment). Effective control of water quality thus requires comprehensive, intersectoral policies. Chilean aquaculture has made extensive use of *antibiotics*; regulations were

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established in 2003 to start controlling their use. Accidental escapes of adult salmon from sea cages in *aquatic ecosystems* have not been assessed. Particular attention should be paid to the rising demand for fishmeal in salmon farming, which could put pressure on some *sea fish stocks* (e.g. anchovy, mackerel, sardine), even though these stocks are under total allowable catch programmes. Local conflicts have arisen between industrial salmon farming and the tourism industry, though efforts are being made to complete delineation of areas deemed appropriate for aquaculture.

Recommendations:

- further reduce the *environmental impact* of the mining sector (e.g. air pollution by SO_2 and arsenic, water pollution, abandoned sites and tailing dams);
- give special attention to *small and medium-sized mining enterprises* through technological, financial and consultancy assistance and improved relationships with the largest mining firms;
- increase the *financial contribution of the mining sector* to support long-term investment in human and social capital and to apply the polluter pays principle according to the General Environmental Framework Law; consider a mechanism for proper capture of resource rents associated with mineral exploitation;
- promote agreement among stakeholders on *strategic national orientations* concerning forest resources (protection, sustainable management, plantation);
- adopt and implement measures to assure *sustainable management of native forest*, including rewards for environmental services, cross-compliance mechanisms, partnerships and co-operation among stakeholders on overall management;
- strengthen the *enforcement capacities* of the National Forestry Corporation (CONAF);
- improve *environmental and health protection in aquaculture* (e.g. as regards eutrophication, salmon escapes, ecological balance of lakes, antibiotics, epidemiological vigilance, eradication of infectious disease), particularly through *strengthened enforcement* capacities;
- apply the *polluter pays principle* in the aquaculture industry in the context of the General Environmental Framework Law;
- complete a *precise aquaculture coastal zoning plan*; adopt integrated environmental management for coastal areas.

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Integration of environmental and social concerns

Chile made *outstanding progress* over the review period in reducing the share of the population living in poverty, from nearly 39% to 19%. More than 50% of the income of the poorest decile is derived from national social policies addressing: i) *basic income* needs, through transfers such as assistance pensions, family subsidies and water subsidies; ii) slums and other *housing* problems, through measures such as the Chile Barrio programme; iii) *education*, by providing primary education for all; iv) *health*, through a universal access plan (AUGE) covering 56 costly and common diseases; v) *labour* issues, by raising the minimum wage and introducing unemployment insurance; and vi) *extreme poverty* affecting people not covered by social networks, notably through the Chile Solidario programme. Although further progress is needed, improvement in these areas is impressive. Poverty indicators are also taken into account in the distribution of regional funds and in municipal financing.

Regarding *environmental democracy*, progress has been made in the provision of environmental information (e.g. production of environmental statistics and publication of state of the environment reports) and legal bases for access to information, along with public participation and access to justice, and actions such as the establishment of a National Environmental Information System (SINIA). The National Statistics Institute has published environmental data each year since 1990. In 2001 it carried out the first survey on firms' environmental management. Improving participation and access to information have been clear goals of environmental policy in Chile. For instance, the General Environmental Framework Law establishes the principle of participation, while legislation on public transparency and integrity establishes the obligation to inform the public. The large number of environmental disputes treated in court shows that access to justice is exercised in practice. *Health concerns* drove many of the environmental improvements made by Chile in the review period. Remarkable results have been achieved in this respect. Air pollution abatement (e.g. of SO_x and particulates in the Metropolitan Region and of arsenic in Antofagasta Region II) and expansion of environmental infrastructure (drinking water supply, waste water treatment, solid waste disposal in sanitary landfills) have helped reduce and prevent ailments such as respiratory diseases, cancers, cholera, typhoid fever and hepatitis A. Some progress has also been made in *environmental education*, e.g. with the introduction of environmental material in primary and high school, the environmental certification of 132 schools and the environmental scout movement.

However, concerning *environmental information*, work on environmental data, environmental reporting and environmental indicators needs to be

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consolidated and regularly carried out. SINIA is to be further developed to integrate sectoral information, improve the quality of physical environmental information and include economic information on the environment (e.g. environmental expenditure, environmental employment, water prices). Public participation mechanisms and practice, which progressed over the review period, should be made more effective and systematic, both at national and territorial level, particularly in association with project-based EIAs and strategic environmental assessments (SEAs) of public policies, plans and programmes. Despite remarkable *environmental health* progress, much remains to be done. Health problems that have emerged or remain on the health-environment agenda include those related to outdoor air pollution from NO_x, ozone and fine particulates; to indoor pollution, which especially affects the poor; and to lack of access to safe water supply and sanitation services, also for the poor (in line with United Nations goals). For instance, 900 000 people still lack drinking water supply and sanitation. Continuous efforts are needed to combat respiratory diseases (particularly in children), cancer and emerging allergies. Environmental

Recommendations:

- consolidate efforts to produce environmental *data, state of the environment reports and environmental indicators* so as to strengthen decision making and public information, taking into account international methodologies;
- continue to develop *public participation* in processes such as project-based environmental impact assessments and strategic environmental assessments of public policies, plans and programmes;
- continue efforts to improve *health* through targeted environmental progress, with special attention to the poor; review the health impacts of *pesticide* use on agricultural workers and rural communities and implement risk reduction strategies and measures;
- strengthen *environmental education and awareness* through a long-term strategy of environmental learning and a national environmental education plan, including: i) further integration of environmental material in primary and secondary school curricula, and ii) development of environmental knowledge through professional associations and environmental management systems within enterprises;
- develop *environmental employment*, with specific attention to the material and cultural heritage as a base for tourism development and to biofood production for agriculture development.

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improvements should result in further health progress and related benefits in terms of reduced health costs, improved well-being and increased productivity in the Chilean economy. Regarding *environmental education and awareness*, much remains to be done concerning formal school curricula, as well as in the private sector (e.g. involving staff more in certification and corporate social responsibility, and promoting environmental training through professional associations) and the public sector (e.g. in association with sustainable development initiatives, project-related EIAs and SEAs of *public policies, plans and programmes*, and use of environmental performance indicators). Education and environmental campaigns increase acceptance of environmental policies and help prevent illegal dumping, energy inefficiency, water wastage, overuse of private transport and unhealthy behaviour.

3. Strengthening International Commitments

Over the review period, Chile concluded a number of trade agreements incorporating environmental dimensions and participated in global efforts to address environmental challenges. In the context of *trade agreements*, Chile has taken on significant obligations to promote high standards of environmental protection, to enforce environmental laws effectively and to not derogate such laws to attract investment. It has also promoted corporate social responsibility, with particular attention to environmental management in key export sectors. Chile has been a strong participant in the global environmental agenda as well, signing and ratifying most major *multilateral environmental agreements* and taking an active role in efforts to address ozone layer depletion as well as marine and maritime issues, especially as regards potential oil spills in its southern seaways, which receive heavy international traffic. At *regional level* Chile has been active in work to preserve the Antarctic, to reverse the vicuña's endangered status (efforts involve Argentina, Bolivia, Ecuador and Peru), to combat desertification of the Altiplano-Puna ecosystem shared with Peru, Argentina and Bolivia, and to preserve Ramsar Convention wetlands.

Chile's *trade and environment* agenda is influenced by market access concerns and treaty negotiating dynamics vis-à-vis its trade partners, as well as efforts to identify and address possible environmental effects of very rapid growth in natural resource-based export sectors. Chilean export companies have made progress in product certification and environmental management, improving Chile's reputation as a reliable supplier and securing access to foreign markets, but this has not always prevented local environmental damage from rapidly expanding export sectors. Regarding *multilateral environmental*

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agreements ratified by Chile, some lack follow-up implementation: legislation may be pending (e.g. on native forests and persistent organic pollutants), national action plans may not be in place (e.g. on biodiversity) or enforcement may be too weak (e.g. regarding endangered species).

Recommendations:

- continue efforts leading to *ratification and implementation of international agreements* and, as appropriate, OECD legal instruments, and publish periodic reviews of actions taken to meet international environmental commitments;
- continue to promote *mutually supportive trade and environment policies* through effective implementation and strengthening of the environmental regulatory framework and promotion of corporate social responsibility;
- ensure that co-operative activities associated with *trade agreements* are targeted to mitigate any adverse environmental impacts from large-scale natural resource exportation;
- strengthen *chemical and hazardous waste management* according to international agreements, notably the Stockholm, Rotterdam and Basel Conventions; complete and implement national plans for persistent organic pollutants and hazardous waste; strengthen enforcement activities, develop pollutant release and transfer registers and improve the regulatory framework to better manage chemicals throughout their life cycle;
- continue national and bilateral efforts in the areas of research, monitoring and sustainable management of *marine ecosystems* (e.g. sustainable fisheries, prevention of marine pollution); strengthen oil spill prevention and mitigation capacities;
- develop a balanced, scheduled strategy concerning *climate change* issues; strengthen *energy efficiency and greenhouse gas mitigation* policies, including through a cleaner energy mix, and promote the use of clean development mechanisms in the context of the UNFCCC and the Kyoto Protocol;
- develop further *international environmental policies* reflecting potential OECD membership, and an increasing role in Latin America and the world.

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2

AIR MANAGEMENT*

Features

- Air clean-up in Santiago
- Air clean-up around copper smelters
- Air management in transport policy
- Air management in energy policy
- Energy outlook

* This chapter reviews progress since 1990.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- make further progress with the implementation of *air quality programmes*, including those concerning the mining sector and those focusing on $PM_{2.5}$, PM_{10} and ozone; monitor progress and the programmes' impact on health through appropriate *indicators*;
- develop nationwide *emission standards* (e.g. for a range of industrial sources and for toxic air pollutants);
- develop *air monitoring* in all major cities and an integrated air data management system;
- develop *energy efficiency* measures for all aspects of energy consumption;
- review the future *energy supply mix* (including contingency plans), taking into account environmental concerns (such as emissions of air pollutants and greenhouse gases);
- implement air, traffic and transport management plans in the Metropolitan Region; develop and implement improved plans to reduce *emissions from transport* in all cities.

Conclusions

Changes in *fuel quality* have helped reduce the amount of sulphur from mobile and stationary sources and have eliminated lead from petrol. National *ambient air quality standards* have been made more stringent and, for some air pollutants such as particulate matter, include triggers for alerts, pre-emergencies and emergencies. *New vehicle standards* will be only five years behind the EU and US standards. *Plans for air pollution prevention and control in the Metropolitan Region* (1998 and 2004) have been, respectively, implemented and launched, allowing significant reductions in emissions of criteria pollutants and in the number of pre-emergencies. No emergency levels have been recorded since 2000. The transport plan of Santiago could significantly improve traffic management in the Metropolitan Region. An emission trading programme for particulates was established in 1992 for point sources. *Switching to natural gas* contributed to sizable reductions in PM_{10} and $PM_{2.5}$ levels. The elimination of coal subsidies was also environmentally beneficial. Sulphur, particulate and arsenic emissions from copper smelters have been considerably reduced.

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Chile continues to face *major health and air pollution challenges* in the Metropolitan Region (which accounts for 40% of the country's population and 48% of GDP) and in the mining sector (with major sources of SO_x, particulates and arsenic). *General emission standards are lacking* for industrial processes and for emitters of toxic air contaminants (except arsenic from copper smelters). Air quality is monitored, and emission inventories have been developed, only for a few major cities and for areas surrounding copper smelters. Emissions of SO_x remain very high, mainly because of copper smelter emissions, and should be further reduced. The pollution prevention and control goals for *NO_x emissions* in the Metropolitan Region were not achieved, largely because of traffic growth; new, more stringent goals have been set for 2010. The national *energy efficiency* programme has been discontinued. Little effort has been made to diversify *energy sources* with a view to reducing emissions of air pollutants and greenhouse gases. Highly polluting solid fuels (e.g. coal and coke) are untaxed. Little attention has been given to the use of fiscal instruments to internalise environmental externalities in the transport and energy sectors.

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1. Air Pollution Management

1.1 Policy objectives

The main air-related objectives of Chile include *air quality standards* (Table 2.1) and *air emission standards* for stationary and mobile sources. Some of these standards are nationwide, others regional or plant-specific (Box 2.1). Objectives also include fuel-related standards. Particular air pollution problems occur in the Santiago Metropolitan Region, from mining activities in central and northern Chile and from the burning of wood for fuel in southern cities. Major sources in the mining sector include copper smelters emitting SO_2 and PM_{10}, and other mining processes generating particulates.

1.2 Pollution in the Metropolitan Region

The 6 million inhabitants of the Santiago agglomeration are exposed to high levels of air pollution, resulting in respiratory diseases and premature deaths (Chapter 7). The World Health Organization ranks Santiago among the world's worst-polluted cities. *Santiago's air pollution problems* are due mainly to industrial and transport emissions, made worse by its site: a valley surrounded by the Andes and

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Cordillera de la Costa mountain ranges, with little wind and rain to disperse emissions. Pollution is further exacerbated in the colder months between April and September by the natural phenomenon of thermal inversion. In the winter, concentrations of most pollutants (particularly PM_{10}, $PM_{2.5}$ and CO) reach their highest level. An exception is ozone, whose concentrations peak in the summer because of the chemistry involved. Other airborne contaminants in Santiago are SO_2, NO_2, VOCs and heavy metals. PM_{10} is the main air pollution problem.

In 1990 the Special Commission for Decontamination of the Metropolitan Region (CEDRM), which later became the regional office of the National Environment Commission (CONAMA) in the Metropolitan Region, released an *air*

Table 2.1 **National primary standards for ambient air quality**

Pollutant	Unit[a]	Limit value[b] (µg/m³)	Allowed exceedance	Date normative process began	Entry into force	Supreme Decree No.[c]
PM_{10}	Mobile 24-hour average	150[d] (150)	98th percentile annual	1997	1998	59/98 and 45/01
	Annual average	50	None (3-year average)	1999	2005	45/01
SO_2	Daily average	250 (365)	99th percentile (3-year average)	1999	2006	113/02
	Annual average	80 (80)	None (3-year average)			
Ozone	Mobile 8-hour average	120 (160 1h)	99th percentile (3-year average)	1999	2006	112/02
CO	Hourly maximum	30 000 (40 000)	99th percentile (3-year average)	1999	2006	115/02
	Mobile 8-hour average	10 000 (10 000)	99th percentile (3-year average)			
NO_2	Annual average	100 (100)	None (3-year average)	1999	2006	114/02
	Hourly maximum	400	99th percentile (3-year average)			
Lead	Annual average	0.5	None (2-year average)	1998	2001	136/00

a) Short-term measurement is used to determine critical air pollution episodes or to activate immediate preventive steps.
b) The 1978 Ministry of Health standards (in brackets) are retained in areas where standards do not yet apply.
c) Supreme Decrees of SEGPRES.
d) To be reduced to 120 µg/m³ in 2012 unless a quality standard is set meanwhile for $PM_{2.5}$.
Source: CONAMA.

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quality plan for Santiago defining lines of action, some of which are still being taken (Table 2.2). For example, it provided for inspection of stationary sources (through the public health services) and of mobile sources (by an inspection department established in the Ministry of Transport.

In the medium term the CEDRM plan was directed at *stationary sources* mainly emitting PM_{10} and SO_2. It aimed at reducing emissions from these sources by 70%. In 1992 the Ministry of Health set standards for existing and new stationary sources located in the Metropolitan Region and emitting more than one tonne per day of PM_{10} and three tonnes per day of SO_2. For existing sources the PM_{10} limit was set at 112 mg/m^3 by 1993 and 56 mg/m^3 by 1998. New sources could enter the Metropolitan Region provided they obtained emission offsets from existing sources compensating for 25% of emissions by 1994, 50% by 1995, 75% by 1996 and 100% by 1997. Thus, the total allowable emissions for each source were calculated to form the basis for a tradable permit programme. Emission standards were enforced by the Programme for Control of Emissions from Stationary Sources under the Ministry of Health.

Table 2.2 **Air quality plans**

Location	Region	Type of activity	Owner	Year area was declared "saturated"	Year of clean-up plan	Pollutants subject to emission reduction targets
Las Ventanas	V	Copper smelter/refinery + coal-fired power plant	ENAMI[a]	1993	1992	SO_2, PM_{10}
Santiago	RM[b]	Urban centre		1996	1998[c]	PM_{10}, TSP, CO, ozone
Caletones	VI	Copper smelter	CODELCO[d]	1994	1998	SO_2, PM_{10}
Maria Elena y Pedro de Valdivia	II	Speciality fertiliser and iodine plant	Private	1993	1998	PM_{10}
Potrerillos	III	Copper smelter	CODELCO[d]	1997	1998	SO_2, PM_{10}
Chuquicamata	II	Copper smelter	CODELCO[d]	1991	1993[e]	SO_2, PM_{10}
Chagres	V	Copper smelter	Private		None	None
Paipote	III	Copper smelter	ENAMI[a]	1993	1994	SO_2, PM_{10}, arsenic

a) National Mining Company.
b) Metropolitan Region.
c) Updated in 2004.
d) National Copper Corporation.
e) Revised in 2000.
Source: CONAMA.

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Box 2.1 Institutional and regulatory framework for air management

Ambient air quality standards

Among the institutions involved in air management, the Ministry of Health and CONAMA's parent body, the Ministry General Secretariat of the Presidency (SEGPRES), are responsible for issuing primary *ambient air quality standards* (Table 2.1). Primary standards are aimed at protecting human health. Originally set in 1978 for TSP, SO_2, CO, ozone and NO_2 (and in 1992 for SO_2 and PM_{10} in areas surrounding major pollution sources), they were revised in 1998 (PM_{10}) and 2002 (other air pollutants). Primary standards have not yet been set for other pollutants, including VOCs and heavy metals (except lead). A standard for arsenic compounds is being prepared.

Secondary quality standards are aimed at protecting agricultural production and ecosystems. They have been provided since 1992 by the Ministry of Mining. For the north, where the drier regions with most of the copper smelters are located, the SO_2 primary standards are only complemented by an hourly maximum of 1 000 $\mu g/m^3$. For the southern regions, with their humid climate and more farming and forestry, the annual standard has been lowered to 60 $\mu g/m^3$, the daily value to 260 $\mu g/m^3$ and the hourly value to 700 $\mu g/m^3$. A secondary standard for iron (contained in soil sediments) of 30 mg/m^3 per day, issued by the Ministry of Agriculture, applies when olive trees are in bloom in the Huasco valley, site of an iron ore pellet plant.

To *enforce compliance with air quality standards*, the Regional Environment Commissions (COREMAs) ask SEGPRES to issue a Supreme Decree declaring the area where a standard is exceeded to be "saturated". An air quality plan is then supposed to be initiated within 90 days. Since 1992 such plans have been implemented for Santiago and for major mining pollution sources (Table 2.2). From 1995 the plans have been prepared using the procedure established in the 1994 General Environmental Framework Law.

Emission standards

CONAMA has the primary responsibility for setting *emission standards* for stationary sources (with the Ministry of Health) and for vehicles (with the Ministry of Transport and Telecommunications). COREMAs are responsible for issuing *air emission permits* to projects requiring environmental impact assessment. In co-ordination with CONAMA, *enforcement activity is shared* by the Ministries of Transport and Telecommunications (for motor vehicle emissions), Agriculture (for fire used in farming), Mining (for plants releasing anhydrous sulphur, particulate matter and arsenic) and Health (for stationary sources in the Metropolitan Region). Since 1999 an emission standard for arsenic has applied to major sources.

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A second medium-term measure in the CEDRM plan concerned PM_{10}, CO and photochemical oxidants from *mobile sources*, especially public transport (buses) and private vehicles. Emission standards for buses were established, differentiating between new and old vehicles. New buses had to comply with a standard that was equivalent to the USEPA 1984 standard. Old buses had to meet stricter exhaust opacity standards set by the Ministry of Transport. The standards were related to engine power. Enforcement proved difficult as it became common to rent new engines before inspection. For cars (mostly with petrol engines), the CEDRM plan envisioned combining emission standards with congestion pricing and road pricing. The emission standards went into effect for new cars, but the pricing plans were not implemented. Since 1992, all new cars to be used in the Metropolitan Region and two adjacent regions have had to be equipped with three-way catalytic converters. This requirement was extended to the rest of the country in 1994.

The CEDRM plan also focused on *emergency procedures* for periods of particularly unfavourable meteorological conditions. An air quality index for PM_{10} and, to a lesser extent, indexes for other air pollutants were used to declare existence of an episode. Compulsory measures during episodes included restrictions on vehicle use, industrial production and residential heating. However, enforcement was weak because the number of inspectors was limited. Since 1997, real time monitoring has been carried out for PM_{10} in central Santiago.

In 1998 the *Metropolitan Region's Air Pollution Prevention and Clean-up Plan* (PPDA) was launched, following enactment of the 1994 General Environmental Framework Law and the extended powers granted to CONAMA. It was prompted by the Metropolitan Region's classification in 1996 as a "saturated" zone for PM_{10}, ozone, CO and total suspended particulates (TSP) and a "latent" zone for NO_2 (Chilean law defines a saturated zone as one in which one or more standards are exceeded and a latent zone as one where the level of pollution is at 80-100% of the maximum allowed). The PPDA set *emission reduction targets* for PM_{10}, CO, SO_x, NO_x and VOCs (Table 2.3) and established *air quality targets*. In 1999 a pollution forecasting system was introduced to activate short-term preventive measures prior to critical episodes involving PM_{10}. The key PPDA objectives are to reduce human exposure to the pollution most dangerous to health; eliminate critical *PM_{10} pollution episodes* (emergencies, pre-emergencies and alerts) and reduce $PM_{2.5}$, the PM fraction most damaging to human health; reverse the trend of increasing *concentrations* of PM_{10}, ozone, CO and NO_2; avoid generation of *NO_x* in areas experiencing latency and saturation; and reduce the pollutant concentrations to below the limits set by *ambient air quality standards*.

In 2004 the PPDA was updated, with *new emission reduction targets* that are more stringent for PM_{10} and NO_x (75% reduction in PM_{10} emissions and 40%

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reduction in NO_x by 2005, from 1997 levels). The new PPDA seeks to eliminate pre-emergencies by 2005 and to meet air quality standards by 2010. VOC emission reduction targets were unchanged despite the need to keep ozone levels from rising in the region.

Concerning economic instruments, a *tradable emission permit* programme was begun in 1992 to control TSP from stationary sources in the Metropolitan Region. It has been very helpful in establishing an inventory of emissions, as it was based on grandfathering permits. Its overall effectiveness in reducing TSP emissions has been limited, compared to that of the switch to natural gas, as it involves only industrial and residential boilers. Enforcement problems and insufficient information on trading volumes and prices also limit its effect. Proposals to expand and improve the programme have been made (Chapter 5).

Table 2.3 **Metropolitan Region: air management performance**[a]

(%)

Pollutant	Reduction target 2000[b]	Effective reduction 2000[b]	Initial reduction target 2005[b]	Revised reduction target 2005[c]
PM_{10}	7.5	29	30	75
CO	7.5	8	25	25
SO_x	7.5	61	25	25
NO_x	7.5	–10	25	40
VOCs	7.5	4	25	25

a) Compliance with the emission targets of the Air Pollution Prevention and Clean-up Plan (PPDA) for the Metropolitan Region. The plan was released in 1998 and revised in January 2004.
b) 1995 base year.
c) 1997 base year.
Source: PPDA.

1.3 Emissions from the mining sector

The *main air pollutants from the mining sector* are *SO_2, arsenic and PM_{10}*. The copper industry is partly state-owned, the main enterprises being the National Copper Corporation (CODELCO) and the National Mining Company (ENAMI). Private companies and foreign capital account for an increasing share of production, however. CODELCO operates the larger mines and is the biggest producer of ore

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concentrates and copper. ENAMI buys ore concentrates from small and medium-sized producers and produces copper. The areas most threatened by air pollution from this industry are in northern Chile, where the world's largest copper mine, Chuquicamata, is located.

Comparative cost advantage and policies to encourage private investment in the mining sector contributed to the *expansion of Chile's copper industry in the 1980s*. Increasing awareness of the negative environmental and health effects of smelter operations forced Chilean authorities to start taking serious measures on pollution control. A further impetus was the risk of being accused of environmental dumping: such an allegation was made by the US copper industry in 1984 and supported by the US International Trade Commission.

The first plant to be *effectively regulated* was the Chagres smelter, in 1985. SO_2 and PM_{10} emissions from the Chuquicamata smelter came under regulation in 1991 (with stricter standards in 1993 and 2001), after an air quality monitoring network was established in 1986 in the CODELCO-owned housing for mine workers and in the neighbouring city of Calama. By 1989, Chuquicamata, Chagres and Paipote had sizable sulphur recovery.

The approach to air pollution control in the mining sector is based on meeting ambient air quality objectives rather than imposing uniform emission standards. A system of tradable permits was not envisaged, as most emissions originate with a few state-owned players. Instead, government and industry jointly *seek the most cost-effective technological solutions* to meet the air quality targets in areas subject to clean-up plans (Table 2.2). The management of every regulated emission source must prepare a *clean-up plan* for air quality in areas surrounding copper smelters where standards have been exceeded. The plans (prepared jointly by environmental authorities and state-owned copper smelters) set SO_2 and PM_{10} emission reduction targets. Since 1994 they have been approved by presidential decree. They have helped reduce SO_2 emissions by more than 70% (Chapter 6). Since 1992, air clean-up plans have been implemented for all five state-owned copper smelters (Table 2.2).

1.4 Pollution from biomass combustion

It is estimated that from 7-10 million m^3 of firewood is consumed each year in Chile, mostly *in southern regions*. Surveys in Temuco (Region IX) revealed that mobile sources and firewood combustion for residential heating were the two main causes of air pollution by fine particulates. Measures to improve air quality in cities where firewood is extensively used were initiated in Region IX in 1997. They have since been progressively extended to other southern regions. The measures include

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periodic monitoring of ambient air quality in Temuco (Region IX), Osorno (Region X), Valdivia (Region X) and Coyhaique (Region XI). A voluntary firewood quality certification programme has been developed, based on technical standards prepared by CONAMA. Producers of wood stoves voluntarily committed themselves to develop energy-efficient devices (e.g. double-chamber technology). Good practices in the use of firewood and wood stoves have been disseminated, including through public awareness and education campaigns involving international expertise.

In the Metropolitan Region, the 1990 CEDRM plan banned the use of wood in open fireplaces. In 1993, the bakery sector voluntarily agreed to replace firewood with liquefied petroleum gas, which almost halved firewood consumption in Santiago. Under the 2004 PPDA, from 2006 all new wood stoves installed in the Metropolitan Region for residential heating will have to meet particulate emission standards of 7.5 g/hour (down to 4.5 g/hour from 2008 for the province of Santiago). From 2006, as part of the tradable emission permit programme introduced in the region in 1992 to control TSP from stationary sources, producers and importers of wood stoves will be required to buy offsets equal to 150% of their calculated TSP emissions.

2. Results Achieved

2.1 Emissions

Between 1990 and 2001, *air pollutant emissions* decreased by 64% for SO_x, doubled for NO_x and rose by 57% for VOCs and 62% for CO (Table 2.4). SO_2 emissions from the largest mining sources were reduced to less than one-third of 1991 levels. Per unit of GDP, however, remaining SO_x emissions are still very high by OECD standards (Figure 2.1). Copper smelters still account for 76% of these emissions and fuel combustion at stationary sources for 23%. The doubling of NO_x emissions over the decade can be attributed to rises in fuel combustion from stationary sources and in traffic volumes: the former accounts for nearly 60% of NO_x emissions and the latter for almost 40%. Per unit of GDP, NO_x emissions exceed the OECD average. The increase in VOC and CO emissions is largely due to the rise in fuel combustion, especially for industry and electricity generation. Mobile sources contribute around 30% of VOCs and 25% of CO. Petrol-fuelled cars generate most of the NO_x and CO attributed to motor vehicle traffic, while diesel vehicles (mostly buses and trucks) are the source not only of PM_{10} but also one-third of the traffic-related NO_x. PM_{10} emissions, which have declined in recent years, are largely from industry, diesel vehicles and unpaved roads.

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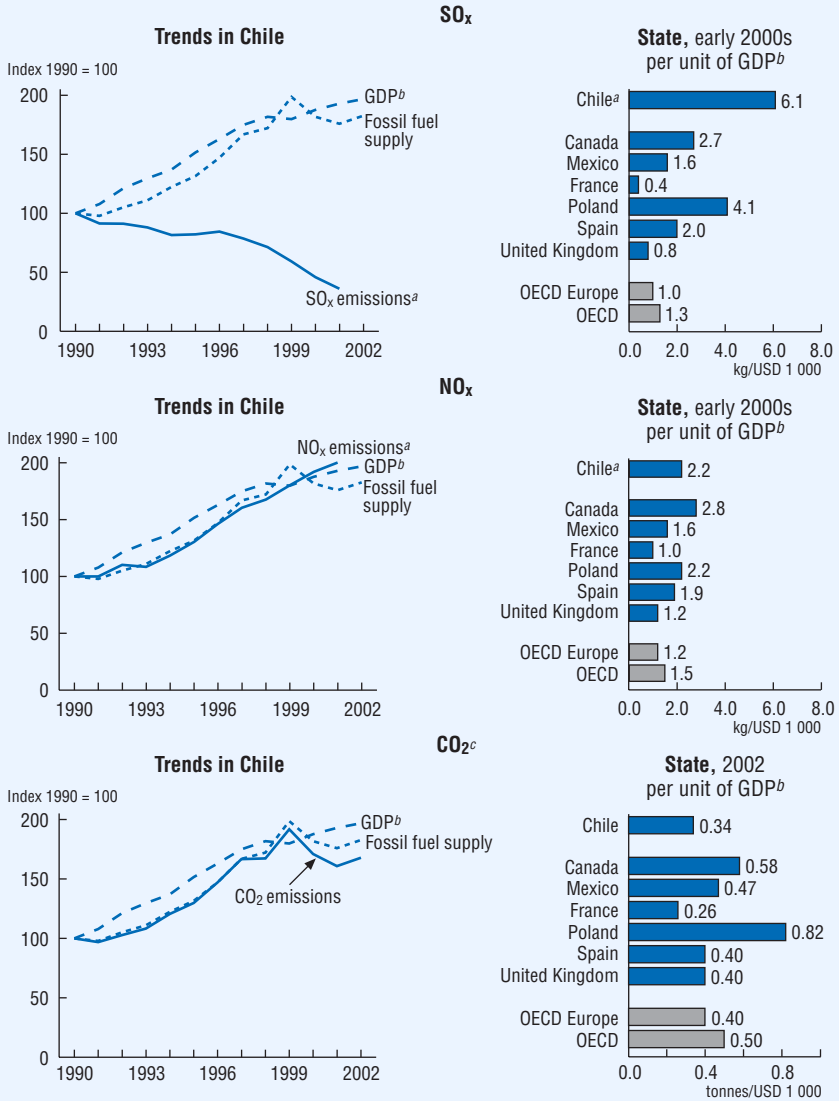
Figure 2.1 **Air pollutant emissions**



a) Includes Secretariat estimates.
b) GDP at 1995 prices and purchasing power parities.
c) Emissions from energy use only; excludes international marine and aviation bunkers.
Source: CONAMA; OECD; IEA-OECD.

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In the Metropolitan Region, PPDA targets were met for SO_x (largely), PM_{10} and CO (Table 2.3). PM_{10} emission growth in the transport sector was more than offset by industrial conversions to natural gas. Increased reliance on natural gas in industry also explains the dramatic fall in SO_x emissions and, together with the spread of catalytic converters in light vehicles, the decrease in CO emissions. NO_x emissions, by contrast, have continued to rise because of increases in the transport sector.

Table 2.4 **Air pollutant emissions by source,**[a] 1990 and 2001

('000 tonnes)

		SO_2	NO_x	NMVOCs	CO
Total mobile sources	1990	4.4	66.4	61.8	322.3
	2001	8.8	111.6	59.3	320.7
Total stationary sources	1990	2 252.1	79.7	66.7	461.8
	2001	805.1	180.7	142.9	948.8
of which:					
Energy combustion[b]	1990	144.7	75.4	47.4	408.3
	2001	183.4	173.3	102.4	871.0
Industrial processes	1990	2 103.9	1.0	2.4	4.4
	2001	618.2	3.1	22.9	15.0
Use of solvents	1990	–	–	14.2	–
	2001	–	–	14.2	–
Other stationary sources	1990	3.4	3.2	2.7	49.1
	2001	3.5	4.3	3.4	62.8
Total	1990	2 256.5	146.1	128.6	784.0
	2001	813.8	292.3	202.2	1 269.5
Change 2001/1990 (%)		*–63.9*	*100.1*	*57.3*	*61.9*

a) Includes OECD Secretariat estimates for 2001.
b) Mainly power plants and industry.
Source: CONAMA.

2.2 Ambient air quality

PM_{10} concentrations in the Metropolitan Region decreased from some 100 µg/m^3 in the early 1990s to around 70 µg/m^3 in 2003 (annual average). Despite these advances, however, considerable progress is needed in the region for PM_{10}, ozone and CO, whose concentrations still exceed standards. While PM_{10} levels have fallen dramatically, the number of alerts has remained high. Ozone concentrations are unchanged. As regards critical episodes of urban air pollution by *PM_{10}*, no environmental emergencies have

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been recorded in the Metropolitan Region since 1999. Despite thresholds that are stringent by international standards (e.g. compared to California), emissions have been reduced enough to eliminate emergencies and reduce pre-emergencies. The *approach to air quality monitoring* has been to focus on places where pollution from specific emission sources was strongly suspected. The Environmental Impact Assesment System has provided complementary information in parts of the country where industrial, mining or energy-related projects are operating (Chapter 5).

Trends in ambient air quality have been monitored in *five cities of more than 150 000 population* that are particularly vulnerable to air pollution. They are Santiago (home to 40% of Chile's population); Talcahuano (in the Concepción urban area), long a key industrial centre, with SO_2 and PM_{10} problems; the suburbs of Quillota, where a gas-burning power plant was built in the late 1990s, raising NO_x and ozone levels; and two regional capitals: Temuco, in the heavily wooded south, affected by PM_{10} from residential firewood use, and Antofagasta, in the arid north, where the PM_{10} is of natural origin (dust). SO_2 concentrations have been reduced in Talcahuano through a voluntary approach, and NO_2 concentrations have been stabilised in Quillota. But the ambient air quality standard is still exceeded for PM_{10} in Santiago, Talcahuano and Temuco (annual average), and for ozone in Santiago. In 1998, air monitoring started at Viña del Mar in the Valparaíso urban area.

Air quality has also been monitored for nearly ten years *around copper smelters* at Altonorte, Chagres, Chuquicamata, Ventanas, Caletones, Potrerillos and Paipote, as well as in the vicinity of a coal-fired power plant in Ventanas. Most air clean-up plans in the mining sector have been successful. For the Potrerillos smelter at El Salvador in Region III, instead of aiming to achieve air quality standards CODELCO decided to relocate the local population in neighbouring cities and to build housing for mine workers three kilometres away from the smelter. A similar process is taking place at Chuquicamata.

Unleaded petrol was introduced in 1992. Its use exceeded that of leaded petrol in 1997 (in volume) and now leaded petrol has been totally phased out. This resulted in a significant decrease in atmospheric *lead concentration*. Elemental lead is not monitored, since leaded petrol was the main source of lead pollution in most cities. Nevertheless, CONAMA is co-ordinating studies in areas where lead levels are believed to be elevated.

3. Air Management and the Transport Sector

Chile's transport sector accounts for about 5% of GDP, up from 4.5% in the mid-1990s. *Transport demand* is growing rapidly, generating congestion and air

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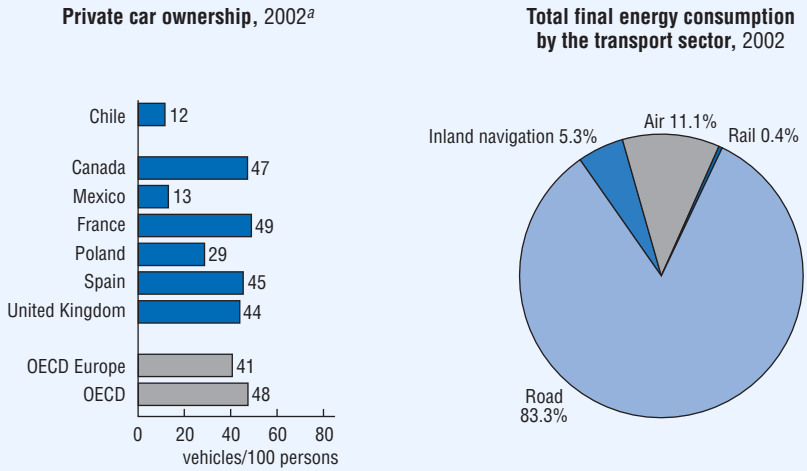
pollution. Mobile sources account for almost 40% of NO_x, 30% of NMVOC and 25% of CO emissions (Table 2.4). Among the various transport modes, road vehicles produce the greatest impact by far (Figure 2.2). Some 87% of motor vehicles are passenger cars, of which 96% run on petrol. Buses and trucks are diesel fuelled.

Over the review period, Chile made important decisions in designing and applying *measures to curb atmospheric emissions from transport*. Measures to achieve the 1998 *PPDA emission reduction targets* in the sector included reducing per-vehicle emissions by promoting demand for new vehicles, improving inspections of vehicles in use and raising fuel quality; reducing freight and passenger traffic in the Metropolitan Region, including through road pricing and parking fees; incorporating environmental variables into transport planning; and reducing trip frequency by motor vehicles through measures such as improved co-ordination between land use planning and transport infrastructure planning and the introduction of travel demand management plans. The 2004 PPDA put increased emphasis on fleet renewal and fuel quality improvement. Also helping to reduce air pollution are traffic management (e.g. bus management, motor vehicle use restrictions, efficient use of infrastructure) and urban transport planning (e.g. 2000-10 Transantiago plan) (Box 2.2).

Figure 2.2 **Transport sector**



a) Or latest available year.
Source: National Statistics Institute; OECD; IEA-OECD.

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Box 2.2 Traffic management and urban transport planning in the Metropolitan Region

Traffic management

In the 1970s and 1980s, entry into the *market for public transport by bus* was unregulated, as were tariff setting and the selection of bus lines. In the 1990s, the oldest 20% of the bus fleet was forced to retire and *bidding for bus routes* was introduced for the most congested streets in central Santiago. This change improved the traffic situation considerably by reducing overcapacity in the market and overuse and congestion. Old buses were replaced by more fuel-efficient ones. However, a number of smaller operators moved their lines to adjacent residential areas, reducing the effectiveness of the reform.

In the 1980s, the Metropolitan Region intendant began imposing *motor vehicle use restrictions* in Santiago when poor air quality was expected. Since the early 1990s, a rotating schedule based on licence plates has restricted by 20% the number of cars, buses and trucks on given weekdays from March 1 to December 31 (January and February are holiday period in Chile). More stringent restrictions on vehicle use (reducing traffic by 40-60%) apply during critical air pollution episodes, including alerts. For vehicles equipped with catalytic converters, since 2001 restrictions on use have applied only in pre-emergency and emergency conditions. This provision helped accelerate modernisation of the motor vehicle fleet (around 75% of private cars in the Metropolitan Region now have catalytic converters) but also led some people to buy second cars that are cheaper and more polluting. As a result, the number of trips by motor vehicle decreases by only 5% in pre-emergency conditions.

Santiago's *public transport and road infrastructure* is generally well managed and continuously improved. The 40 km of publicly owned and operated subway (underground) lines efficiently provide 800 000 passenger trips per day, and other public transport (bus, suburban rail, collective taxis and regular taxis) provides 4.5 million passenger trips per day. Since 1995, highway projects have been contracted out to private firms. Private investors plan to operate two trolley lines in central Santiago. A computer system controls traffic signals.

However, further improvements to *traffic flows* are necessary. Many operators still share routes and bus lanes, leading to operating inefficiencies and dangerous driving behaviour when drivers tout for passengers. Bus ownership remains highly fragmented, with most owners having just one bus. Oversupply during off-peak hours contributes to unnecessary congestion and pollution, and increases operating costs. Bus routes are long, crossing the entire city, and most run through the city centre and on the most heavily travelled streets. There is no *tariff integration* among bus routes.

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Box 2.2 **Traffic management and urban transport planning in the Metropolitan Region** *(cont.)*

Urban transport planning

The *1995-2000 Urban Transport Plan for Santiago* called for traffic flow improvement through dedicated bus lanes, extension of the subway system and improvement of suburban train service. It also called for road expansion. The *2000-10 Urban Transport Plan for Santiago* (Transantiago) seeks to maintain the share of public transport in overall transport use, to promote efficient management of transport demand, including internalising all costs of car travel, and to promote land use policies that take into account environmental and transport dimensions, including helping reduce average trip length. The plan is consistent with the PPDA and aims at reducing emissions of PM_{10} from public transport by 75% and of NO_x by 40%, from 1997 levels.

A priority of Transantiago is to *modernise and integrate bus and subway services*. Plans include expanding the *subway network* to 85 km of track and to 3.5 million passengers per day, opening three new suburban rail lines and investing USD 750 million in *new road infrastructure*, bus stops and bus-metro transfer stations. Transantiago provides not only for more efficient bus use (reducing fleet size and increasing bus occupancy and average speed) but also for renewal of the fleet, with the introduction of clean technology. This plan involves reducing average route length by 60% (from 62 km to 25 km), cutting the number of buses from 7 500 to 5 300 in rush hour and to 4 500 the rest of the day, designing a route network crossing the city via dedicated streets and traffic lanes, and introducing an integrated fare system using contactless smart cards.

The *initial measures taken* under Transantiago (dedicated bus lanes and streets, one-way traffic in peak hours) have demonstrated that air pollution and traffic congestion can be substantially mitigated at low cost. Since 2000, bus passengers' travel time has been reduced by 15-35% and bus occupancy rates increased by 16%. By mid-2004, PM_{10} and NO_x emissions from transport in the Metropolitan Region had been reduced by 56% and 40%, respectively, from 1997 levels. It is expected that the reductions will reach 86% and 77% by mid-2006. USD 1 billion is being invested in the state-owned subway line: 6 km of line extensions and a new line of 32 km have already been tendered. The design of the bus trunk network, feeder routes and transfer stations should improve average trip length and connections between subway, buses and suburban trains. New concessions for the private bus network should be put out to tender by 2005-06 to meet an ambitious target of 15 bus companies running 200 to 700 buses each.

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3.1 Vehicles

The share of *Chilean households owning at least one car* reached 59% in 2002, up from 45% in 1992. The motor vehicle fleet in 2002 comprised 1.7 million passenger cars, 80 000 sport utility vehicles (SUVs), 450 000 pickups, 120 000 trucks, 108 000 light commercial vehicles, 103 000 taxis, 34 000 buses, 3 400 mini-buses and 72 000 other vehicles. Cars with catalytic converters were introduced in 1992.

Modernising the motor vehicle stock

Private car ownership is low by OECD standards (Figure 2.2) but rapidly increasing. Purchases of new cars have risen quickly as income has increased and the economy opened. At the same time, however, the number of old cars retired has been relatively low. As a result, car ownership has greatly increased and with it total mileage driven and pollutant emission levels. Despite restrictions on car use (for cars without catalytic converters), more efficient provision of public transport and expansion of the subway system in Santiago (with USD 250 million in investment in recent years), private car ownership rose from eight vehicles per 100 persons in 1991 to 12 in 2002. The population increased by 30% in this period but car registrations by 103%. The combined number of passenger cars, SUVs and pickups rose from some 150 000 in the early 1970s to 2.2 million in 2002.

While the import of used vehicles is prohibited for environmental reasons, *car sales should continue to rise* as income grows and trade is further liberalised (Chile has virtually no motor-vehicle industry). Low and declining interest rates in recent years have made car loans more affordable. In 2003 dealers introduced a guaranteed trade-in price, meaning buyers of new cars can halve their purchase price if they return properly serviced cars within two years and 40 000 km. All this will increase the motor vehicle stock but also speed up its renewal.

Car inspection

Since 1994 the *mandatory vehicle inspection system* has been overhauled twice. A general inspection must be carried out each year (by accredited centres), which includes control of air pollutant emissions. For vehicles without catalytic converters, air pollutant emissions must be checked every six months (every four months for vehicles registered prior to 1992 and for diesel vehicles).

Since 1995, random on-road inspections have been carried out in Chile's major urban centres. Over 1995-2003, the annual *average of inspected vehicles violating emission standards was 12%* (ranging from 9% to 20% of the 40 000 to 100 000 vehicles inspected in a given year). The violation rate is generally higher for diesel than for petrol vehicles: 11% of all diesel vehicles inspected in 2003 were in

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violation, as were 9% of Santiago's buses, compared with 6% for medium-sized taxis (colectivos), 4% for other taxis and 3% for cars. Vehicles in violation have three months to comply with emission standards; otherwise they are subject to fines of USD 50-500, or impounded.

Improving vehicle emission standards

In the early 1990s the Ministry of Transport, in co-operation with CONAMA, began defining *emission standards for new motor vehicles* based on US and EU regulations. Dual standards often exist, under which new engines can meet either US or EU standards. Standards for the Santiago area are generally more stringent or were introduced earlier than those for the rest of the country. The latest standards apply to CO, hydrocarbons and opacity from diesel vehicles (from 2000); non-methane hydrocarbons (NMHC) from light and medium compressed natural gas (CNG) vehicles (from 2000); CO and total hydrocarbons (THC) from motorcycles (from 2001); and CO, THC, NMHC, methane, NO_x and particulates from buses in the Metropolitan Region (from 2003). Chile has not set a specific date to adopt Euro IV for heavy vehicles and urban buses even though 50 ppm diesel fuel is already available in Santiago; Euro IV, which enters into force in 2005 in the EU, will likely require the use of both particulate filters and NO_x reduction. For light vehicles, the emission standards that will apply in Santiago from 2005 permit much higher emissions of NO_x and particulates than the US Tier 2 standard (in force as of 2004 in the US), which Chile does not intend to adopt yet. The guiding principle in the adoption of vehicle emission standards has been to lag between two and five years behind the leading countries, pending market stabilisation and verification of the results.

Reducing excess bus capacity

In the late 1970s the state-run bus company was closed down and the Ministry of Transport declared urban public buses to be a completely free access system. Anyone who owned a bus could participate in urban public transport without having to comply with any regulations regarding tariffs, passenger safety or service quality. The bus fleet mushroomed to 13 000 vehicles, many underused and badly maintained, and half of them more than 12 years old. NO_x and PM_{10} emissions from diesel combustion rose dramatically.

Regulation was *reimposed on the bus sector* in 1990. In 1991, the Ministry of Transport retired 2 600 buses, 20% of the fleet, by compensating owners of buses older than 18 years for their scrap value. Provision was made for a further 1 800 vehicles to be retired as they reached the age limit. The ministry set up a registry of vehicles in public transport and began controlling new entries. Regulations on air pollution and technical inspection improved, and quality standards covering age, size and emission technology were introduced in Santiago. The PPDA lowered

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the bus age ceiling to 12 years and set a target to phase out another 2 700 old buses by the end of 2004. Since 1990 the measures in the Metropolitan Region have shrunk the fleet from 12 500 buses with an average age of 15 years to the current 7 500 buses with an average age of five years, thereby meeting the PPDA target.

3.2 Fuel quality

New emission control technology is gradually being introduced, necessitating fuel quality improvements. Since 1997, under the General Environmental Framework Law (Law 19.300), *fuel quality standards* have been increasingly tightened. The maximum sulphur content of road fuel sold in the Metropolitan Region was 5 000 ppm in 1990 but is now lower than EU and US standards (Table 2.5). Since July 2004 the diesel sold in Santiago, at 50 ppm maximum sulphur content, is the cleanest in any major Latin American city. Looser fuel quality standards apply in the rest of the country. In all regions but Santiago, by 2007 diesel sulphur content is due to decrease from 3 000 ppm now to 350 ppm and benzene content in petrol from 5% to 1%.

Table 2.5 **Fuel quality standards: maximum sulphur content**

(ppm)

	Metropolitan Region		European Union		United States	
	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol
1993					500	
1996			500		500	
1997	1 500		500		500	
1998	1 500	1 000	500		500	
2000	1 000	1 000	350	150	500	
2001	300	400	350	150	500	
2004	50	30	350	150	500	300[a]
2005	50	30	50[b]	50[b]	500	80[c]
2006	50	30	50[b]	50[b]	15[d]	80[c]
2009	50	30	10[b]	10[b]	15[d]	80[c]

a) USEPA Tier 2 Motor Vehicle Emission Standards and Gasoline Sulfur Control Requirements; national average sulphur content must be 120 ppm.
b) Directive 2003/17/EC relating to the quality of petrol and diesel fuels.
c) USEPA Tier 2 standards; national average sulphur content must be 30 ppm.
d) USEPA Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements.
Source: Ministry of Transport and Telecommunications.

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Such fuel quality improvement will provide *many environmental benefits*. Fuel combustion emits SO_2 and sulphate particulates. Any reduction in fuel sulphur immediately reduces these compounds, and, as sulphur levels decline past a certain point, the benefits increase to include other pollutant emissions. Reduced-sulphur fuel (150-51 ppm) makes existing vehicles run cleaner, decreasing emissions of CO, HC and NO_x from catalyst-equipped petrol vehicles and particulate emissions from diesel with or without catalysis. Low-sulphur fuel (50-11 ppm) permits the use of advanced diesel control technology leading to further improvements in air quality. Diesel particulate filters can be used without low-sulphur fuel but achieve only about half the control efficiency. Selective catalytic reduction can be used for over 80% control of NO_x emissions. Ultra-low-sulphur fuel (10 ppm or less) permits the use of NO_x absorbers, increasing NO_x control to over 90% in both diesel and petrol vehicles and enabling more fuel-efficient engine design. With the addition of filters, control of particulates approaches 100%.

Chile has three refineries, all run by the state oil company, ENAP. The largest is near Talcahuano in Bío-Bío Region VIII. Another is north of Santiago and the third north of Punta Arenas in southern Chile. In June 2004 ENAP announced plans to increase the production of its refineries to meet domestic demand for cleaner diesel and gasoline. *Extensive enforcement is required* to keep cheaper, high-sulphur diesel fuel from being imported and used instead of low-sulphur diesel. The use of high-sulphur diesel damages expensive emission control devices that need low-sulphur fuel, and could thus have a devastating economic impact on some bus owners.

In the longer term, Santiago will increase the use of alternative fuels in public transport. In 2000 tests were carried out with buses running on CNG, and in 2001 a prototype hybrid (diesel-electric) bus was introduced. So far 500 taxis have been converted from petrol to CNG, but no buses have yet been converted from diesel to CNG. The aim is to have enough vehicles that installing CNG service stations in Santiago would become economic.

4. Air Management and the Energy Sector

4.1 Policy objectives

The PPDA seeks to control emissions from the energy sector in the Metropolitan Region through incentives to use clean technology and improve fuel quality. Even more significant progress towards air quality objectives could be made by *curbing industrial and residential energy demand*, in particular by internalising external costs in energy prices. More broadly, future energy efficiency measures, the energy mix and energy prices will influence air quality in Chile (Box 2.3).

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Box 2.3 **Energy outlook**

The annual rate of growth in electricity demand has largely followed GDP growth: it was 8% in the 1990s, 4.5% in 2002 and 6.6% in 2003, and is expected to average more than 7% in 2004-08. Chile had planned to lessen its dependence on hydropower by adding combined-cycle electricity generation plants fuelled by natural gas from Argentina. The plan included building one such plant, of around 400 MW, each year in 2003-08, two in 2009 and one in 2010, with the aim of raising the share of natural gas in TPES to 33% by 2010.

Short-term responses to restricted natural gas supply

In April 2004, *Argentina began restricting natural gas exports to Chile* to meet its own booming demand. Between April and June 2004, deliveries fell short of contracted volumes by 20-50% per day. In June 2004, after negotiations, Argentina agreed to reduce the peak restriction level to about 10%. Chile's northern electricity grid was the most affected by the restrictions. Gas-fired power plants in northern Chile, particularly those that cannot switch fuels, have had to buy electricity from third parties to meet contractual obligations.

The restrictions prompted the government to reconsider its energy policy in the short term. It is now *encouraging power producers to invest in back-up capacity* by proposing to allow gas-fired plants that can switch to oil to charge higher prices than those using only natural gas. In addition, *hydropower projects have been revived*. The new Ralco hydropower plant on the Bío-Bío River in Region VIII began operating in late 2004. It had originally been expected to open in 2003 but protests from four Pehuenche Indian women who refused to be relocated delayed completion. The plant generates 690 MW, increasing the central grid's installed capacity by 8%. In 2004 approval was granted to a private generator, following an environmental impact study, for a project to build two hydroelectric plants with a total generating capacity of 300 MW on the Tinguiririca River in Region VI. Work started in June 2004. Chile also envisages having ENAP build a *liquefied natural gas* port and regasification plant by 2008 to expand and diversify natural gas supplies, though this gas might be too expensive for electricity generation. Measures to *boost investments in electricity generation* include an amendment to the electricity law in January 2004, ending an "investment strike" by changing the regulatory regime to enable higher profitability. This move attracted new entrants to the electricity sector and should revive about USD 3 billion in long-shelved generation and transmission projects.

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Box 2.3 **Energy outlook** *(cont.)*

Expanding the supply of renewables

The natural gas import restrictions will likely lead to some *switching back to coal and oil* in electricity generation, at least in the short term, to the detriment of both the economy and the air. This is an additional incentive for Chile to improve its *energy efficiency* by curbing energy demand. Also, the 2005-15 energy plan is expected to *promote increased reliance on renewable sources of energy*. The 2004 amendment to the electricity law provides for access to the grid by small generating stations, and one proposal would let generators of less than 9 MW relying on "unconventional" renewables use the transmission systems for free. These measures, however, do not seem sufficient to foster private investment in renewable energy projects, given the much lower cost of generating electricity from fossil fuels. Further temporary incentives would be needed to extend the use of renewable resources enough to respond in any significant way to increasing electricity demand.

Efforts should be made to encourage the use of such untapped resources as *geothermal energy* and remaining *hydroelectric potential*. Based on a preliminary assessment, the country's geothermal potential is estimated at 8 000 MW (equivalent to 74% of current installed capacity). Of its estimated 24 000 MW in hydroelectric potential only 4 130 MW is now exploited by hydropower plants, mostly in central and southern Chile. A reform of the water code submitted to Congress is likely to include a substantial and growing annual charge on unused water rights, payable following a grace period (Chapter 3). It is designed to penalise electricity companies that have secured water rights by proposing to build hydroelectric plants but have not carried out the projects, preventing exploitation of this hydroelectric potential by others. The three largest hydroelectric generators exploit *only 14% of the water rights* registered in their names. A master plan for hydro and geothermal energy resources could be prepared. Finally, Chile has considerable potential for *using wood for energy*, given the continuous increase in the growing stock on tree plantations, and the room to make better use of residue from timber harvest.

Progress is needed to improve energy *efficiency in industry and in electricity generation* (notably at coal- and oil-fired plants), which together are responsible for about 23% of SO_x emissions, 60% of NO_x, 70% of CO and 50% of NMVOCs (Table 2.4). Lowering the sulphur content of heavy fuel oil, as was done for road fuel, would also reduce NO_x, particulate and CO emissions. Since SO_x emissions (both per capita and per unit of GDP) remain very high by OECD standards, efforts to *improve*

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industrial processes in the mining sector should be pursued, as copper smelters still account for 76% of total SO_x emissions. The Chilean approach has been to set ambient air quality standards and look for the best available technology not entailing excessive cost (BATNEEC), such as sulphate tanks, meanwhile restricting industrial production during critical air pollution episodes (i.e. when the air quality standards are exceeded). A similar approach has been adopted for PM_{10} emissions from copper smelters. Trading mechanisms are not an option, given the limited number of players. Nor have emission charges (based on emission standards for stationary sources) been envisaged.

4.2 Energy intensity and energy efficiency

Total primary energy supply (TPES) grew 81%, at a slightly lower rate than GDP (Table 5.1). In 2002, *energy intensity* was similar to the OECD Europe average, somewhat below the OECD average (Figure 2.3) and somewhat above that of Argentina and Brazil. It has improved steadily except in 1999, when the El Niño phenomenon brought a long period of dry weather and low temperatures. On the other hand, since 1990 per capita energy consumption has grown faster in Chile than anywhere else in South America, and currently is the continent's second highest, after Argentina. Industry accounts for 38% of total final energy consumption, transport for 32% and the residential/commercial sector for 30%.

A national programme for efficient energy use ran from 1992 to 2000. Pilot initiatives aimed at promoting *energy efficiency* included energy audits at 40 industrial firms, with recommendations of energy saving measures that resulted, in public sector buildings, in energy savings ranging from 25% to 55%. In addition 70% of Chile's public lighting services were upgraded to be more energy efficient. In 2000 the virtual absence of a regulatory framework to promote energy efficiency prompted redefinition of the focus of the National Energy Commission (CNE), putting greater emphasis on its regulatory and standard-setting functions, as opposed to the mere execution of specific projects. The commission is assessing the potential for cogeneration. It is also developing standards for energy efficiency labelling of electric appliances and thermal regulations for housing construction. An energy efficiency programme for state institutions and a draft policy document on energy efficiency are being prepared.

4.3 Energy mix

Chile's current *sources of energy supply* are oil (39%), natural gas (25%), wood biomass (17%), coal (11%) and hydropower (8%) (Figure 2.3). The country has

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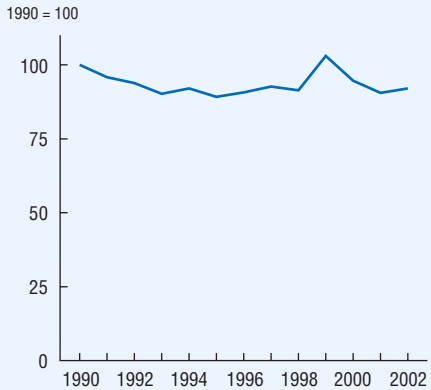
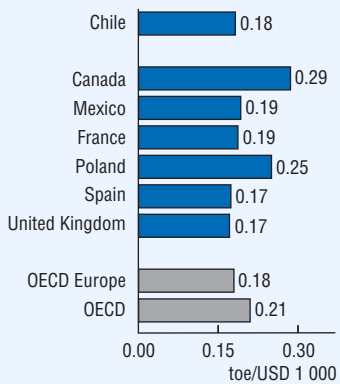
Figure 2.3 **Energy structure and intensity**

Energy[a] per unit of GDP[b]

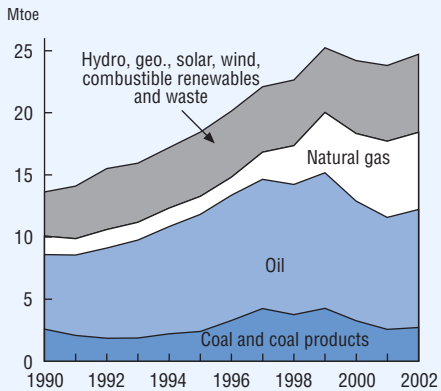
Trend in Chile, 1990-2002



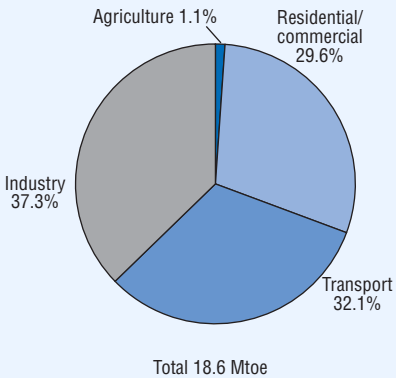
State, 2002



Energy supply by source,[c] 1990-2002



Total final energy consumption by sector, 2002



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

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limited indigenous energy resources other than hydropower and biomass, and it uses scarcely any "unconventional" renewable energy sources such as geothermal, solar and wind power. Indigenous resources supply about 3% of its oil, 15% of coal and 25% of natural gas. Rapidly rising energy demand has increased *dependence on energy imports*: fuel and lubricants accounted for 16% of the total value of imports in 2003, up from 9% in 1997. Energy imports represent 70% of its TPES: Chile's main source of crude oil and natural gas is Argentina while its coal imports come primarily from Canada, Australia and Colombia.

There has been a clear trend towards *replacing coal with natural gas in electricity generation*. In the early 1990s, increased energy demand, environmental concerns and security of supply considerations prompted the government to encourage natural gas use. Gas consumption has increased sharply since 1997 with the opening of pipelines from Argentina. Meanwhile, the competitiveness of coal declined after coal subsidies stopped in 1995, and the country's largest coal mine closed in 1997. Almost two-thirds of imported coal is used to generate electricity, largely as a back-up to hydropower. For example, coal consumption increased significantly during droughts in 1998-99. Little progress has been made towards improving the *quality of solid fuels* such as coal and coke.

Hydropower, long Chile's single largest power source, represents some 51% of electricity generation. Plants burning oil, natural gas and coal account for around 47%, and other renewables (mainly wind) for less than 1%. Since droughts periodically curtail hydropower production, causing supply shortfalls and blackouts, the government began in the 1990s to diversify the energy mix and reduce reliance on hydropower, mainly by building gas-fired power plants. While nothing in Chilean regulation bars the sale of electricity produced from renewable sources (any generator can sell electricity as a spot producer), there is no proactive policy to promote the spread of renewables such as geothermal and wind power or biomass. Companies wishing to provide electricity from *renewable sources must compete on the same economic basis* as traditional energy sources.

4.4 Energy pricing

By OECD standards, *energy prices* in Chile are low when it comes to electricity, similar for oil and quite high for natural gas (Table 2.6). Households pay more than industry (more than twice as much in the case of natural gas).

The import tariff on *crude oil and oil products* is 6%, although the actual tariff paid is much lower as most oil is imported from countries with which Chile has preferential trade agreements. In 2002, however, Argentina issued a decree imposing

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a 20% tax on crude oil exports and a 5% tax on oil derivatives such as petrol, diesel fuel, kerosene and lubricants. The rationale was that Argentine oil companies' revenue would increase with the devaluation of the peso and that a tax on exports would help restrain domestic oil price increases. Since 1978 *oil product prices in Chile have been deregulated*. Ex-refinery prices are set freely but have to be consistent with the prices of imported products plus a 6% import tax. Estimated transport, storage and marketing costs are added to ex-refinery prices to yield final retail prices, to which 19% VAT is added. Heavy fuel oil prices for industry are about at the OECD average (at current exchange rates), while light fuel oil prices for households are around 9% lower (Table 2.6).

Chile established an *Oil Price Stabilisation Fund* in 1991 to cushion *domestic oil product prices* from international fluctuations. The fund uses price bands for petrol, kerosene, diesel, fuel oil and liquid gas. The limits of each price band are 12.5% above and below a reference price, set weekly. The limits are compared to a parity

Table 2.6 **Energy prices in selected OECD countries,**[a] 2002

	Electricity		Oil		Natural gas	
	Industry (USD/kWh)	Households (USD/kWh)	Industry[b] (USD/tonne)	Households[c] (USD/ 1 000 litres)	Industry (USD/10^7 kcal)	Households (USD/10^7 kcal)
Chile	0.055	0.083	204.6	332.2	216.4	481.3
Canada	. .	. .	179.2	316.0	125.3	236.2
Mexico	0.056	0.092	117.6	. .	122.7	. .
France	0.037	0.105	175.6	343.3	171.9	425.6
Poland	0.049	0.084	131.1	356.4	173.1	336.9
Spain	0.048	0.114	184.5	348.4	165.5	496.9
United Kingdom	0.052	0.105	203.1	238.8	146.4	317.0
OECD	0.062[d]	0.102[d]	205.7	364.7	162.0	348.7
Chilean price/OECD price (%)	*87*[d]	*82*[d]	*99*	*91*	*134*	*138*
Argentina	0.020	0.035	143.7	215.6	53.0	86.7
Bolivia	0.043	0.055	403.4	327.6	69.9	265.3
Brazil	0.036	0.084	130.3	180.2	98.3	81.2

a) USD at current exchange rates.
b) High-sulphur oil.
c) Light fuel oil.
d) 2001 data.
Source: Latin American Energy Organization; OECD-IEA.

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price, which is based on average international prices plus cost, insurance, freight and customs duties. When the parity price exceeds the upper limit of the price band, the difference is compensated from the fund. If the parity price falls below the lower limit of the band, the difference is paid into the fund. Because international oil prices tended to increase after the initial USD 200 million fund was set up, the government lent it increasing amounts. The growing burden on public finances led the government in 2000 to change the fund rules. The fund is now capped, and under the new rules it acts only as a stabilisation fund instead of providing a subsidy (it no longer receives budgetary transfers).

The *elimination of coal subsidies* was economically beneficial, while gradual removal of oil subsidies incurred short-term economic costs. The environment clearly benefited in both cases through reductions in CO, particulates and CO_2. Recent trade agreements with Canada and Colombia exempt coal imports from these countries from the import tax, however, and Chile has no fiscal measure to internalise externalities associated with coal use.

Electricity prices for households are 18% lower than the OECD average and those for industry are 13% lower (at current exchange rates) (Table 2.6). The Chilean electricity industry is wholly in private hands, with the government carrying out regulation, monitoring and indicative planning (Box 2.4). The *electricity market is partly regulated and partly free*. Consumers with connected capacity of up to 500 kW are part of the regulated market. Those whose electricity demand exceeds that or who have other non-standard requirements are free to negotiate contracts with generators. The large industrial and mining companies in the second category account for over 90% of total electricity sales. Regulated consumers pay a fixed tariff calculated by the CNE. Every six months, the distribution value component of the tariff is determined and node prices are updated. Before the new Electricity Law was approved in January 2004 the regulated market consisted of consumers with capacity of up to 2 MW.

Fiscal measures related to energy take little account of environmental concerns. Road fuel prices are low. In addition to VAT of 19% there are very low registration taxes and a surcharge on luxury imported cars that is due to fall gradually from 85% in 2003 to zero in 2007. Fuels used in industrial production processes and electricity generation are subject only to VAT (Chapter 5).

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Box 2.4 **Institutional framework for energy policy**

Most of Chile's energy sector has been privatised. *Energy policy decisions* are the shared responsibility of the CNE, the Ministry of Economy and Energy and the Superintendency of Electricity and Fuels (SEC). The CNE has the authority to propose regulated tariffs and to prepare (non-binding) plans for new generation capacity. The ministry revises and approves proposed tariffs and oversees the granting of concessions to generation, distribution and transmission companies. The SEC was established in 1985 to regulate the electricity industry, making sure that all generators, distributors and transmission operators comply with electricity legislation.

Privatisation of the electricity industry began in the 1980s and was completed in 1998 when the state sold its controlling share of Edelaysen, a generating company, to a private investor. Private companies transmit electricity sold by generators to power distributors, final customers and other generators. Chile has 13 major power distributors. Under the 1982 Electricity Law, a concession is required for the construction of hydroelectric plants and transmission lines. Antitrust legislation prevents generators from owning transmission assets. Foreign investment is allowed in all activities, including transmission and hydropower generation. A majority of the generation and transmission capacity is foreign-owned. The SEC sets and enforces technical regulations in the energy sector. Companies engaging in the transport, storage or sale of combustibles must register with the SEC.

The *electricity system* is divided into four autonomous grids. There are marked differences in market conditions between the northern grid (SING, 3 650 MW) and the central grid (SIC, 7 000 MW). Unregulated customers (mostly large mining and industrial operations) account for over 90% of electricity sales. The SIC supplies mostly regulated clients. The SING generating capacity is mostly gas-fired and that of the SIC mostly hydroelectric. The SING has massive overcapacity (peak electricity demand reached just 40% of capacity in 2002) due to the construction in 1998-99 of two rival gas pipelines from Argentina. To connect the two grids would require building a long transmission line, an idea that is not attractive economically owing to the construction costs and power losses involved.

The *distribution of oil products was privatised* in the late 1970s and is now carried out by both domestic and foreign firms. The state oil company, ENAP, is still responsible for exploration, production, importing and refining. Local, ENAP-owned refineries meet about 85% of Chile's fuel demand. *Coal* can be imported by any operator. Two small state-owned coal mines remain in operation.

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3

WATER MANAGEMENT*

Features

- Drinking water and health
- Rapid sanitation progress
- Water service pricing
- Trading in water rights
- Expansion of irrigation
- Pesticide management

* This chapter reviews progress since 1990.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- continue to invest in *sewerage, waste water treatment and other sanitation infrastructure* in urban and rural areas;
- increase the effective treatment of *industrial effluents*, and strengthen water inspection and enforcement capacities;
- reduce the *effects of agriculture* (e.g. those related to irrigation, nutrients, pesticides and salinisation) on water quality and quantity;
- develop an *integrated watershed approach* to improve water and forest resource management and to provide environment-related services more efficiently;
- give greater weight in water management to protection of *aquatic ecosystems*; improve the integration of nature concerns in water management by setting up a *robust regime for minimum ecological flows and biological water quality standards*;
- improve the *information and knowledge base* for water management (e.g. monitoring of ambient water quality, registry of water rights, data on expenditure and financing).

Conclusions

Since the late 1990s Chile has *undertaken a major water reform* concerning the delivery of water supply and sanitation services. As a result, provision of *water infrastructure* has dramatically increased in line with the regionalisation and privatisation of water companies. Two-thirds of the urban population is now connected to waste water treatment, and plans call for urban sewage treatment to continue to increase. *Full cost recovery* pricing applies to public water supply and sewage treatment, in the context of price regulation at the regional level and subsidies to the poorest 18-20% of the population. Water prices increase in summer to reflect water scarcity. *Minimum river flow* is included in the 1994 General Environmental Framework Law and is broadly taken into account in the allocation of surface water rights; more specific legal provisions have been proposed for inclusion in the Water Code. A pioneering nationwide system of *tradable water rights* was introduced for surface water and groundwater with the 1981 Water Code, but active trading remains mainly confined to some irrigated areas. There is high compliance with the World Health Organization drinking water quality standards. *Effluent discharge standards* were recently introduced for industry, covering both direct discharges and discharges to sewers.

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However, even though most Chilean water bodies are of acceptable quality, *water quality* is poor in some lakes, rivers and coastal waters, mainly due to untreated urban and industrial sewage discharges. There is also pressure from heavy metals from mining in the north, salmon farming inputs in the south and farm inputs in rural areas. A large share of freshwater species is endangered. There are no *water quality objectives* aimed at preserving ecosystems, though they are being discussed. Water quality monitoring and inspection are dispersed among various agencies. Only the Health Code provides authority for enforcement (sanctions), environmental standards having a lower legal status. *Irrigation subsidies* have contributed to water scarcity problems in the centre-north, though efforts are being made to increase cost recovery. *Flood management* has not received much attention in urban planning and there is a lack of storm water collectors. The concept of *river basin management* is only just being talked about.

♦ ♦ ♦

1. Water Management Objectives

National *water quality standards* were first established as technical references in 1978. The standards for *irrigation water* cover various substances (including arsenic, boron, copper and iron) and salt content, and include a limit on faecal coliforms of 1 000/100 ml. A 1987 amendment allows authorities in charge of public works to set less stringent standards for heavy metals where appropriate. Following a cholera outbreak in the early 1990s, the limit on faecal coliforms was enshrined in a 1995 Supreme Decree from the Ministry of Health (the decree applies to fruit and vegetables grown at ground level and usually consumed raw). There are no irrigation water standards for pesticides. *Bathing waters* must meet the same faecal coliform limit as irrigation water, along with physical and chemical parameters; not included in these parameters, however, are heavy metals (which can originate from mining) and antibiotics (which can originate from fish farming). Standards for *aquatic life* are few, though they include dissolved oxygen requirements. *Monitoring* of biological parameters (single-cell organisms, eggs), chemical parameters (non-accumulative chemicals, cyanide, detergent), nutrients, heavy metals and toxic contaminants (pesticides, persistent bioaccumulative chemicals) is left to enforcement authorities' discretion. *Drinking water quality standards* were established in 1984.

The development of *emission standards* for industrial and municipal sewage discharges began with enactment of the 1994 General Environmental Framework Law. Technical reference standards were first issued in 1996 for discharges into the

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sewer system, as two-thirds of industrial plants nationwide discharge into public sewerage, and in Santiago the share is 82%. They led to issuance of official standards in 1998 (amended in 2000). Standards were later set for direct discharges into marine and inland surface waters (2000) and groundwater (2002). All emission standards came into force with immediate effect for new facilities and will apply from September 2006 for existing ones. The standards require uniform discharge rates from all sources, regardless of the quality status of the receiving body. They apply at the national level, are the same for all industries and cover all sites.

Water quality objectives have not yet been set, though "primary" objectives (those aimed at protecting human health) are about to be approved: they will cover, at the national level, both inland and marine waters, but not groundwater. Secondary water quality objectives (aimed at preserving ecosystems) have not been designed yet, though preliminary work has started for eight rivers (Aconcagua, Aysén, Bío-Bío, Elqui, Loa, Maipo-Mapocho, Serrano, and Cruces in the Valdivia basin). No stretches of Chilean rivers have been designated for specific water uses, so water quality objectives cannot be set according to the major use of rivers. There are no quantitative targets regarding *improvement of water resource management*. River basin management is perceived as a long-term goal. Several different implementing and monitoring authorities are in charge of water management (Box 3.1).

Box 3.1 **Institutional framework for water management**

The *General Water Directorate* (DGA) in the Ministry of Public Works is responsible for inland (surface and ground) water resource management, including water quality control and the granting and registering of water rights. The *Ministry of Health* sets the standards related to health and enforces them though its health services. SISS, established in 1990, monitors the quality of drinking water, grants licenses for discharges of industrial waste water, and sets and enforces discharge standards. It also supervises water supply companies and administers water tariffs. In the Ministry of Agriculture, the *Agriculture and Livestock Service* (SAG) monitors irrigation water quality and enforces related regulations while the *National Irrigation Commission* oversees irrigation infrastructure development. The *General Directorate of the Maritime Territory and Merchant Marine* (DIRECTEMAR) in the Ministry of Defense regulates discharges of waste water from industry, including mining, into ports, navigable rivers and lakes as well as waste dumping at sea (under the London Dumping Convention). Finally, the *National Environment Commission* (CONAMA) co-ordinates the process of updating water quality and emission standards and issuing new ones.

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2. Water Quality Management

2.1 State of water quality

Drinking water quality

In the early 1990s, direct use of contaminated surface water for human consumption in Chile was relatively low and mostly confined to rural areas. In 1991-92 a cholera epidemic in Peru, Bolivia and Brazil, and a number of cases in Chile, served to underline politically the importance of drinking water quality. The quality of drinking water has since been regularly upgraded. It now largely *complies with domestic standards*, and Chile is cholera-free.

After copper smelters started operating in Region II, *arsenic concentrations* in drinking water supplies increased, reaching 580 µg/litre (population-weighted average) in the mid-1950s. Following installation of arsenic treatment plants in the early 1970s, arsenic concentrations were reduced to less than 50 µg/litre, in line with the domestic standard. Arsenic levels in Region II have since been further reduced to 10 µg/litre, in line with the standard set by the World Health Organization (WHO). A survey in the early 1990s revealed that bladder and lung cancer rates were markedly higher in Region II than in the rest of Chile (Chapter 7). It estimated that arsenic accounted for as much as 7% of all deaths among those aged 30 and over, the greatest impact ever reported from environmental exposure to a carcinogen in a major population. A study now under way in the region is assessing the link between childhood arsenic exposure and increased mortality rates for cardiovascular, peripheral vascular and cerebrovascular diseases.

High levels of boron have been found in aquifers supplying Region I with drinking water, a phenomenon with potential health effects (though little has been documented). There is no drinking water standard for boron in Chile, despite the WHO recommendation to set one at 0.3 mg/litre.

In 1990, a countrywide survey conducted by the Superintendency of Sanitation Services (SISS) revealed that out of 395 aquifers from which drinking water was abstracted, 102 (or 26%) were found to be of poor quality. High levels of *nitrates* were found for 45 aquifers and of *iron and magnesium* for 35 aquifers. There is no evidence that the situation has improved. No comprehensive study on soil or groundwater pollution by pesticides has been done.

Irrigation water quality

In the Metropolitan Region of Santiago, most municipal and industrial sewage was long discharged untreated. Concentrations of faecal coliforms in the Mapocho

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River's downstream waters ranged in 1980 between 100 000 and 1 million per 100 ml (the maximum should be 1 000/100 ml). The situation has improved considerably with the sewage treatment plants of El Trebal (2001) and La Farfana (2003). Nationwide almost 16 000 cases of waterborne diseases (accounting for 0.12% of the Chilean population) such as typhoid fever and hepatitis occurred in 1990 because of consumption of vegetables produced with irrigation water contaminated by *untreated domestic and industrial sewage*. The situation has improved dramatically, as shown by the 90% drop in morbidity rates from typhoid fever (Chapter 7).

In some monitoring stations, irrigation water drawn from the Maipo and Mapocho Rivers (Metropolitan Region), the Aconcagua (Region V) and the Cachapoal (Region VI) has been found to be contaminated by *heavy metals, both of natural origin and from mine discharges*, including arsenic, copper and molybdenum. The use of water from the Lluta River, where *boron* levels were as high as 15 mg/litre, led to necrosis in avocado, lemon, orange and cherimoya trees north of Arica (Region I), and ultimately to the disappearance of these fruit tree species in the area.

Surface water quality

Some river sections have excess concentrations of *boron* in Regions I, II, III and IV, *arsenic* in Regions I and II, *copper* in Regions IV, VI and the Metropolitan Region, and *iron* in Region VI. Arsenic and boron of volcanic origin are commonly found in surface waters on northern Chile's high plateaux. Natural concentrations can be as high as 0.7 mg/litre for arsenic and 5 mg/litre for boron. To some degree, however, the high levels of arsenic and copper in Chilean surface waters are linked to *mining and industry*. Surface waters in arid zones commonly have a naturally high salt concentration, sometimes exacerbated by poor irrigation practices.

Though Chile has no water quality classes, the *quality* of the Limarí *River* (Region IV) was characterised as "extremely poor" due to *agricultural run-off*. Nitrate levels in other Chilean rivers are generally found to be acceptable. Water quality is "poor" in the Maipo (Region V), the Rapel (Region VI) and the Mataquito (Region VII), which all receive *untreated municipal and industrial sewage*. Progress is expected with the spread of urban sewage treatment. Water quality is "bad" in the Loa (Region II) and the Aconcagua (Region V), both exposed to mine discharges. In southern Chile effluents from *timber processing* flow into the Bío-Bío River, the Coliumo Bay and the Golf of Arauco. In the early 1990s, larger plants installed their own treatment facilities.

Most *Chilean lakes* show increases in total phosphorus and total nitrogen, and decreases in dissolved oxygen. Lakes Calafquén, Llanquihue, Riñihue and Villarica are oligotrophic (i.e. in early stages of eutrophication) because of both point and non-point sources of pollution, including aquaculture. In southern Chile, the conversion into

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grassland of forested watersheds around lakes has also contributed to nitrogen run-off, as has recently been observed at Lake Rupanco (Region X). The fisheries sector is financing research into the effects of salmon farming on lake water quality.

Coastal water quality

The main *land-based sources of marine pollution* are untreated municipal sewage (21% of Chile's population lives less than 10 kilometres from the coast), direct discharge of sewage from activities including mining and fish meal processing, and, in central regions, agricultural nutrient run-off via rivers. In the area of Viña del Mar in Valparaíso Region V, untreated *urban and industrial sewage* was discharged directly into the sea for many years and beaches were highly polluted by faecal coliforms. The situation has greatly improved since 1999; sewage now undergoes pre-treatment and is discharged far out to sea via an underwater conduit. Until the late 1970s *mining waste* was discharged directly into the ocean. In the Chañaral Bay, for instance, between 30 000 and 35 000 tonnes per day was discharged for about 50 years. Sewage from *fish meal processing* is still an issue: some 85% of the Chilean sea fish catch is used for fish meal production, and while treatment has greatly advanced in the north (which accounts for one-third of the total catch), progress is needed in central and southern Chile, where the annual sea fish catch has increased to reach 3.5 million tonnes.

Marine-based sources of marine pollution include oil spills and fish farming. Southern Chile has been affected by oil spills resulting from drilling on the continental platform and from oil tanker traffic in the Magellan Straits (Chapter 8). Aquaculture in marine waters and lakes of southern regions is now subject to specific environmental regulations and new projects must undergo environmental impact assessment (Chapter 6). The main water quality issues associated with fish farming are nitrogen and phosphorus from excess feedstuff, toxic contaminants (notably fungicides and antibiotics) and decreases in dissolved oxygen.

2.2 Reducing point sources of pollution

Urban sewage treatment

In the early 1990s almost 98% of the urban population was supplied with drinking water, and 85% of urban households were connected to sewerage. By late 2003 *public water supply* reached 99.8% of urban households, and 94.7% had *sewerage* connections, both high proportions by Latin American standards. In rural areas, a potable water programme has increased public water supply coverage to 98%, but there is no sewerage infrastructure (it is not justified on economic grounds, given the low population density).

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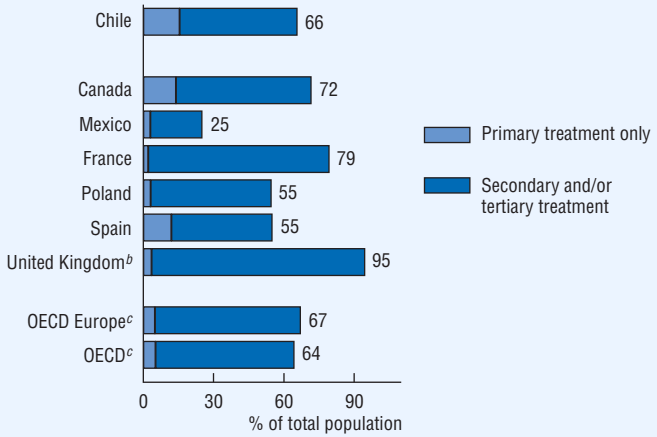
Figure 3.1 **Population connected to public waste water treatment plant**, 2003[a]



a) Or latest available year.
b) England and Wales only.
c) Secretariat estimates.
Source: SISS; OECD.

Most cities still discharged sewage untreated at sea or into rivers in the early 1990s: only 24 *sewage treatment plants* existed in the whole country. By 2003, 66% of the urban population was connected to sewage treatment, in line with the OECD average (Figure 3.1), and a target of 99% was set for 2014. This rapid progress was made possible by a proactive process of privatisation accompanied by well-targeted social subsidies.

In the absence of quality objectives for recipient waters, it was decided after a cost-benefit analysis (including savings from possible health-related agricultural trade restrictions) that sewage treatment plant effluent should meet irrigation water standards. In 2003, compliance with this unambitious standard was high, but not uniformly so. As from March 2001 new plants must comply with the 2000 standards for direct discharges into water bodies. In the future, decisions on the *level of sewage treatment* (primary, secondary or tertiary) should be based on forthcoming river quality objectives.

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Industrial sewage treatment

Since 1998, most industries have been required by law to treat effluents before discharging them into waterways or sewerage. *Progress on compliance has been slow*, however: in 2003, of the 1 530 firms discharging into sewer systems, only around 40% met the 1998 emission standards, and of the 142 *firms with their own treatment plant* (authorised by decree), fewer than 60% complied with the 2000 standards for direct discharges into water bodies. Some USD 1 billion in investment is required for all firms to comply with the 1998 emission standards. To speed up compliance, SISS has established a voluntary evaluation procedure called PRIDE for firms that voluntarily anticipate compliance deadlines. In 2003, of the 96 firms that followed the PRIDE procedure, five got an award for good management of industrial sewage.

Many *other firms* do not have an approved treatment plant, nor do they discharge into sewers. They mostly discharge into ambient waters. These firms may voluntarily agree to limit their effluents by following an evaluation procedure called MAPRO, prepared by SISS. In 2003, 127 firms followed the MAPRO procedure in Regions V, VI, VII, VIII, IX and XI and the Metropolitan Region. Nevertheless, the share of firms with treatment plants or connections to public sewerage will have to increase significantly, as new water quality standards have recently been put into effect.

In 2003, 56% of sewage from *large-scale mining activity* (including mining towns) was treated. Mining companies should also take measures to ensure that toxic sewage disposal facilities behind tailing dams are secured from major accidents, so as to prevent spills into nearby rivers. Such measures need to deal with pollution not only while the mines are in operation but also after their closure.

3. Water Resource Management

Chilean rivers generally have high-altitude sources and are relatively short, thus running rapidly towards the ocean, which limits their potential for consumptive uses. Nationwide the intensity of water use is less than 2%. The *northern subtropical regions* (Regions I to IV) basically consist of arid zones, including the Atacama Desert. Water resources there are scarce and land use is mainly dependent on supply from a few major rivers – Lluta and San José (Region I), Loa (Region II), Huasco and Copiapó (Region III), Elqui, Limarí and Choapa (Region IV) – and aquifers in high plateau basins. Rivers in Region I are dry part of the year. In *central Chile* (Regions V to IX), a Mediterranean climate prevails, with minimum average annual rainfall of 350 mm. The amount of water available from the many rivers crossing the central valley has thus far been sufficient for various water uses and consumption in this highly populated region. In the *south* (Regions X to XII), annual rainfall ranges

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between 500 mm and 2 200 mm. With numerous fjords and lakes, and low urbanisation, there is enough water for most uses, and many potential hydropower sites exist.

Abstraction by sector and by source

Freshwater abstraction increased by 160% between 1990 and 2002 (Table 3.1), essentially reflecting a dramatic rise in non-consumptive use by hydro plants. A 25-year government water demand forecast, to 2017, sees demand from households, mining and industry roughly doubling and agricultural use growing by 20%. Projected demand for hydropower generation is uncertain, as it depends on the extent of natural gas use in electricity generation; estimates suggest potential growth of up to tenfold. *Irrigation accounts for most water consumption*: 84.5% nationwide, though the share varies by region. About *half of the drinking water supply* (by volume) comes from *surface waters* and *half from groundwater*, but in arid and semi-arid zones the share of groundwater in total water use is high, and drinking water mainly comes from aquifers.

Table 3.1 **Freshwater abstraction by major use**

(%)

	1990	1993	1999	2002	Change 1990-2002[a] (%)
Irrigation	28	24	17	13	*25*
Drinking water supply	2	1	1	1	*34*
Industry	5	4	3	3	*64*
of which: Mining	2	2	1	1	*23*
Power plant cooling	65	71	79	83	*230*
Total (m^3/s)	1 822	2 277	3 678	4 743	*160*

a) Based on values in m^3/s.
Source: DGA.

In the northern regions, water scarcity has meant *increasing competition among the main water users*: mining, intensively irrigated agriculture and drinking water supply. Pollution of watercourses aggravates such conflict. Many aquifers of Regions I and II have little or no recharge capacity. Mining companies have often had to buy

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groundwater rights from local farming communities. *In response to water scarcity*, the big mining companies committed to improve water use efficiency as part of a voluntary clean production agreement signed with the government in 2002. They are also pursuing opportunities to reuse treated urban waste water. For instance, since 2002 treated waste water from Antofagasta and recycled water from the copper mine of Minera Escondida have been transported 50 kilometres for use at Altonorte copper smelter. Average per capita *drinking water consumption has slightly decreased* in recent years, from 63 m^3 in 1998 to 61 m^3 in 2002, reflecting water price rises. Consumption is higher in the Metropolitan Region at 85 m^3, reflecting higher average income and housing area. However, although water prices are higher in the north than in the rest of the country, water consumption in the northern regions is not lower. Nationwide, 32% of piped drinking water supply is lost to leakage, according to the average for the 19 largest water companies.

In contrast, *little progress has been made to improve water use efficiency in agriculture*. Irrigation subsidies are still in place, and the government plans to expand the irrigated area. In the mid-1970s the spread of high-density tree plantations (e.g. 2 500 trees/hectare) led to aquifer depletion in Regions VII and VIII. Since the mid-1980s, reductions in planting densities have reduced pressure on water.

Storm water management

Infrastructure for evacuating storm water is deficient following 30 years of inadequate urban planning in this regard. Privatisation of state sanitation agencies, formerly responsible for storm water management, exacerbated the problem. In 1997 responsibility was handed to what are now the Ministry of Public Works (MOP) and the Ministry of Housing and Urban Development (MINVU). MOP is responsible for primary drainage networks and for drafting master plans for storm water drainage in cities above 50 000 inhabitants (all the master plans have now been drafted). MINVU supervises secondary drainage systems. Some USD 2 billion would be needed to develop the required storm water drainage infrastructure nationwide, including USD 600 million for Santiago. Preventive measures have been taken to reduce surface water run-off upstream of major cities.

The work is likely to be undertaken by the water companies as a supplement to their regular service. In 2003 it was decided to impose storm water drainage obligations on urban developers and to open urban storm water management to *concession*. MOP and regional governments are to approve infrastructure development plans and SISS is to supervise concession holders. Investment, maintenance and operation costs are to be recovered from beneficiaries of the service. The system of targeted social subsidies that applies to charges for drinking water (and, more recently, sanitation) will be expanded to storm water drainage.

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4. Economic Instruments

4.1 Water pricing

Privatisation of water utilities

The water sector was privatised later than other public utilities. The process was initiated with the 1989 General Law of Sanitation Services and the actual privatisation began in 1998 after necessary reform in pricing policy. By 2000 the first five regional companies had been partly privatised: the former Metropolitan Water Works Company (EMOS), renamed Aguas Andinas (Metropolitan Region), ESVAL (Region V), ESSEL (Region VI), ESSBíO (Region VIII) and ESSAL (Region X). In 2001 the government decided to change its approach, opting for 30-year concessions. By the end of 2003 *private participation in water and sanitation services* covered 76% of the population served, compared to 5% in 1998. Now 49 operators comprise the sector, of which ten are state-owned and seven have state participation (Table 3.2). Three private water companies (Aguas Andinas, ESSBíO and ESVAL) serve almost two-thirds of customers.

Over 1998-2003 the privatisation/concessions programme brought in more than *USD 2 billion in foreign direct investment*. Between 2004 and 2014, USD 1.3 billion would be required to achieve full coverage of drinking water supply (including rural areas) and 99% coverage of urban sewage treatment, with treatment plants accounting for USD 490 million of that sum.

Price setting

Until the late 1980s, *water tariffs covered only part of operating costs*. The few investments were mostly funded through budgetary transfers. High leakage in the distribution and collection networks, poor service quality and delays in provision of services for new urban areas characterised the sector. Prior to privatisation, a new policy had to be adopted to allow water companies to fully recover their costs.

This *new water pricing regulatory framework was set up in 1989*. Modelled on previous developments in the electricity sector, it involved separate supervisory and regulatory functions; the possibility of creating private companies with limited liability; marginal cost pricing; and full cost recovery, including return on investment. SISS, established in 1990, regulates water prices. The shift to tariffs that cover the cost of investments was made gradually over 1990-98. Shortly before privatisation began the rate of return on capital among public water companies averaged more than 6%. The new pricing system allows full cost recovery through relatively homogeneous tariffs within pricing zones (regions). The marginal costs are calculated separately for drinking water supply and sewage treatment, and the calculation formula is to be revised every five years.

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Water prices rose considerably between 1990 and 2003, more than doubling in some regions (Figure 3.2). By late 2003, the *average water bill came to USD 0.75/m*^{3} (including drinking water supply, sewerage and sewage treatment). Expansion of sewage treatment accounted for most of the increase. The prices were higher in the extreme north (USD 1.77/m^3 in Region II, USD 1.18 USD/m^3 in Region I) and extreme south (USD 1.21/m^3 in Region XI). Water bills typically include a fixed charge (up to 8% of the bill) and a constant volumetric rate that applies to both water supply (up to 98% of the bill) and sewage treatment (up to 27% of the bill). There is no pollution charge. Some 97% of clients of the 19 main water companies have water meters, half of which are less than five year old. SISS ranks the water companies

Table 3.2 **Companies providing urban water and sanitation services,** late 2003

Regions	Total number of companies[a]	Companies with concessions		
		Number of companies	Number of clients (households)	
			('000)	(%)
I	2	2	116	*3*
II	1	1	118	*3*
III	1	1	71	*2*
IV	4	3	155	*4*
V	8	3[b]	480	*13*
Metropolitan	19	18[c]	1 629	*44*
VI and VIII	1	1[d]	559	*15*
VII	4	3	177	*5*
IX	3	3	166	*4*
X	3	3	180	*5*
XI	2	1	21	*1*
XII	1	1	42	*1*
Total	49	40[e]	3 714[f]	*100*

a) Total number of companies (with or without concessions) providing public water supply, sewerage and waste water treatment services.
b) Includes ESVAL, the Sanitary Service Company of Valparaíso (473 000 clients).
c) Includes Aguas Andinas (1.3 million clients) and SMAPA, the Municipal Company for Drinking Water and Sewerage (166 000 clients).
d) Includes ESSBÍO, the Sanitary Service Company of Region VIII (Bío-Bío). ESSBIO (559 000 clients) also serves Region VI.
e) Covering 3.46 million clients (93.2% of the total).
f) Equivalent to 14.03 million people connected to public water supply, 13.32 million connected to sewerage and 9.24 million connected to sewage treatment, i.e., respectively, 99.8%, 94.7% and 65.7% of the total urban population of 14.06 million people.
Source: DGA.

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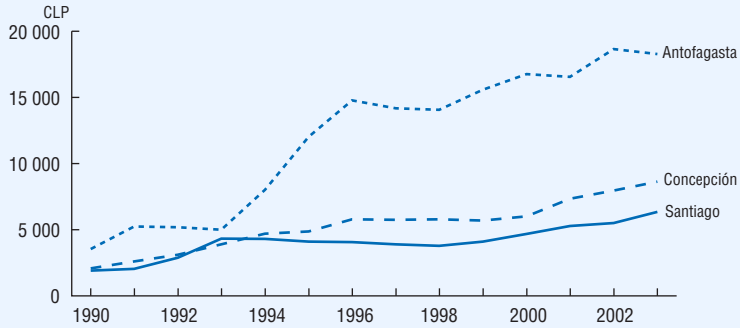
Figure 3.2 **Trends in household water prices,**[a] 1990-2003



a) 2003 constant prices, including VAT, covering water supply and sewage treatment services based on average monthly consumption of 15 m^3.
Source: Ministry of Economy and Energy.

according to service quality (i.e. drinking water quality, continuity in supplying drinking water and sewerage, accuracy of water pricing and delay in answering client requests).

Subsidies for the poor

To reduce the regressive distributional effects of tariff changes in *urban areas*, it was decided that price increases should be accompanied by a subsidy targeted to the poorest urban families. Introduced in 1989, the subsidy now applies to water and sewerage and is funded from the central budget. The *potential beneficiaries* were defined initially as the poorest 20% in each region, who had to apply for water supply subsidies by filling out a Socio-economic Evaluation Form (SEF), unless they had already done so for other social coverage. The available funds were divided among applicants according to their SEF points. Initially eligibility criteria included having no arrears with the water company and consuming less than 20 m^3 per month. In 1991 the latter requirement was abolished, and the subsidy was extended to families sharing a house and to housing compounds sharing a water meter; the potential beneficiaries were redefined as the poorest 20% nationwide. In 1995 the subsidy was extended to rural consumers. With the expansion of sewage treatment since 2001, the targeted subsidy has also been made available for sanitation services.

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In practice, municipalities pay the subsidy directly to the water companies and customers are billed for the difference. The subsidy is granted for three years, after which application must be renewed. Initially the *subsidy rate* was equal to 50% of the bill, up to 10 m^3 per month. In 1993, to provide greater relief in regions with larger price increases (Regions I, II, XI), the subsidy was adjusted at between 40% and 75% of the monthly bill for up to 15 m^3. In 1994 the range was widened to 25-85% for up to 20 m^3 and the rates could differ between regions. In practice, however, the lower end of the range has never been chosen, as it would have been politically unpopular to go under the initial subsidy rate of 50% in low-cost areas. For rural consumers the subsidy covers 50% of the bill for the first 15 m^3 consumed. Beneficiaries of Chile Solidario, a programme aiming to improve the poorest households' access to social protection, are totally exempt from the fixed component and do not pay for the first 15 m^3 consumed. In 2003 the subsidy ranged from 82% in Region I (zone 2) to 50% in the Metropolitan Region.

Despite the dramatic rise in water prices in 1990-98, the subsidy has allowed connections to drinking water supply to continue increasing. By 1998, 99.3% of all urban families were connected, of which *17.4% were subsidised*. In 1998, budgetary transfers for the subsidy amounted to USD 35 million, including USD 1.3 million for rural areas. Since 1998 the *number of beneficiaries has continued to increase* but not the budget, which has stayed at USD 35-40 million a year, thus covering a smaller portion of the water bill. In 2003 there were 615 000 eligible families in urban areas (16.6% of water company clients) and 61 500 eligible families in rural areas. About 73% of the rural beneficiaries were in the poorest group, as measured by their SEF scores. Some USD 40 million, equivalent to 6.2% of water bill receipts, was transferred to urban beneficiaries. The average monthly subsidy was around USD 6 in urban areas and less than USD 1 in rural areas. It ranged between USD 3 in Las Condes (Santiago) and USD 20 in Iquique (Region I).

4.2 Trading in water rights

Although water is considered a national asset in Chile, individuals can own perpetual and irreversible *water use rights* (Box 3.2), which are independent of land use and land ownership. Trade in water rights is fairly unrestricted, and there is a real *free market*, where water rights are traded without a government intermediary. Water rights trading in Chile thus differs fundamentally from that in the western United States, for instance, where water rights are defined by prior appropriation and trading is subject to relatively restrictive rules.

Level of transactions

Most short-term transactions take place among irrigators, particularly as regards seasonal rentals. The degree of long-term intersectoral trade is increasing, with water

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Box 3.2 **Trading in water rights: legal provisions**

Chile's first constitution (1833) provided for water use rights and the 1980 constitution reiterated this provision, but not until the *1981 Water Code* was there a legal basis for the trading system. The Water Code specifies procedures and proofs of claim for *regularising water rights*, favouring parties that had exercised the rights for at least five years regardless of whether those rights had been registered. DGA grants *new water rights* free of charge (Table 3.3). Parties can register objections if the granting of new water rights impairs their own right. The grandfathering of initial water rights was made proportional to their use in 1975, thus benefiting those who were actively using water (mostly poor farmers). *Transactions in water rights* can include short-term or annual sales, leases and permanent transfers.

Where appropriate, *water rights are allocated for legally defined sections of rivers* (e.g. between two tributaries). Holders of rights in one section have no claims to water in another. The owners of water rights downstream are not legally protected from changes in upstream water use that would significantly reduce flows. In case of drought, they have no assurance that their section of the river will receive any water. Nevertheless, DGA may temporarily suspend water rights and allow water redistribution in declared drought disaster areas, and affected right holders may file for financial compensation. The Water Code defines *groundwater abstraction rights* and allows trading in them.

The Water Code does not identify any *priority uses in the granting of new rights* (e.g. drinking water does not take precedence over irrigation). New rights are granted either for *consumptive uses* (irrigation, industry, municipal) or *non-consumptive uses* (hydropower generation, aquaculture). Within each of these two categories, however, user rights are granted *independently of use*. On a given section, rights for non-consumptive use do not restrict rights for consumptive use unless otherwise agreed between right holders. Both types of rights can be traded. Rights for consumptive uses do not include water quality requirements. Holders of rights for non-consumptive uses must return water with the original quantity, quality and potential for use retained.

"Permanent water rights" are expressed in terms of flow (litres per second). When flows are high, DGA may grant "contingent rights" to any excess after all user rights are satisfied. The Water Code does not explicitly refer to *minimum environmental flows*, but the 1994 General Environmental Framework Law does. Since 1994 DGA has broadly taken minimum river flow into account when allocating water rights. An amendment to the Water Code in 1992 provides for the protection of aquifers that supply wetlands in Regions I and II.

Many low-cost sites were first granted to state-owned *electric utilities*. Following privatisation of these utilities, the rights were transferred to private hydro corporations, which thus own more user rights than they will probably need for the foreseeable future. ENDESA, the largest hydroelectric company, is the main holder of non-consumptive rights.

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supply companies buying rights from irrigators. In such cases the principle factors determining price during negotiations are the distance from the company's intake point, the quantity of water and the information available to the seller. The prices of traded water rights signal the opportunity cost of using water. They create incentives to apply the most cost-efficient water conservation options, thereby helping preserve the resource and reducing the need for new water supply investments. In some areas, decreasing the use of irrigation water also has positive environmental effects by reducing salinisation.

The most *active trading* has developed in the *Limarí River valley* (Region IV), where buyers purchase rights to at least 7.2 million cubic metres of water per year. In addition to permanent sales of rights, an active spot market exists in drought years. The conditions for trade in the Limarí valley have been eased by the existence of reservoirs in the valley, adjustable canal gates with flow meters, well-organised water user associations and access by purchasers to the canal system. Some trade has also developed in northern regions, with mining companies buying abstraction rights from farmers.

Table 3.3 **Granting of new water rights,**[a] 2001

(%)

Regions	Groundwater	Surface waters	
		Consumptive uses	Non-consumptive uses
I	2	3	0
II	0	0	0
III	8	0	0
IV	5	0	0
V	19	51	1
Metropolitan	18	0	70
VI	15	0	0
VII	16	2	0
VIII	6	4	3
IX	1	13	8
X	8	17	14
XI	0	4	3
XII	0	6	2
Total (litres/s)	19 716	101 753	202 492

a) Granted by DGA. Water rights were first allocated after the 1981 Water Code went into effect.
Source: DGA.

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Water markets have been inactive in most other parts of the country, however, and thus have had a *limited impact on the efficiency of water use* and the reallocation of resources (Table 3.3). The greatest economic impact of the 1981 Water Code has been the boost to *private investment in the hydro sector* due to the increased legal security of property rights. The code has been much less successful in addressing the issues of co-ordinating multiple water uses, managing river basins, resolving water conflicts (between sectors or between consumptive and non-consumptive uses), protecting river ecosystems and assuring minimum river flows.

A major impediment to the proper functioning of water markets has been the *lack of a central register* of water right holders and transactions, which means administrative delays in establishing new rights and authorising transfers. The Water Code specified that DGA was to designate original rights and keep a national water register, but the task proved overwhelming (water markets can be characterised as thin markets with high transaction costs). There are some 300 000 historical users, and the number of requests handled by DGA has risen steadily. The 5 600 requests in 2003 (up from 1 500 in 1993) broke down as follows: granting new rights (51%), regularising old rights (10%), authorising groundwater abstraction (4%), changing capture areas (3%) and other transactions (32%). The *limited enforcement of water markets* has resulted in many water conflicts going to higher courts, with varying results.

Reforming the Water Code

Starting in 1990, a series of changes to the Water Code were proposed to address *growing public concerns about river basin management, environmental protection, monopoly and speculation*. A debate took place about whether reforms to the Water Code should seek to make water markets work more smoothly and in more circumstances, or instead to limit their scope.

A first proposal was to *foster river basin management*, so as to: i) deal with increasing water management complexity due to rising demand for all uses and the need to manage both surface and groundwater resources; and ii) allow some form of regulation of the water markets and address downstream flows, water quality and environmental flows. In 1992, drawing on the French and Spanish experiences, watershed management corporations were proposed as a complement to the largely agricultural water user associations. The idea was not pursued, however. It has been suggested that *DGA should be given explicit responsibility to enforce minimum flows* when allocating water rights, lending the force of law to the de facto situation.

A second proposal, in the early 1990s, was to withdraw water rights that had not been used for five years. The granting of water rights free of charge and without conditions (including any obligation to use the water) encouraged speculation and

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hoarding. Most non-consumptive rights are held by one private hydropower corporation. In 1995 a revised proposal was to *charge holders for non-exerted rights* to both consumptive and non-consumptive uses, at an annual rate that would differ by region according to intensity of water use. In 1997 the Constitutional Court confirmed that the government could attach conditions to water rights, and the Antimonopoly Commission recommended that no further non-consumptive rights be granted until the Water Code was amended to require effective use of water. Hydropower companies claim that the proposal to charge for unused water rights could be *attacked on constitutional grounds*. They argue that since the original rights were not conditional on effective and beneficial use, imposing charges to induce new companies to enter the hydropower market would infringe property rights, which are constitutionally protected.

A third proposal was to *foster sustainable use of aquifers*. The proposed measures were to: i) form groundwater user associations; ii) grant provisional abstraction rights when there is uncertainty over the state of the resource; and iii) activate groundwater markets. Provisional rights would become definitive in five years if empirical evidence showed that they did not affect existing rights. The Supreme Court of Justice ruled that the government could reject requests for groundwater abstraction rights when it is determined that the result would be unsustainable exploitation.

It has also been suggested that the model adopted in air pollution control, in which new entrants must buy pollution emission rights, could be followed in the water sector. Such a programme could also necessitate reforms to the water rights system. In particular, *water rights would have to incorporate ambient water quality standards*. This would increase the cost-effectiveness of meeting emission standards for industrial waste water.

5. Water Management in Agriculture

Agriculture is a key sector of the Chilean economy (Box 3.3), and the *penetration of new international markets* is a priority of Chile's agricultural policies (Box 3.4).

5.1 Two types of farming

The 1967 *Land Reform Law* mandated redistribution of farm estates larger than 80 hectares. Nine million hectares had been redistributed by 1973, and some 10 million hectares were then state-owned. After 1973 more emphasis was put on

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Box 3.3 **Key features of the agriculture sector**

Chile's agriculture sector (excluding food processing) is *important in terms of production, employment and trade*. It contributes 4.3% to GDP and employs around 13% of the economically active population. Exports of agricultural goods and processed food (excluding fish and forest products) total about USD 4 billion a year and account for 17% of total exports. The main export markets are the United States, the European Union and Japan. Imports of agricultural goods, totalling some USD 1.4 billion a year, are led by beef and maize. About 35% of these imports come from Argentina.

Farmers increasingly produce goods aimed at export markets. Products include wine, berries, frozen food, other semi-processed foodstuffs and preserves. Food and food product exports have grown 6% a year on average since the late 1990s. Chile is one of the *world's largest exporters of fresh and processed fruits*, especially producing grapes, apples, avocados and pears. The area devoted to fruit growing covered 211 000 hectares in 2003, up from 187 000 hectares in 1996. This includes 102 000 hectares of wine vineyards, up from 54 000 hectares in 1995. Not only are Chile's climate and geography favourable, but its producers can target off-season northern hemisphere markets, giving exporters a competitive edge especially in fresh fruit.

There are *strong regional differences*. Farming in northern Chile (Regions I to VII), which relies on irrigation, is export-oriented while producers in southern Chile (Regions VIII to XII), where cattle farming and annual crops predominate, cater mostly for the domestic market. Trade liberalisation has led to diversification in farming in the last few years, including a shift from annual crops to fruit and vegetables and livestock breeding. Foreign direct investment has helped increase the sector's productivity, contributing to far-reaching modernisation of production methods. The state does not own commercial farmland. Foreigners may own any amount of agricultural land.

market-oriented farming. About 30% of the expropriated land was returned to former owners, 20% was auctioned off and 30% was allocated to small-scale farmers. This radical change in land policy was accompanied by a progressive reduction of farm support. As a result, about one-third of farm owners sold their land and went to work for other owners. Farm ownership remains very fragmented.

A clear distinction can be made between modern, commercial, *export-oriented agriculture* and more *traditional small farms* serving mostly the domestic market. The former consists of medium-sized and large businesses relying on intensive production techniques and improved irrigation systems. The latter account for 80% of the rural population, more than 50% of arable land and 30% of irrigated land.

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Box 3.4 **Agricultural policies**

Chile actively participates in World Trade Organization (WTO) negotiations on agriculture, advocating elimination of *export subsidies* and substantial reductions in domestic support and trade barriers. Chile is a founding member of the Cairns Group, a coalition of 17 agricultural exporting countries. It has notified the WTO that it does not provide agricultural export subsidies.

Agriculture traditionally enjoyed more protection than other economic sectors. Since 1997, *border protection* in agriculture has decreased, in line with progressive trade liberalisation. A "most favoured nation" (MFN) tariff of 6% now applies to many agricultural goods, though higher tariffs (through a price band system) may apply to MFN imports of sugar, wheat and wheat flour. While Chile bound most tariff lines at 25%, some agricultural products are bound at 31.5%, including dairy products, wheat and wheat flour, oilseeds and oleaginous fruit, and vegetable fats and oils. The bound rate for sugar is 98%.

Under most of *Chile's preferential agreements*, various agricultural products are subject to longer phase-out periods and face higher average tariffs than non-agricultural goods. Average tariff rates for agricultural imports in 2003 were 0.5% for Mexico, 0.8% for Mercosur countries, 0.9% for Canada, 1.3% for the European Union, 1.5% for Costa Rica and 1.8% for El Salvador. Sugar, wheat and vegetable oils are subject to particularly long phase-out periods.

Targeted measures for export-oriented agriculture (e.g. fruits, vegetables, flowers) were initiated in the 1960s. *Domestic support* has also been available for many decades to small landowners, but the concept of contract farming involving associations and other joint venture proposals is gradually taking over. The role of the state in cereal production and marketing is limited to the Wheat Marketing Board. No administered prices or direct payments are available to Chilean farmers. To reduce input costs, irrigation projects receive subsidies totalling about USD 70 million a year. A soil conservation programme with a budget of USD 35 million supports fertiliser purchases. Agricultural producers with net annual sales below USD 333 000 have access to the Guarantee Fund for Small Enterprises, which provides credit guarantees and interest concessions for investment projects and exports. Since 2002 the state has reduced the cost of crop insurance through subsidies totalling USD 2.5 million a year, covering 50% of the premium plus a lump sum of up to USD 1 300 per crop season. General services to the agricultural sector (USD 110 million a year) include research, training, inspection, marketing and promotion. The National Agricultural Research Institute has an annual budget of USD 10 million. With USD 6 million a year, the Foundation for Agricultural Innovation contributes up to 70% of the cost of individual agricultural R&D projects.

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According to the latest National Agricultural Census, Chile has nearly 330 000 farms, including 126 000 subsistence farms and 176 000 small farms. While the smaller farms tend to specialise in vegetables, flowers and dairy products, larger farms (which hold 77% of the agricultural area in use) tend to focus on wood and wood products, fruit and cattle. Chile's total land area of 72.7 million hectares is 2.4% arable and permanent crop land, 18.4% permanent grassland and 38.8% forest and woodland, the rest being dry open areas, wetlands and built-up areas (Figure 3.3).

5.2 Water use in agriculture

The cost of expanding irrigation

Because arid and semi-arid conditions prevail in much of the country, *irrigated agriculture is very important in Chile*. About 40% of the crop land (1.2 million hectares) is irrigated, compared with an average of 13.7% for Latin America as a whole. Some 1.8 million hectares are classified as having "irrigation potential". Over 1990-99, 70 000 hectares were opened to irrigation and 200 000 hectares of irrigated land were improved. Plans for 2000-10 call for the irrigated area to expand by 300 000 hectares and for improvements to be made on 400 000 hectares.

In the mid-1960s the trend was to build reservoirs with public funds, and the government supported construction of irrigation infrastructure. In 1975 this policy was replaced by *direct incentives* for farm-level irrigation projects. A 1985 law on private investment in irrigation and drainage works introduced subsidies for improving and expanding irrigation. Projects competed for financial support covering up to 75% of the investment, with a ceiling of USD 700 000 for projects from water user associations and USD 350 000 for individual projects. Separate subsidy programmes were launched in 1990 for commercial farmers and small-scale farmers, aimed particularly at increasing participation by the latter, and state support of large-scale irrigation projects was resumed.

In the late 1990s the concept that *farmers must pay for water* was introduced with the development of reservoir concessions, whereby private companies make the necessary investments and charge for the water, thus increasing cost recovery. This was an important policy shift, as farmers had long believed that the state had an obligation to build large reservoir-based irrigation projects and provide water for free. In 2000 construction of the El Bato reservoir (Region IV) was put under concession to bring 3 600 hectares into irrigation, and feasibility studies are under way on concessions for other priority projects.

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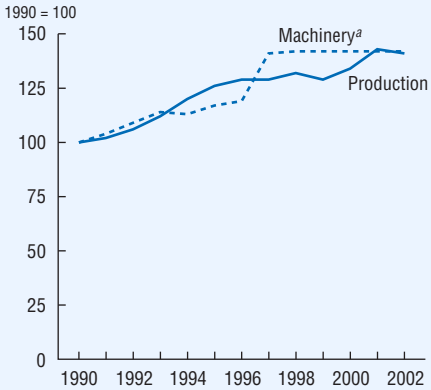
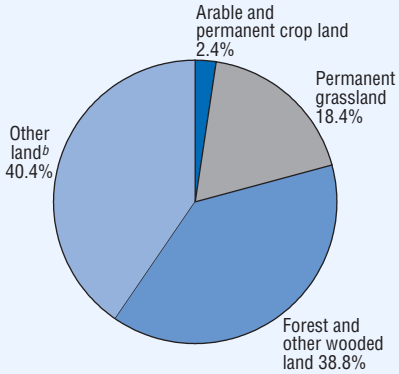
Figure 3.3 **Agriculture**

Trends in Chile, 1990-2002

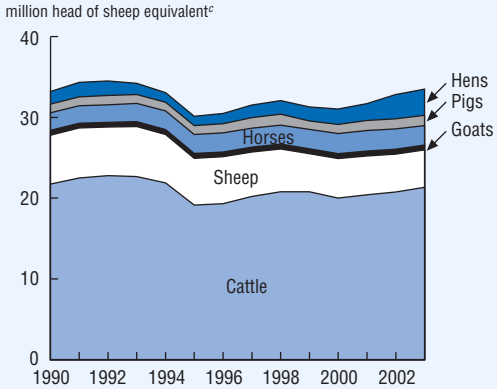


Land use

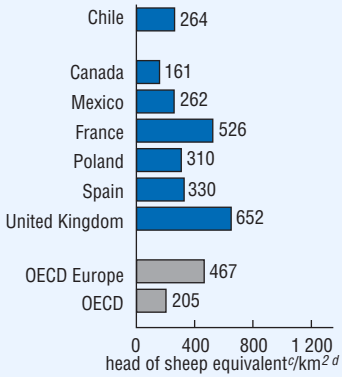


Livestock

Trends in Chile, 1990-2003



Density, 2003



a) Tractors and combined harvester-threshers in use.
b) Includes dry open land, 34% of total land area.
c) 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.
d) Of arable, permanent crop land and permanent grassland.
Source: National Statistics Institute; FAO; OECD.

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Over 1985-2003, *budgetary outlays* under the 1985 law amounted to USD 284 million, representing 57% of total investments and involving more than a million hectares and 168 000 farms. Small and medium-sized irrigation projects received around 80% of this support. Opening the irrigation sector to private participation is expected to bring some private investments of USD 600 million and expansion of the irrigated area by 185 000 hectares.

The role of water markets

Water markets enhance water use efficiency. If a farm's return on water use is less than market value (e.g. what a municipality would pay for the water), right holders may either adopt more efficient irrigation techniques or sell the water. Other benefits of active water markets include less risk of local water conflicts (water prices are responsive to scarcity), more flexibility in responding to market orientation (e.g. a shift from cereals to fruits and vegetables), less need to build new water infrastructure or buy more land, and increased revenue (water that is saved can be sold). Efficiency gains have been high in areas of Chile where trading has been active, such as the Limarí River valley.

However, the *effectiveness of markets may be constrained by high transaction costs* (i.e. for measuring and transporting water, protecting the rights of other users, accounting for water quality and enforcement). In many river basins in Chile, fixed dividers make it difficult and expensive to reallocate water. Where the benefits of reallocation are large, however, as in the case of selling rights from agriculture to municipal uses in the Elqui River basin (Region IV), it is worth making the investment. Systematic cost-benefit analysis of investment in technology and human capital would point to the most promising opportunities, thereby extending the reach of water markets.

Soil conservation

Agricultural soil degradation is a major issue in Chile. The absence of effective soil management and conservation objectives, including for forest tree planting, has resulted in high rates of declining soil fertility, desertification and flooding. *Erosion* is estimated to affect almost half the total land area, with 9 million hectares showing some degree of degradation. The affected area grows by some 40 000 hectares per year, and desertification is spreading by 6 000 hectares per year. *Soil salinisation in irrigated areas* results from the use of increasingly saline waters for irrigation and from intensive production techniques combined with inefficient water use. Almost all irrigated land in Regions III and IV is affected by salinisation, resulting in a 25% decline in yields.

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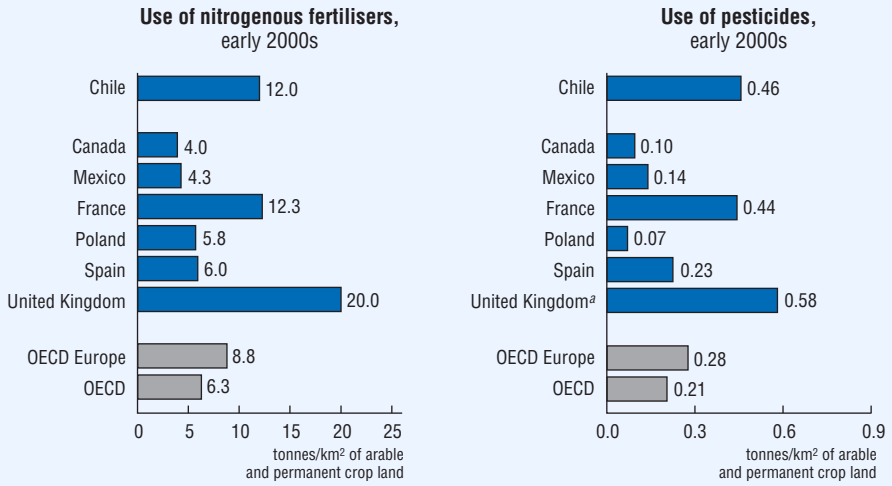
5.3 Non-point sources of water pollution

An emerging issue

Water pollution from agricultural run-off is an important issue in Chile. The *intensity of fertiliser and pesticide use* is well above the OECD average (Figure 3.4). Increases in agricultural exports were long coupled with intensification of production. In the 1980s nitrogenous fertiliser use rose by 223% and the volume of pesticide imports increased by a factor of eight to nine. Since 1990 reliance on chemicals has been slightly decoupled from the rise in production, with nitrogenous fertiliser use increasing by 28% and pesticide use by 16%, though phosphorous fertiliser use rose by 50% and that of potash fertiliser by 160%.

As a result of the intense use of chemicals, there is an *urgent need to combat non-point water pollution from agricultural sources*. In 2001 the Ministry of Agriculture released a *code of good farming practices*. To implement the code, clean

Figure 3.4 **Agricultural inputs**



a) Great Britain only.
Source: FAO; OECD.

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production agreements were signed with fruit growers (2001), the wine industry (2003) and timber corporations (2004). These agreements, like an earlier one with pig producers (1999-2001), also address water quality standards, including for irrigation water. To help growers meet importer countries' requirements, the Agriculture and Livestock Service (SAG) and the Chilean exporters' association offer advice on farm management practices. Through a SAG research fund, the sector finances research on livestock effluent management and the environmental effects of agricultural pollution. Pesticide and fertiliser subsidies were phased out in the early 1980s, but targeted soil conservation programmes still support the purchase of fertiliser.

Pesticide risk management

The *1980 Plant Protection Law* regulates the production, import, distribution and use of pesticides. SAG supervises agricultural pesticide registration, including information on substances' chemical composition, instructions for use, and environmental and health safety assessments. The Public Health Institute of the Ministry of Health registers pesticides for sanitary and domestic uses. In 1990, of the 110 pesticides registered in Chile, 24 did not meet the USEPA tolerance thresholds. In 2000 a new department was established in SAG to strengthen enforcement of pesticide legislation and a commission was formed to advise SAG on the impact of pesticides on health and the environment. The commissioners represent CONAMA and the ministries in charge of agriculture, health and labour. In seven regions pesticide committees have been established to co-ordinate enforcement among the various entities involved. Since 2002, spraying contractors have had to be accredited; some 5 000 have received accreditation, which should improve efficiency of pesticide use in such aspects as density, site-specificity and timeliness of application.

Foodstuffs for *export markets* must meet quality requirements of the importing countries. As a result, pesticide use is generally higher on products for the domestic market. Chile applies the UN Codex Alimentarius for maximum residue limits (tolerance). Importers are requested to submit a certificate of free sale from the country of origin. However, little residue testing is performed for domestically sold crops.

Chile is preparing a national implementation plan under the *Stockholm Convention on Persistent Organic Pollutants* (POPs). The plan should include priority setting and costs for management and remediation actions. A recent POPs survey revealed the presence, mainly in Regions V and X, of over 500 kg of *banned substances*: DDT (82%), aldrin (14%), heptachlor (3%) and hexachlorobenzene (1%). Banned pesticides (Table 3.4) were found at some 17% of the farms and distribution and storage facilities surveyed. POPs storage facilities were also assessed: 11% were below standard and 47% were too close to houses, wells or stables.

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Under the Montreal Protocol, Chile has committed itself to phasing out *methyl bromide imports* by 2015 (interim targets are 283 tonnes by the end of 2004 and 203 tonnes by 2006). Alternatives are being developed, particularly for tomato, chili and fruit growing.

Table 3.4 **Bans on import, production and use of pesticides**

Pesticide	Year banned	Drinking water quality standards[a] (μg/l)
Sodium monofluoroacetate (compound 1080)	1982	None
Dichlorodiphenyltrichloroethane[b] (DDT)	1984	1
Ethylene dibromide (EDB)	1985	None
Dieldrin,[b] endrin,[b] heptachlor,[b] chlordan[b]	1987	0.03; 0.2; 0.1; 0.3
Aldrin[b]	1988	0.03
Daminozide	1989	None
Pesticides with mercury salts (inorganic and organic)	1993	None
Mevinphos	1994	None
2,4,5-T, chlordimeform, toxaphen[b] (campheclor)	1998	10; none; 5
Lindane	1998	3
Ethyl parathion, methyl parathion	1999	None
Hexachlorobenzene[b] (HCB)	2002	0.01
Mirex[b]	2002	None
Pentachlorophenol (PCP) and its salts	2004	None

a) An additional drinking water quality standard applies to metoxichlor (30 μg/l).
b) These are the highly dangerous pesticides covered by the Stockholm Convention on POPs, which entered into force on 17 May 2004.
Source: SAG; National Standards Institute.

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4

NATURE CONSERVATION AND BIODIVERSITY*

Features

- Highly endemic biodiversity
- Public and private protected areas
- The need for spatial planning
- Win-win opportunities in nature and tourism management
- The alerce, the "South American redwood"

* This chapter reviews progress since 1990.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- complete, firmly implement and devote adequate resources to the *national and regional biodiversity strategies and action plans*;
- review *institutional and legislative arrangements* for the management of nature and biodiversity;
- develop a *strategic vision* of the complementary roles of state and private protected areas in order to achieve a *coherent network of core protected areas*, buffer zones and ecological corridors;
- step up *financial efforts* to meet the target of protecting 10% of all significant ecosystems in Chile (including coastal and marine areas) and boost *nature-related enforcement* activities;
- mount a co-ordinated effort by state agencies and academia to build the *scientific knowledge base* (including cataloguing of living species) required for nature management;
- speed up progress towards establishing an *effective land use planning* system capable of taking biodiversity values into account;
- identify and use further mechanisms, including economic instruments, for creating win-win opportunities in *tourism and nature policies*.

Conclusions

Since 1990 Chile has enacted several laws with a nature protection dimension, and it adopted a *national biodiversity strategy* in late 2003. More detailed regional biodiversity strategies and a national biodiversity action plan are in preparation. Natural resource laws and regulations incorporate sustainable management provisions, as do the plans for tourism development. Chile has designated for *legal protection* almost one-fifth of its territory, including nine Ramsar sites and seven UNESCO biosphere reserves. In addition, private interests (NGOs, companies and individuals) manage almost 17 000 km^2 (equivalent to about 12% of state protected areas) for conservation purposes. Agencies operate recovery programmes for *threatened species* such as the Andean deer and the flamingo but not for freshwater species. Progress has been made in recent years in setting up and consolidating a knowledge base about nature and ecosystems.

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Nevertheless, the protection of nature has so far not been given enough emphasis and resources to deal with long-term threats to Chile's highly endemic biodiversity. There is *no dedicated nature conservation law*, and *institutional and management structures* make conservation objectives secondary to the wider goals of relevant agencies. Despite improvements over the review period, nature and biodiversity protection and its enforcement are still *underfunded*. The country's species, their conservation status and the functioning of Chile's ecosystems remain *insufficiently known*. Government policies do not adequately acknowledge the value of *nature as a vital asset for the tourism industry* or make the most of tourism's potential to contribute to the financing of nature management. Despite the high overall protection ratio, many significant ecosystems and habitat types are under-represented, and the *target of protecting 10% of all significant ecosystems* by 2010 will not be met at the present rate of progress. The management of protected areas suffers from a lack of financing and investment. The absence of effective arrangements for spatial planning, other than sectoral planning mechanisms, leaves habitats outside of protected areas vulnerable to destruction. *Native forests* not in protected areas continue to suffer from fires of human origin and illegal cutting of valuable species. Only limited progress has been made so far in integrating biodiversity considerations in *water management*.

♦ ♦ ♦

1. Policy Objectives

The paramount *mandate for government action on biodiversity* is Article 19 of the 1980 constitution, which asserts that the state is responsible for nature protection. Chile does not have a dedicated nature law, but during the review period it adopted or updated several laws relevant to nature conservation and biodiversity. Among these are the 1994 General Environmental Framework Law (Law 19.300) and the 1996 Hunting Law (Law 19.473). The articles in the framework law specifically referring to nature protection include Article 34, which provides the legal basis for the National System of State-protected Wilderness Areas (SNASPE), and Article 35, which gives the state a role in promoting privately owned protected areas. More than 20 legal texts refer to national parks. These and other laws, however, do not add up to a comprehensive framework for nature protection. For instance, no provisions exist for the protection of non-forest flora. Natural resources are an important part of the Chilean economy and environmental standards have been incorporated into natural resource laws (e.g. various amendments to the General Fishing and Aquaculture Law) and associated regulations. A native forest bill containing extensive environmental clauses has been on the drawing board since 1992 (Chapter 6).

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Chile has until recently had few explicit *policy objectives* in respect of the protection of nature, but this situation is changing. For instance, one of four main themes of the national Environmental Agenda 2002-06 concerns protection of the natural heritage. The agenda lists 72 priority sites with high biodiversity value and sets the goal of protecting them by 2006.

The overarching objective of the *National Biodiversity Strategy*, adopted in December 2003 in accordance with the UN Convention on Biological Diversity, is to "conserve the country's biodiversity by fostering sustainable management to safeguard the life-giving capacity of biodiversity and guarantee access to its benefits for the well-being of present and future generations". The strategy also includes nine more specific objectives as well as eight strategic lines of action. The one quantitative objective is to protect at least 10% of the surface area of all significant ecosystem types by 2010. The strategic lines of action cover all aspects of nature policy: ecosystems and biodiversity; species and genetic heritage; sustainable production practices; institutions and sectoral integration; instruments; public awareness and education; research; and funding issues (Table 4.1).

The objectives of the biodiversity strategy are generic statements of policy direction, but greater detail can be found in the 13 *regional strategies*. Most of these are being elaborated, as is the national biodiversity action plan, which details specific tasks and allocates responsibilities to individual agencies. The action plan signals a new, comprehensive and integrated approach to nature management and could greatly enhance Chilean biodiversity *as long as the strategies and action plan are backed up with sufficient new funding for implementation.*

2. Performance on Flora and Fauna Species

2.1 Species and genetic biodiversity

Chile is home to a host of emblematic species, such as the Andean condor and Andean deer (both feature on the nation's coat of arms), the vicuña, the monkey puzzle tree and the alerce tree (Box 4.1). The number of living species in Chile is conservatively estimated at 29 000. Although this number is not large compared to that of many other countries, species biodiversity is characterised by a *high degree of endemism*. Among plants, for instance, 55% of dicotyledon, 33% of gymnosperm and 29% of ferns and club mosses can be found only in Chile. Insect endemism approaches 44% of lepidoptera, 45% of coleoptera, 53% of diptera and 92% of heteroptera. Among vertebrates, almost 78% of amphibians are endemic, followed by reptiles at 59%. Endemism for bird species, the most numerous group, is much lower,

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Table 4.1 **National Biodiversity Strategy**

General objective
To conserve the country's biodiversity by fostering sustainable management to safeguard the life-giving capacity of biodiversity and guarantee access to its benefits for the well-being of present and future generations

Specific objectives	Strategic lines of action
1. To the extent possible, natural habitats and ecosystems shall be maintained and recovered, and those ecosystems modified in productive and urban settings shall be protected	
2. Actions shall be proposed towards the long-term survival of the representative biodiversity at the ecosystem, species and genetic levels, beginning with the protection of at least 10% of the surface area of each of the most relevant ecosystems by 2010	1. Ensure ECOSYSTEM CONSERVATION AND RECOVERY to significantly slow the loss of biological diversity by 2010
3. Conditions and lines of action shall be set to ensure that viable populations of flora and fauna are maintained in natural environments; actions that allow for ex situ conservation shall be implemented	2. Ensure the preservation of SPECIES AND THE GENETIC HERITAGE
4. Incentives shall be created for actions that demonstrate the value of biodiversity conservation and therefore encourage changes in the behavior and decision making of economic actors directly involved in the use of biodiversity	3. Promote SUSTAINABLE PRODUCTION PRACTICES that safeguard biodiversity
5. Extraction methods that prevent overexploitation of resources and allow for sustainability of production shall be encouraged; at the same time, alternative non-extractive uses of the biodiversity that are sustainable and economically profitable shall also be encouraged	4. Strengthen INTERINSTITUTIONAL AND INTERSECTORAL CO-ORDINATION for the integrated management of biodiversity
6. The present co-ordination of the public administration system for biodiversity shall be strengthened and improved, in particular by the creation of a national system of protected areas that is both public and private and land-based and aquatic, by enhancing the legal and institutional framework and by developing new management instruments such as land use plans, different types of protected areas, standards, incentives and others	5. Establish the FORMAL AND INFORMAL MECHANISMS required for optimal management of biodiversity
7. Research activities required for building knowledge on conservation and sustainable use of biodiversity shall be strengthened	6. Strengthen ENVIRONMENTAL EDUCATION, PUBLIC AWARENESS AND ACCESS TO INFORMATION on biodiversity
8. Currently available information systems and educational programmes and their application to policy design and administration shall be strengthened, harmonised and integrated, with mechanisms established to provide opportunities for participation by different stakeholders wishing to have access to and/or support the system	7. Strengthen and co-ordinate RESEARCH to improve knowledge of conservation and the sustainable use of biodiversity
9. Knowledge shall be passed on through formal and informal education to strengthen citizens' relationship to and contact with biodiversity, thus facilitating learning on the sustainable use of the natural heritage and knowledge of the attributes and functions of the biological diversity	8. Consolidate the FUNDING mechanisms required for adequate conservation of biodiversity

Source: National Biodiversity Strategy of the Republic of Chile.

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Box 4.1 **The alerce, the "South America redwood"**

The *alerce*, a member of the cypress family, is sometimes called the redwood of South America. *Fitzroya cupressoides* (the name refers to the captain on Darwin's voyage) is second only to the bristlecone pine for longevity, living 3 000 to 4 000 years. It grows extremely slowly, the thickness of its trunk increasing by 1 cm every 15 to 20 years. The alerce can reach as much as 50 metres in height and 3-4 metres in diameter. The natural home of this iconic tree is the Valdivian temperate rainforest, one of the world's biodiversity hot spots, between the city of Valdivia and the island of Chiloé, at 39° to 43° latitude south.

The *timber of the alerce* is beautiful, resistant to rot and insects, and ideal for use in furniture, joinery and construction. It is therefore very sought after and has a high commercial value. The conifer has been logged since the mid-17th century. Exploitation was so intense that natural regrowth and regeneration no longer occur. The alerce features on the IUCN Red List as endangered, i.e. facing a very high risk of extinction in the wild in the near future. The area taken up by remaining forest stands with at least one alerce per hectare is estimated at 263 000 hecatres, 113 000 hectares of which are under protection (some 46 000 hectares as part of the SNAPSE and around 67 000 hectares in privately protected areas). The biggest stands are found at 41° to 42° latitude south in the high cordillera; populations elsewhere are small. The alerce is also in CITES Appendix I, the list of most endangered species.

The Chilean government declared the alerce a *natural monument* in 1976 under Supreme Decree 490. Logging is prohibited, but naturally fallen trees, or those killed by fire before protection, may be exploited under the Special Work Plan for the Extraction of Dead Alerce Wood, supervised by the National Forestry Corporation (CONAF). It is proving difficult to *implement and enforce protection rules*, not least because no reliable estimates exist of the volumes of dead alerce timber potentially available for legal exploitation, and their locations are not well known. Moreover, illegal logging in remote areas has been impossible to halt.

only 2%. Little is known about the genetic diversity of Chilean species, a topic now attracting attention in the context of the biodiversity convention and the national biotechnology development policy.

In the absence of comprehensive species inventories, it is difficult to evaluate information about the *conservation status of Chilean species* in terms of the share of known species in difficulty, but it is clear there are no grounds for complacency. Some partial evaluations suggest that about one-fifth (161) of the 823 vertebrate species (mammals, birds, reptiles, amphibians and freshwater fish) analysed are endangered or vulnerable. Freshwater fish are the most affected group, with 41 out of 44 species experiencing

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serious conservation problems (Figure 4.1). The IUCN Red List database contains 250 plant and animal species for Chile, of which 18 are critically endangered (e.g. the short-tailed chinchilla), 16 are endangered (e.g. the alerce and the southern river otter) and 62 are listed as vulnerable (e.g. the monkey puzzle tree). Ninety-three species are listed as "data deficient", i.e. lacking adequate information on which to base a direct or indirect assessment of the conservation status. For the 35 species for which population trends are indicated, only the humpback whale shows an upwards tendency (due to an international ban on whaling), while 31 species are listed as being in decline.

2.2 Protecting endangered species

Efforts to protect *particular flora species* began in the 1940s when Chile prohibited the cutting or logging of certain tree species. Five species of trees from northern Chile were initially protected by supreme decree under what was then called the Ministry of Lands and Colonisation. In 1976, the alerce was declared a natural monument under the 1940 Washington Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, followed by the monkey puzzle tree or Chilean pine (1990) and five other species with conservation problems in central and southern Chile (1995). The challenge has been to give effect to this paper protection in the face of economic pressures, limited enforcement resources and, sometimes, the lack of a strong conservation ethic among the population.

The *protection of animal species* is provided for under the 1996 Hunting Law, which also transposes the requirements of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) with respect to trafficking in endangered species. The law includes all species named in CITES and the migratory species convention (Bonn Convention). The hunting, capture, sale and exportation of most Chilean native species is prohibited. This includes all amphibians and reptiles, 90 mammals and some 430 bird species. Twenty-five bird species (23 native and two exotic) and 11 mammals may be hunted part of the year; 23 vertebrate species have been declared pests and may be hunted without restriction. The Hunting Law requires hunters to be licensed (about 26 000 were in 2000) and provides for no-hunting areas. As of 2003, 13 such areas with a combined area of 11 160 km^2 had been designated, up from just 316 km^2 a decade earlier. Again, though, converting these good intentions into action is proving difficult, not least because of weak enforcement: no more than 150-200 infractions are reported each year, including in the context of CITES. This includes penal and administrative sanctions up to USD 5 000 (or twice this amount in case of relapse). The Agriculture and Livestock Service (SAG) enforces compliance with the Hunting Law and CITES, with the assistance of about 100 ad honorem game inspectors.

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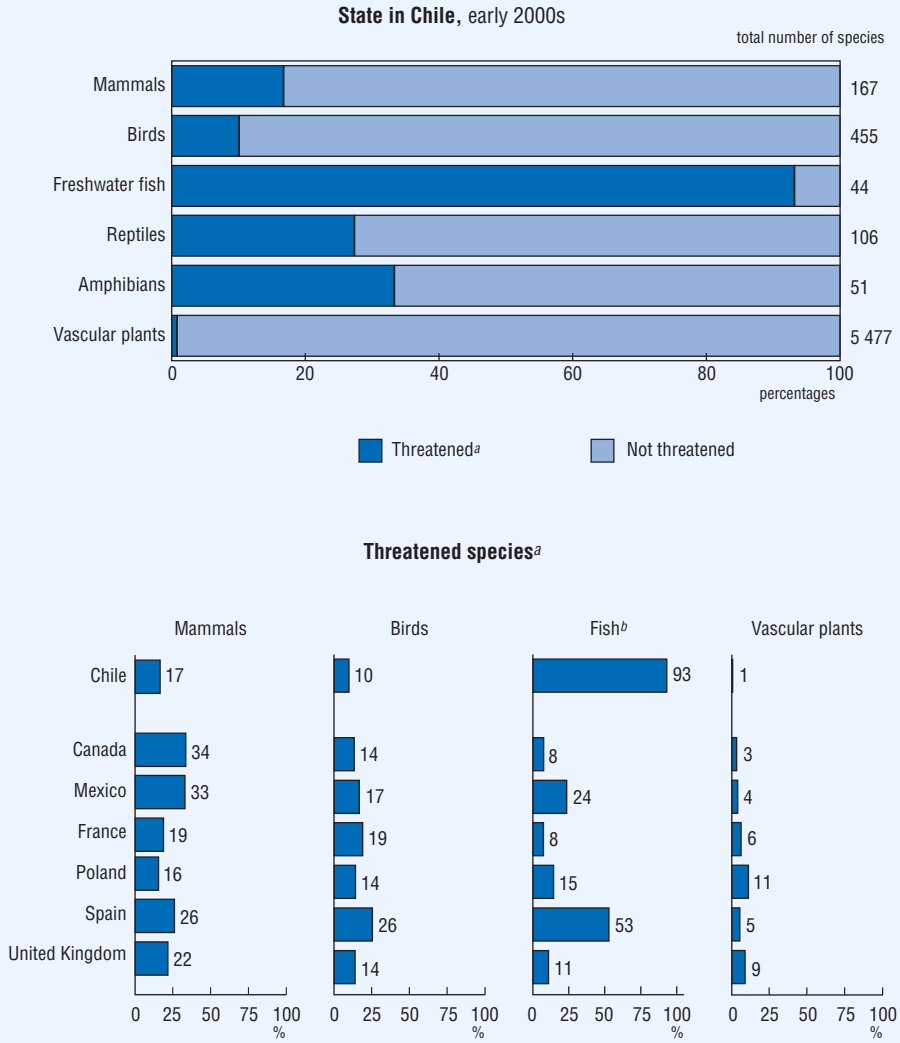
Figure 4.1 **Fauna and flora**



a) IUCN categories "critically endangered", "endangered" and "vulnerable" in % of known species.
b) Freshwater fish only for Chile, Poland, Spain and United Kingdom.
Source: CONAF/SAG; OECD.

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In addition to the passive protection of species, various agencies are engaged in proactive *species recovery programmes*. For example, CONAF, which manages state-protected wilderness areas, is using national and international funding for the protection of the southern huemul deer, the flamingo, the black-necked swan, the Juan Fernández fur seal and the Chilean palm tree. Many other species (notably marine mammals, albatrosses and petrels) are in difficulty and should come under specific recovery programmes. Chile has signed and initiated ratification of the 2001 Agreement on the Conservation of Albatrosses and Petrels to the Bonn Convention. The proposal in the National Biodiversity Strategy for closer inter-agency co-ordination in this area, which would allow priorities to be set on the basis of objective, explicit conservation criteria, is promising. A multi-agency project involving participation of indigenous communities has had some success in sustainable management of the vicuña in the wild and in captivity (Chapter 8).

3. Performance on Habitats and Protected Areas

3.1 Ecosystem biodiversity

Geographically, Chile stretches from north of the tropic of Capricorn to the peri-antarctic waters south of Cape Horn. The *remarkable diversity of its ecosystems* is shaped not only by this range in latitude but also by differences in altitude and by the natural boundaries formed by the Andes and the Pacific. Wetlands can be found at sea level as well as high in the Andes (at 4 400 metres). Chilean ecosystems range from places with little apparent life (e.g. the Atacama Desert, the world's driest) to biodiversity hotspots such as the Valdivian temperate rainforests.

Four major biogeographic zones run the length of the country: the Andes, the central valley, the coastal mountain range and the coastal zone. Within these, eight ecological or vegetation regions, 21 vegetation subregions, 85 plant formations and 229 plant communities have been delineated (Table 4.2). Some Chilean ecosystems are recognised as being of international importance. For instance, the Valdivian temperate rainforests are among the top conservation priorities of the WWF Global 200, a ranking of the world's most biologically outstanding habitats. Conservation International has designated an area of central Chile covering almost 40% of the country as one of the world's top 25 biodiversity hot spots.

3.2 System of State-protected wilderness areas

Chile *designated protected areas* as early as 1907 and established its first national park (Vicente Pérez Rosales National Park in Los Lagos Region X) in 1926.

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These early efforts were mainly motivated by a desire to promote tourism and involved land not used for other purposes. Conservation objectives came to the fore in 1984 (Law 18.362) with the creation of SNASPE, which recognises three types of protected areas: national parks, national reserves and natural monuments.

The SNASPE network now covers *around 19% of the national territory* (141 230 km^2), well above the IUCN minimum criterion of 10%. The network comprises 31 national parks, 48 national reserves and 15 natural monuments

Table 4.2 **Protection ratio of Chilean ecosystems**, 2004

Ecological/vegetation region			Ecological/vegetation subregion		Number of vegetation formations	
National surface (%)		PR[a] (%)		PR[a] (%)	(#)	Representation in SNASPE
22	Desert	*< 5*	Absolute desert	*< 5*	6	7 out of 17 not represented
			Andean desert	*< 5*	6	
			Coastal desert	*< 5*	3	
			Flowering desert	*0*	2	
17	High Andean steppes	*< 5*	Highland and puna	*< 5*	7	4 out of 12 not represented
			Mediterranean Andes	*< 5*	5	
10	Scrubland and sclerophyllous forest	*< 5*	Scrubland steppe	*< 5*	4	7 out of 14 not represented
			Scrubland and pine forest	*< 5*	5	
			Sclerophyllous forest	*< 5*	5	
8	Deciduous forest	*< 5*	Deciduous mountain forest	*< 5*	4	1 out of 10 not represented
			Deciduous plains forest	*< 5*	4	
			Deciduous Andean forest	*< 5*	2	
3	Laurifolius forest	*> 5*	Valdivian laurifolius forest	*65*	4	All types represented
			Laurifolius forest of Juan Fernández Archipelago	*100*	2	
7	Andean Patagonian forest	*8*	Araucanía range	*> 10*	5	All types represented
			Patagonian range	*> 10*	5	
18	Evergreen forests and peat bogs	*57*	Evergreen with coniferous	*> 10*	5	All types represented
			Microphyllous evergreen	*> 10*	4	
			Peat bogs[b]	*> 10*	5	
4	Patagonian steppes	*< 5*	Scrubland and Aysén	*< 5*	1	All types represented
			Magallanes Patagonia	*< 5*	1	

a) PR = protection ratio, i.e. ratio of protected SNASPE area to total area of the category.
b) Includes scrubland and marshland steppes.
Source: CONAMA.

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(Table 4.3). All the national parks fall in IUCN Category II (national park), the reserves are in Category IV (managed nature reserve/wildlife sanctuary) and the monuments in Category III (natural monument/natural landmark). SNASPE includes nine Ramsar sites and seven UNESCO biosphere reserves. Chile also has three World Heritage Sites, but these protect cultural (e.g. Easter Island) rather than natural heritage.

Notwithstanding its large extent overall, many SNASPE areas are too small and isolated from each other to have much conservation value and the system is *not representative enough* of the diversity of Chilean ecosystems. Almost one-quarter of the SNASPE protected area is permanently covered in snow and ice and 57% consists of the evergreen forest and peat bog ecosystem type, which makes up 18% of the national surface area. The protection ratio is less than 5% for four of the eight landscapes types (desert, scrubland, deciduous forest and Patagonian steppes). A similar picture emerges at smaller scales: the protection ratio is below 5% for 13 of the 21 subregions, and flowering desert is not represented at all. At a more detailed level still, 17 of the 85 vegetation formations are not present in SNASPE (Table 4.2).

Table 4.3 **Protected areas**, 2004

Mandate	Type	Number	Area (km^2)
SNASPE[a]	Total	94	141 230
of which:	National parks	31	87 177
	National reserves	48	53 874
	Natural monuments	15	179
Marine protected areas[b]	Marine reserve	1	3
Fishery decrees	Genetic reserves	2	15
Coastal marine areas[c]	Easter Island submarine parks	3	. .
	Coastal marine protected area	2	710
National monuments[d]	Natural sanctuaries	28	–
Areas on private land	Total		17 000
of which:	RAPP	133	3 866
	Parques de Chile	400	6 000
	Other private parks	Various	7 000

a) Under Law 18.362. Includes seven UNESCO/MAB biosphere reserves and nine Ramsar wetlands (covering 1 000 km^2). For reference, the total continental land area of Chile is 756 626 km^2.
b) Under the Fishing Law (Law 18.892).
c) Under Decree 475 of 1975.
d) Under Law 17.288. Includes a Ramsar wetland site.
Source: CONAMA.

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Twenty-one areas with a combined area of 4 109 km^2 were added to the original SNASPE area between 1984 and 2000, and further additions are planned. However, the rate of progress falls far short of the 26 000 to 30 000 km^2 that need to be added if Chile is to achieve its objective of *protecting 10% of all significant ecosystems by 2010*. Much of the work of identifying the most suitable areas is done: a 1993 survey by CONAF identified locations with high on-site biodiversity, and 21 urgent priority sites were pinpointed for protection, along with 30 important priority sites, 31 "interest" sites and 19 "specific interest" sites.

CONAF manages the SNASPE network through its Wildlife Heritage Programme and for this purpose employs 538 people (11% technical personnel, 72% rangers, 11% other workers and 6% administrative staff). Management plans exist for 51 parks and reserves. Positive efforts in recent years include the establishment of seven regional and 14 local advisory councils to encourage more community participation in the management of the network. The National Environment Commission (CONAMA), in association with the Ministry of Education, has set up 30 education centres in parks to promote environmental education for the more than 1 million people who visit the SNASPE network every year. The network also hosts numerous scientific research projects. In addition, SNASPE promotes local development and the empowerment of indigenous people (Box 4.2).

3.3 Other types of state protected areas

While the SNASPE network includes some *marine areas*, it is as extensions of terrestrial areas rather than for their own sake. Three separate marine reserves were created under the aegis of the National Fisheries Service (SERNAPESCA, part of the Ministry of Economy and Energy) and the Coastal Zone Office of the Ministry of Defence (Table 4.3). In addition, by decree, since mid-2003 CONAMA has co-ordinated the establishment of coastal marine protected areas. The first such area, the Francisco Coloane Marine Protected Area (670 km^2) in the Strait of Magellan, was created with the help of funding from the Global Environment Facility. Two other areas are in the planning stage. Also, the General Fishing and Aquaculture Law provides for the designation of sustainable management areas to regulate fishing in marine and inland waters.

The Ministry of Education operates a system of *national monuments* to protect Chile's historic, archaeological, cultural and natural heritage. Among them are 28 natural sanctuaries, mostly sites such as islets, lagoons or geological formations too small to have great biodiversity value, but nonetheless with a certain iconic significance.

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Box 4.2 **Nature conservation, tourism and indigenous communities' empowerment**

Since 1990 major efforts have been made to promote the participation of *indigenous people* in economic, social and cultural activities at national level. In 1993 the Indigenous Law was enacted and the National Corporation for Indigenous Development was formed. Today, public investment directed to indigenous communities accounts for 0.69% of the national budget, and programmes of land transfer, housing, education and micro-credit are in place. CONAF and the Agricultural and Livestock Development Institute of the Ministry of Agriculture have developed programmes to boost participation by indigenous communities in *sustainable forest management* and in formulating and implementing *territorial development programmes*.

SNASPE also serves to promote local development and indigenous groups' empowerment when a protected area shares space with an Indigenous Development Area. *Los Flamencos National Reserve* (73.986 ha), in the *Atacama La Grande Indigenous Development Area*, is a successful example. CONAF and communities of the Atacameño indigenous group formed an eco-ethno-tourism partnership in 2000, with support from San Pedro de Atacama municipality and mining companies, to administer part of the park and protect nature and archeological sites. The communities collect entrance fees (from 55 000 visitors in 2003) and invest the revenue for nature and heritage conservation and for social development.

3.4 Privately protected areas

Private sector participation in creating protected areas has emerged during the past 15 years. It takes several forms: i) private parks; ii) land donations to SNASPE; iii) land owned by groups of individuals (called conservation communities) for recreational or productive ends but managed for conservation purposes; iv) commercial eco-property and ecotourism projects; and v) private administration of state-owned conservation land (outside SNASPE areas) for ecotourism purposes.

Most privately protected areas consist of native forest vegetation in Araucanía Region IX and Los Lagos Region X. The individuals, groups, NGOs and businesses that own these areas are generally inspired by a sense of stewardship but in addition have a *mix of motivations* such as investment for the future, recreation or sustainable production in logging or ranching. Two-thirds of the owners are individuals or groups of individuals. The 3 000 km^2 Pumalín Park in Los Lagos is owned by a wealthy US citizen. Many owners are not at all well to do, however.

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Privately protected areas now cover almost 17 000 km^2, or the equivalent of *about 12% of the SNASPE network* (Table 4.3). The National Committee for the Defence of Flora and Fauna, an environmental umbrella organisation with more than a hundred members (individuals, NGOs, universities, and foundations), in 1997 founded the Network of Privately Protected Areas (RAPP), which now comprises 133 sites totalling 3 866 km^2.

This movement emerged spontaneously in the late 1980s without any significant guidance or intervention by the government. Notwithstanding the good intentions of the owners, privately protected areas so far have made a *limited contribution to nature protection*. The selection of sites is largely random (though, like SNASPE sites, strongly concentrated in native forest areas) and takes little account of biodiversity priorities. Most of the areas are small and isolated. With a few exceptions, they lack baseline studies, management plans and trained personnel. Although some legal instruments (e.g. covenant on the title limiting the uses to which the land can be put) exist to safeguard their position, most of the areas are not thus protected.

If private initiatives to create protected areas are to make a real contribution to nature conservation, *they need to be better integrated with government efforts*. The government needs to develop an overall strategic vision in which SNASPE would function as a system of core areas with a high level of protection, surrounded and linked by private areas serving as buffer areas and ecological corridors. The General Environmental Framework Law's Article 35 is aimed at promoting privately protected areas, but a regulation giving effect to this intention still is in the draft stage. Such areas need some form of legal recognition, and private initiatives should be steered towards identified biodiversity priority areas. The government could contribute technical expertise and training for the management of private areas, as well as financial incentives such as those proposed in the forthcoming native forest law (but not limited to native forests).

4. Integration of Nature Concerns in Sectoral Policies

4.1 Land use planning

Chile does not have a formal nationwide system of spatial planning that could ensure that *areas with high biodiversity value outside of formally protected areas* are identified and taken into account in land use decisions (Chapter 5). A promising step towards the establishment of an environmentally sustainable system of spatial planning is a pilot project being carried out in association with the German agency for technical co-operation, GTZ. In the Metropolitan Region of Santiago, one result of the project will be the integration of the regional biodiversity strategy

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(November 2004) with the regional development strategy (September 2004) and the regional plan for urban development of the Ministry of Housing and Urban Development (April 2005). Another is the drawing up of a land use plan for the coast in Bío-Bío Region VIII.

To make up for the lack of a spatial planning system, the authorities have begun using various *sectoral planning mechanisms* to achieve some degree of integration of nature and land use policies (although so far only 2% of the national territory is covered by any type of planning). The most significant of these efforts is the planning carried out by the Ministry of Housing and Urban Development under the General Urbanism and Construction Law (Law 19.778). In 2002 the ministry and CONAMA agreed to start incorporating present and future protected areas, as well as environmental impact assessments (EIAs), into regional urban development plans, inter-municipal zoning plans and municipal plans. Although the plans focus mainly on urban areas, they have the advantage of being binding on municipalities. Respecting the plans in day-to-day land use decisions will be the key to their ultimate success, and they should therefore be closely monitored.

The *national policy for the use of coastal areas*, overseen by the Coastal Area Office of the Ministry of Defence, can serve as a mechanism for incorporating biodiversity and nature protection considerations into land use in both urban and rural coastal areas. CONAMA is represented on the national and regional commissions that rule on developers' applications for permits to build on the coast. This is a positive factor, but the agency's voice cannot be forceful as long as the policy itself does not explicitly mention nature or biodiversity. The policy should be reviewed in order to introduce the perspective of sustainable development into land use on the coasts.

4.2 Tourism

More than 1.7 million foreign tourists visit Chile every year, and the number continues to grow steadily. The scenic beauty of Chilean landscapes is a drawing card for many tourists; moreover, one in five foreign visitors has a more specific interest in nature and visits a SNASPE area. About one-third of visitors to SNASPE areas come from abroad. Adventure and ecotourism form a fast-growing segment of the overall tourism market.

SERNATUR, the national tourism service, recognises that *nature is a primary asset* for Chile in attracting domestic and international tourists. Its main advertising slogan is "Nature that moves you". The agency can designate special tourism development zones, which may be wholly or partly based on an area's nature values. SERNATUR's draft regional tourism policy for Antofagasta Region II is an example

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of a holistic approach to expansion of the tourism sector within an overall sustainable development framework for the region. The draft policy links state policies on biodiversity, indigenous development, tourism, mining and water resources. It emphasises the need to build capacity at the grass roots. It also recognises that growth in visitor numbers should not put the region's natural assets at risk, and stresses respect for the beliefs and culture of indigenous communities in whose territory the assets are located. The draft policy is a positive initiative, highlighting the potential for co-operation between tourism and nature management. The government should give this aspect a higher profile in its overall development agenda.

Since the 1990s CONAF has supervised a National Parks for Ecotourism programme, which now includes 62 agreements with private companies on the operation of tourism ventures in protected areas. More recently the emphasis of the programme has shifted to promoting tourism development near wildlife protection areas. Ample opportunities remain to *increase the role of protected areas in the type of tourism development* that would benefit nature protection. For example, entry fees to protected areas, now not more than USD 2-3, could be raised and the revenue used for conservation programmes and improving tourists' experience (e.g. by building visitor centres).

The Ministry of National Property is another player in this area. For example, it started a network of scenic trails (Box 4.3). Its main role, however, is to manage public land, some of which is of high conservation or scenic value even if it is not formally protected. The ministry runs a programme inviting private sector proposals for the commercial use of public lands, e.g. for adventure and ecotourism, while respecting nature and biodiversity. So far, *potential developers appear unconvinced* of the commercial viability, and policies may need to be further adjusted. From a nature perspective, commercial use needs to be based on sound knowledge of the habitats and biodiversity in each area, and rules should be clear about what is to be protected and how commercial projects should enhance nature.

4.3 Native and exotic forests

Almost 165 000 km^2 or 22% of Chile's surface area is forested. Of this, 85.9% is native and most of the rest is exotic plantation forest (mainly radiata pine and eucalypts). Chile's primary temperate forests *represent one-third of the planet's remaining temperate rainforests* and therefore have a high biodiversity value globally. The World Bank/WWF Alliance for Forest Conservation and Sustainable Use has designated the native forests of Chile and Argentina as among the most threatened ecoregions in the world. Almost 29% of Chile's native forests are part of SNASPE. Plantation forests' limited nature value is mainly in terms of undergrowth and as corridors for animals.

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Box 4.3 **Of mountain trails and scenic coastal highways**

Providing access to nature is an indispensable facet of nature management around the world. In Chile, a new programme of *Heritage Trails* (Rutas Patrimoniales), run by the Ministry of National Property, is opening up scenic paths for hiking, biking and horse trekking to bring people closer to nature. Another project is the *Sendero de Chile* (Chilean Trail), initiated by CONAMA to celebrate the country's bicentenary in 2010. The Sendero project is aimed at creating a national network of interconnected trails and circuits with the dual objective of building environmental awareness and knowledge among Chileans and promoting tourism.

The Sendero route across both public and private land will *show off the diversity of Chilean ecosystems and cultures*. The 25 sections completed so far total 800 km. The cordillera will be the central axis of the trail, with connections to further paths and circuits in valleys and coastal areas with high scenic or natural qualities. In developing the trail, attention is paid to minimising environmental impact, and environmental education campaigns encourage users to "leave only their footsteps behind". Local communities will be encouraged to develop sustainable tourism initiatives associated with the trail.

However, *not all access projects are as uncontroversial* as the Chilean Trail. A proposal to build a scenic coastal highway from Puerto Montt (Los Lagos Region X) to Concepción (Bío-Bío Region VIII), across a hitherto inaccessible area with one of Chile's highest biodiversity values, has met with stiff resistance from environmental NGOs. The project, called the Camino Costero Sur (CCS, Southern Coastal Highway), is part of a much larger plan conceived about 30 years ago by the military to open up "internal frontiers" and ultimately build a coastal highway all the way to Aríca at the Peruvian border.

The *rationale for the CCS* includes ending the isolation of the area and integrating it into the national road infrastructure, promoting development of a low-income area, allowing development of new tourist areas and providing public access to areas of ecological interest. The plan has not been subject to economic cost-benefit studies or EIA; it is structured as a series of smaller projects, each falling below the EIA threshold.

Environmental NGOs have *reservations about opening up a region of very valuable biodiversity* that so far has been protected by its isolation. They argue that without a robust spatial planning system, such a road would lead to unfettered development and constitute a subsidy to the logging industry. They also claim illegal cutting would irreparably damage native forests. Nevertheless, consultations between a coalition of NGOs and government agencies (Ministry of Public Works, Ministry of National Property, CONAF and CONAMA) resulted in January 2003 in a memorandum of understanding. Among other matters, all parties agreed to co-operate in rehabilitating environmental damage caused by the construction of sections already completed and identify areas with high biodiversity value that need to be protected. More recently, however, the NGOs have complained that they are not being notified of new road construction and have accused the authorities of not keeping to the spirit of the agreement.

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Chile should assume a special responsibility in safeguarding as much of its native forests as possible. The challenge is to ensure that the 71% of native forest outside SNASPE, totalling roughly 100 000 km^2, is managed sustainably. Conversion of native forest to plantation, destruction by arson (in which case, having lost its biodiversity value, an area's protection is often lifted), illegal logging of valuable species and cutting of trees for firewood and charcoal production remain problems (Chapter 6).

Enforcement of protection regulations, even given sufficient resources, will always remain a problem in thinly populated areas. *Instilling a strong conservation ethic in the general population* in relation to native forests must be a key element in safeguarding this global heritage. Environmental education is therefore vital. Initiatives such as charcoal certification can also help raise awareness, and at the same time provide employment.

4.4 Management of inland waters

Progress has been limited so far in *integrating biodiversity considerations in water management.* The General Water Directorate (DGA) of the Ministry of Public Works broadly takes minimum or ecological flows in rivers into account when it considers water rights applications. More specific legal provisions have been proposed as part of the forthcoming revision of the Water Code (Chapter 3). In Regions I and II about 100 aquifers feeding into wetlands and wet-marshy meadows (bofedales) are protected under the Water Code: only the use of water by indigenous communities and of grassland by their camelids (llamas) is allowed. River basin plans would seem an appropriate instrument for setting minimum or ecological flows for whole catchments and identifying the aquatic biodiversity that should be protected. Biological water quality standards for various river types and lakes should complement basin plans. DGA has started elaborating indicative (non-binding) plans in four regions (e.g. the basin of the San José River in Region I).

5. Improving the Management of Nature

5.1 Increasing knowledge about biodiversity

Although progress has been made in recent years (e.g. a nationwide register of native vegetation), *considerable white space still exists on the map of Chilean flora and fauna.* For much of the 19th and 20th centuries, the identification and description of species was a dispersed effort mostly left to academia, although some limited ad hoc inventories were carried out by natural resource management agencies (on

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forestry, agriculture, fisheries) for specific purposes. Only in 1994 did the General Environmental Framework Law give state agencies responsibility for maintaining systematic inventories of living species. More comprehensive biodiversity inventories have since been initiated. In late 2003 CONAMA adopted a standard procedure for cataloguing and describing species' conservation status, based on the IUCN criteria also used in OECD environmental statistics. The need to improve knowledge of Chilean biodiversity, increase understanding of ecosystem functioning and build human capacity is recognised in the National Biodiversity Strategy as one of the eight major lines of action, but these have not yet been funded. Some sort of permanent standing commission involving all agencies with expertise in this field, including universities, should co-ordinate this effort, perhaps under the aegis of the national scientific organisation, CONICYT.

5.2 Enforcing nature protection regulations

CONAF and SAG, both part of the Ministry of Agriculture, are responsible for inspections and enforcement of regulations on protection of wild terrestrial and freshwater fauna (other than fish) and native flora under various statutes, including hunting and forestry legislation. SERNAPESCA is responsible for enforcement of fishing rules in inland and marine waters, as well as of CITES in ports. The Customs Service and national police (Carabineros) are also involved.

Although the institutions are in place, there is widespread dissatisfaction with the *low level of nature enforcement activity*. While from a management perspective it makes sense to have these functions carried out by agencies already in the field for other enforcement responsibilities, nature enforcement priorities will be evaluated against sectoral rather than nature objectives as long as budgets are controlled by these agencies. An additional problem is that enforcement agencies find it difficult to obtain convictions in the judicial system, where violations of environmental regulations are not yet given sufficient weight.

5.3 Reviewing expenditure and financing

CONAF *expenditure on management of the SNASPE network* almost doubled between 1994 and 2000 to USD 4.9 million, but has stagnated in recent years; personnel costs account for about 70% of this amount. The bulk of the expenditure is financed through the state budget, which is supplemented by revenue from visitor entrance fees and from concessions granted to commercial ventures. Very little funding is available for investment. Yet, investment is badly needed, not just for infrastructure improvements in existing protected areas but also to extend the network in

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accordance with the biodiversity strategy objectives. Estimates of the amount needed to even partly meet the 10% target are in the range of USD 100-160 million, or about 20-30 times the current annual operating budget. Even if the private sector finances part of the required extension, it is clear the government will also need to make a large increase in its biodiversity investment.

Other nature-related expenditure is incurred as part of *sectoral agencies' overall enforcement activities*. SAG, which administers the Hunting Law (including CITES), had about USD 0.55 million for this purpose in 2003. CONAF's Standards and Enforcement Division had a budget of USD 3 million that year to promote landholder compliance with forestry and environmental laws. Though much of this activity relates to native forests, the share of the enforcement effort devoted to nature protection per se appears to be the poor cousin of the agency's core development tasks.

5.4 Filling the institutional gap in the sectoral co-ordination model

Chile has opted for a sectoral co-ordination model for organising environmental management, giving resource ministries responsibility for the environmental aspects of their activities and establishing CONAMA as an interministerial agency in the Ministry General Secretariat of the Presidency rather than as a stand-alone environment ministry. Such a model may potentially work as well as any other, provided all interests are represented and are well balanced. In its present incarnation, however, the model does not sufficiently acknowledge that protection of nature and biodiversity amounts to *more than the sustainable management of marketable natural resources* by sectoral development agencies overseeing agriculture, forestry, fishing, aquaculture and so on. For instance, arguments and funding bids in favour of nature are inevitably filtered through the development agendas of sectoral agencies before they even reach the Cabinet.

A *dedicated nature protection agency* established under a *single, comprehensive nature protection law* and responsible for terrestrial and marine habitat protection, species protection and recovery programmes and biodiversity would have a better chance of success than the current arrangement, with its gaps and overlaps. Such an agency would still be consistent with the co-ordination model and would fill a lacuna in the current structure: it would have a seat on the CONAMA board alongside the current agencies and would express a clear voice within government in favour of nature and biodiversity. The sectoral agencies should retain responsibility for the sustainable management of the marketable natural resources in their respective domains; in fact, much remains to be done to ensure that biodiversity considerations are fully integrated in instruments and policy implementation. A review of such issues, announced in the National Biodiversity Strategy but not yet funded, should go ahead.

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6. International Commitments

Chile has ratified *many multilateral agreements on nature conservation* (References II). The earliest was the 1940 Western Hemisphere Convention, though national law still does not yet fully meet its requirements. The country actively implements CITES, but better training of front-line staff is needed. Chile is a party to the 1994 UN Convention to Combat Desertification and adopted a national action plan in May 1997, but implementation of the plan has not been a priority. Chile also is a party to the Bonn Convention on Migratory Species, including the 2001 Agreement on the Conservation of Albatrosses and Petrels, which has special relevance to Chile. Chile is a party to the 1992 Convention on Biological Diversity (ratified in 1994); it released its biodiversity strategy in December 2003, and now has to develop its national action plan.

As a party to the *Ramsar Convention* on wetlands Chile has designated nine sites (the last one in December 2004) with a total area of about 1 000 km^2. Six of these are part of SNASPE, one is a nature sanctuary privately owned by a mining company and another, the Salar del Huasco, is on government-owned land under no particular protection status. Five of the sites are high-altitude (2 300-4 400 metre) relict salt marshes. An Action Plan for the Conservation and Sustainable Use of the Wetlands of the High Andes, agreed by government agencies, indigenous communities and mining companies in 2003, could, if well implemented, make a valuable contribution to the sustainable development of the region. A national strategy for the conservation of wetlands is expected to be adopted in the near future.

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5

ENVIRONMENTAL-ECONOMIC INTERFACE*

Features

- Environmental management in a fast-growing economy
- Environmental Impact Assessment System
- Enforcement capacity
- Economic instruments: prices, taxes, subsidies
- Economic instruments: trading mechanisms

* This chapter reviews progress since 1990 and takes into account the latest OECD Economic Survey of Chile.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- develop *economic analyses of environment-related policies*, expanding both economic information on the environment (e.g. on environmental expenditure, environment-related taxes, health risk assessment, water and energy prices) and cost-benefit analysis of projects and legislation relating to the environment;
- review ways and means of integrating environmental concerns in *fiscal instruments and policies*;
- undertake *strategic environmental assessments* concerning: i) Chile's *energy policy framework* and ii) long-term *transport* plans for the Santiago Metropolitan Region, for other urban areas and at national level;
- based on analysis of the social cost and benefits of *energy efficiency* and *non-conventional renewables*, consider providing a positive financial incentive to encourage faster uptake;
- ensure that successors to the *clean production agreements in the agriculture sector* include dated targets for pesticide and nutrient management, expressed as intensity of use, and annual audited progress reports;
- formalise *institutional integration mechanisms* relating to sustainable development;
- develop and *strengthen the environmental institutions* at national and regional levels;
- further *develop and strengthen regulatory frameworks* (e.g. standards) to improve environmental health and to achieve Chile's international commitments; review ways to strengthen *compliance and enforcement* capacity, including through institutional reforms, for instance the establishment of an environmental inspectorate;
- review the scope for introducing *new economic instruments* (e.g. product charges on hazardous waste, air emission charges, water pollution charges) and improve trading mechanisms;
- further apply the *polluter pays and user pays principles* through appropriate charges (e.g. on waste management, for access to protected areas, for natural resources), with due regard to social constraints;
- further develop and strengthen *land use plans*: municipal and intermunicipal plans, regional urban development plans and coastline and watershed management plans; survey wetlands and assure their protection through regulations and incentives;
- develop a national set of *indicators* to measure environmental performance with respect to domestic objectives and international commitments.

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Conclusions

Integration of environmental concerns in economic decisions

From 1990 to 2004 Chile experienced high, diversified, export-led growth supported by sound macroeconomic and social policies, resulting in significant reductions in poverty but also considerable pressure on some natural resources, though certain pressures (e.g. from SO_x) have been reduced. The 1994 General Environmental Framework Law incorporates the *notion of sustainable development* in recognising three clear objectives: i) sustaining equitable improvement in individuals' quality of life without compromising future generations' expectations; ii) ensuring that socio-economic development and environmental sustainability are complementary; and iii) improving social equity and eradicating poverty. Policy coherence for sustainable development is supported by the Sustainable Development Council, established in 1998 as an advisory body to the President. With few production-based or input subsidies, Chile does not have many potentially *environmentally harmful subsidies*; however, there are subsidies for irrigation water and for afforestation projects, mainly oriented towards small-scale farmers. Availability of *natural gas* from Argentina led to the relatively rapid spread of combined-cycle gas turbine generators beginning in 1998, displacing coal and fuel oil; this, together with retrofitting of home heating systems, led to substantial reductions in emissions of particulate matter from power generation along with lower CO_2 emissions. New public and private investment proposals are subject to EIA, ensuring that some attention is given to environmental considerations at project level. Desire to meet the demands of buyers in Chile's export markets, for instance for *agricultural products*, led to clean production agreements (e.g. with pig producers, winegrowers, fruit and vegetable exporters and cheese producers) and a national certification system for organic products. Implementation of environmental policies does not seem to have diminished the country's *international competitiveness*; in a number of sectors, rigorous compliance with demanding environmental standards is seen as necessary for the penetration of Chilean products on OECD countries' markets.

Overall, Chile has not achieved the strong decoupling between environmental pressures and growth seen in a number of OECD countries (except SO_x and PM_{10} emissions in the Metropolitan Region). A national investment system is responsible for standards, techniques and procedures to guide public sector investment approvals, but gives little attention to environmental issues. Quantitative *cost-benefit analyses* are carried out for the establishment of environmental standards and decontamination plans; they should be used more extensively to support decisions concerning projects and instruments affecting the environment. In the *annual budgeting process* at national level, most environmental expenditure originates with sectoral ministries, where environmental priorities compete with others. Although the sustainable growth

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of the *electric power* sector is an explicit goal of Chilean energy policy, little attention is given to environmental concerns as such. No strategic environmental assessment of national energy development and regional or national transport plans has yet been done. In *agriculture*, environmental concerns are only partially integrated through growing awareness regarding water quality, water quantity in several regions, and pesticide use. More analysis of the environmental significance of distorted market signals is needed in some sectors. Regarding *tax policy*, there is no explicit use of taxes for environmental purposes, and the environment-related taxes in the energy and transport sectors were designed with little attention to their environmental impact. Chile has no national sustainable development strategy. Overall, *integration of environmental concerns into economic and sectoral decision making* should be fostered to improve environmental performance and move towards sustainable development. Such integration is also needed to achieve cost-effective responses to environmental challenges. Economic forces and changes in such sectors as energy, transport, industry, tourism, agriculture and other primary sectors strongly influence environmental conditions and trends, and hence can enhance or diminish the benefits of environmental policies. With its export-led growth, Chile has a considerable chance to capture the economic and environmental benefits of win-win situations.

Implementing environmental policies

During the review period (1990-2004) Chile strengthened its *environmental institutions*, most notably with the 1994 General Environmental Framework Law, which established the National Environment Commission (CONAMA), reporting directly to the President's office through the Ministry General Secretariat of the Presidency. CONAMA is a public body that operates as a decentralised service under a special regime, with a public legal personality and assets. It co-ordinates government environmental policies, prepares environmental regulations and fosters integration of environmental concerns in other policy. Much of Chile's environmental progress over the review period was driven by concerns about pollution's *health impacts* (and related effects on health expenditure and labour productivity) and the need for corporate environmental responsibility in *industries largely exporting to OECD countries*. Chile uses a *wide range of instruments* in connection with environmental policy: environmental impact assessment (EIA), other regulatory instruments, economic instruments (including trading mechanisms), voluntary approaches and planning and information instruments. It has put relatively low emphasis on regulation and information and, more recently, increased focus on land use planning and voluntary approaches. As a precautionary tool, the *EIA system* is well established and has proved active and influential. *Chile was a pioneer* in the use of *trading mechanisms* such as tradable particulate emission permits in Santiago, nationwide

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trading of water rights and individual transferable quotas for some fish species. These programmes have provided invaluable experience and are potential first steps towards wider or more active markets, but at their current scale the economic efficiency benefits are small. A major and successful *reform in water and sanitation service provision* to households led to the restructuring of the water sector, full-cost pricing and rapid infrastructure improvement. This reform reinforced Chile's progress towards fully applying the *polluter pays and user pays principles*. Efforts to ensure that at least half of municipal solid waste is deposited in sanitary landfills were reinforced in 2002, and the target appears to have been reached for the country as a whole. *Voluntary approaches* now involve many firms, accounting for about half of GDP, largely because their export markets are OECD countries where consumers, producers and financial institutions are used to high environmental standards. Total public and private environmental expenditure (including water supply) has reached about 1.25% of GDP in recent years. Most expenditure has gone to water-related infrastructure and reducing copper smelter emissions.

Looking ahead, health issues and export-oriented concerns will continue to drive environmental progress in Chile, including further reductions in air emissions (e.g. from industry, energy production and transport) and continued improvement in water-related infrastructure and domestic and industrial waste management. Nature and biodiversity should increasingly be protected as assets for the domestic and international recreation and tourism industries. As the *road to environmental convergence* with many *OECD countries* will remain long as regards several issues, it will be necessary to strengthen and expand environmental institutions considerably. In particular, stronger actions are needed concerning EIAs; quality and emission standards for air, water, waste and nature management; the use of economic instruments; territorial management policies; and national as well as regional plans and strategies. An *environmental enforcement policy* based on co-ordination of various sectoral enforcement bodies is not the most effective institutional arrangement to assure compliance. Integration of environmental concerns in regional and municipal *land use planning* is needed, and the coverage and implementation of spatial plans should be expanded and strengthened. Economic information and analysis affecting environmental decisions should be strengthened considerably.

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1. Towards Sustainable Development

1.1 Decoupling environmental pressures from economic growth

Over the review period, Chile experienced *strong export-led growth* supported by sound macroeconomic and social policies (Figure 5.1). Some of these export-oriented sectors (e.g. mining, forestry, aquaculture) have been growing at very high rates (Chapter 6). Trade grew more rapidly than GDP and *export diversification* away from copper continued. Most of this diversification, however, has also been intensive in the use of natural resources, notably non-copper minerals and metals in the mining sector, fruit and wine in the agriculture sector, sawn wood and pulp (much of it plantation-based) in the forestry sector and fresh and processed fish from aquaculture. Meanwhile, copper production has continued to grow rapidly even as its export share has fallen. Chile's economic progress has been accompanied by *significant reductions in relative and absolute poverty levels.*

Pressures on natural resources from this economic growth have included shrinking of native forest cover, overexploitation of capture fisheries and increasing water use by industry and agriculture. The decline in native forest cover has slowed in recent years, partly because planted forests have taken up the slack between supply and demand. Fish stocks still appear to be under pressure, however, despite the rapid growth in aquaculture. *Energy use, transport and solid waste generation* have remained *strongly coupled to GDP*, and waste recycling rates are relatively low (Table 5.1).

Nevertheless, *several environmental pressures have been reduced*, in a few cases with strong decoupling from GDP growth. SO_x, CO, PM_{10}, $PM_{2.5}$, VOCs, CFCs and lead have all fallen in absolute terms even as economic activity has expanded (Chapter 2). With increasing use of natural gas, CO_2 has also begun to exhibit weak decoupling with respect to total energy use. In the Santiago Metropolitan Region and several other cities, sanitary landfills are replacing uncontrolled dumps, reducing the environmental impact of waste disposal. Progress has also been substantial in installing waste water treatment plants throughout the country: virtually 100% of households are expected to be connected by 2014 to reduce another major environmental pressure, which has had major health impacts (Chapter 3). Progress on NO_x has been slower, and there has been virtually no progress in reducing ozone in major cities. In agriculture, pesticide use remains high, as does the use of nitrogenous fertiliser.

1.2 Sustainable development and institutional integration

Chile no longer uses formal national development planning or strategic economic planning. It does, however, have *strategic policy formulation*. The

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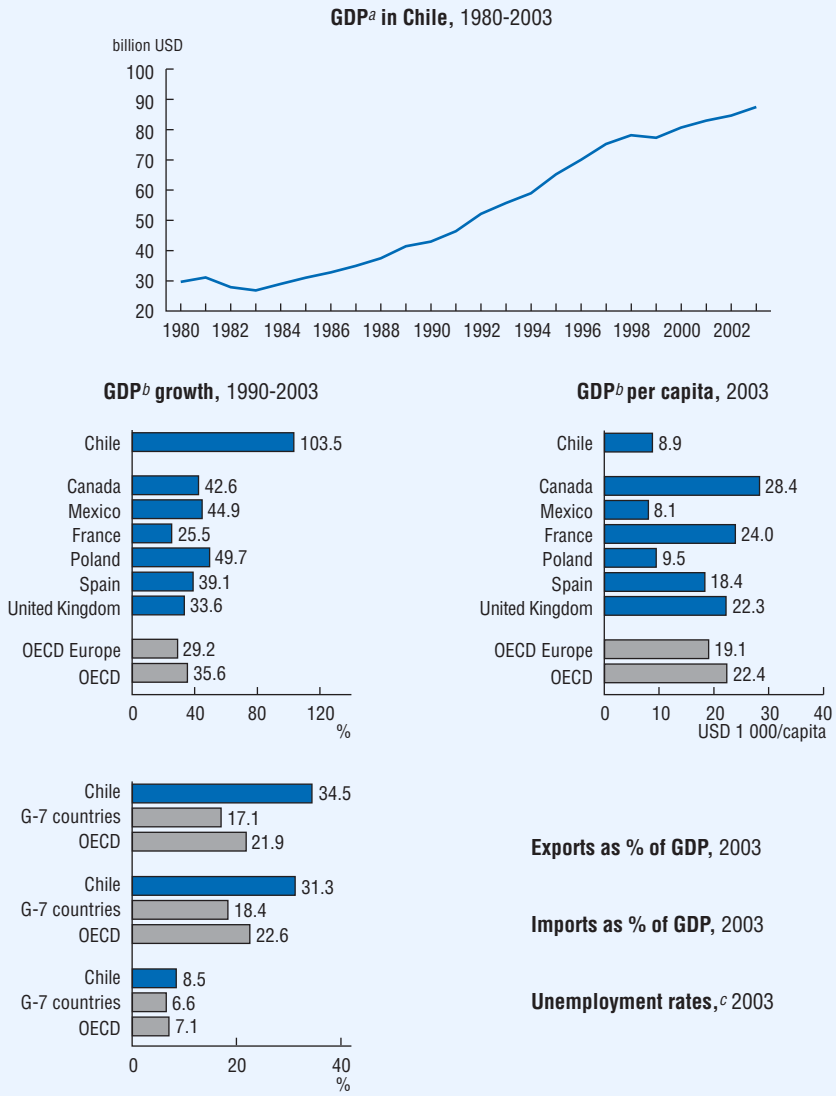
Figure 5.1 **Economic structure and trends**



a) GDP at 1995 prices.
b) GDP at 1995 prices and purchasing power parities.
c) % of total labour force.
Source: *OECD Economic Outlook.*

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government is trying to promote economic growth while seeking to improve Chile's social performance. It is pursuing major social reforms in health care and education and launching or continuing significant reforms in areas including labour markets, taxation and capital markets, regulatory policy, state modernisation and measures to combat corruption, as well as further export promotion. Proposed environmental measures are expected to minimise economic costs and avert conflicts that would discourage foreign or Chilean private investment. This approach is consistent with the 1994 General Environmental Framework Law (Law 19.300), which incorporates the *notion of sustainable development* in recognising three clear objectives: i) sustaining an equitable improvement in individuals' quality of life without compromising future generations' expectations; ii) ensuring that socio-economic development and environmental sustainability are complementary; and iii) improving social equity and eradicating poverty.

Table 5.1 **Economic trends and environmental pressures,** 1990-2003

(%)

Selected economic trends	
GDP[a]	103
Population	20
Agricultural production	43
Mining production (index)	265
Forest harvest[b]	180
Aquaculture harvest[c]	824
Industrial production	161
Total primary energy supply[d]	81
Total final energy consumption[d]	79
Road vehicles	197
Selected environmental pressures	
CO_2 emissions from energy use[e]	68
Emissions of SO_2[f]	–64
Emissions of NO_x[f]	100
Nitrogenous fertiliser use[d]	28

a) At 1995 prices and purchasing power parities.
b) Plantation forest harvest.
c) 17% growth per year on average over 1999-2003, including a doubling over 1999-2001.
d) To 2002.
e) To 2002. Excluding marine and aviation bunkers.
f) To 2001.
Source: CONAMA; FAO; INE; INFOR; SERNAPESCA; IEA-OECD; OECD.

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The *Sustainable Development Council*, established in 1998 as an advisory body to the president, aims to assure effective participation of civil society in matters relating to environmental policy. It reports annually on the state of sustainable development, provides the president with a vision of sustainable development in the medium and long term, and presents suggestions and recommendations for public dissemination. The council's executive secretary is the executive director of CONAMA and its 92 members come from government institutions and the major groups identified in Agenda 21: women, youth, workers, entrepreneurs, local authorities, professional and scientific experts, indigenous people and non-governmental organisations (NGOs).

Public sector investment is organised through the National Investment System (SNI), administered by the Ministry of Planning and Co-operation and Ministry of Finance. To guide the approval process, the SNI issues standards, techniques and procedures. These include project preparation and assessment methodologies incorporating shadow or "social" prices to measure projects' potential impact on economic growth and development; training in project preparation and assessment for staff of public agencies; and an information system (Integrated Project Bank, or BIP) to facilitate institutional co-ordination. Efforts to incorporate environmental concerns directly into this system should be strengthened. However, public sector projects and private investment projects alike must go through the *Environmental Impact Assessment System* (SEIA).

In the national *annual budgeting process* most environmental expenditure originates with sectoral ministries, where environment competes with other priorities in budget formulation. Environmental units of these ministries regularly track current and capital environmental expenditure, but accounting systems generally are not designed with this purpose in mind. Nor, until recently, has there been uniform methodological guidance available to the environmental units, resulting in a lack of comparability among ministries and over time.

Concerning *sectoral integration*, some efforts have been made, for instance in agriculture (Box 5.1 and Chapter 3), electricity (Box 5.2), energy and transport (Chapter 2). However, further progress is needed regarding a range of actions, including strategic environmental assessment.

1.3 Sustainable development and market-based integration

Chile has only a few production-based or input-based subsidies (e.g. irrigation water, afforestation), and consequently has few potentially environmentally harmful subsidies. Moreover, it extensively *applies the user pays principle* to drinking water

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Box 5.1 **Towards integrating environmental concerns in agriculture**

Environmental concerns are only partly integrated in *agriculture*. Issues related to management of relatively *scarce water* in several regions have been coming to the fore. The introduction of tradable water rights is an important policy innovation that has generally helped improve the allocation of water. This fact has reinforced a long-standing tendency in Chilean agriculture to shift from grains to fruit and wine and to establish forest plantations on previously degraded farm land. Concerns about depletion of *aquifers* remain in some areas, however; *wetlands* policy is not well-integrated with agricultural policy; *minimum flows in watercourses* for environmental purposes are envisaged in the 1994 General Environmental Framework Law, but not always enforced; and "secondary" (i.e. environment- rather than health-related) standards for ambient water quality have yet to be established. There is no clear policy designed to ensure that *fertiliser and pesticide intensity* do not endanger human health or the environment. Pesticide health risks are thought to be high for the farm workers handling the substances and for communities subject to pesticide drift. Fertiliser use is associated with eutrophication in some inland water bodies (Chapter 3).

A positive market-driven development, motivated by concern to meet the demands of buyers in Chile's *export markets for agricultural products*, has been the signature of *clean production agreements* with pig producers, winegrowers, fruit and vegetable exporters and cheese producers, along with the establishment of national certification for organic production. An evaluation by the Clean Production Council concluded that 75% of the signatories to the 1999 agreement with pig producers had developed management plans by the end of 2001 that, among other outcomes, had significantly reduced the effluvium generated by pig farms. The clean production agreement signed in 2002 with fruit and vegetable exporters commits them to developing and disseminating good agricultural practices by April 2005, including guidelines on selection, storage, use, handling and application of pesticides. None of these agreements includes commitments to time-bound targets relating to effluent management or pesticide use.

and sanitation services, energy and limited-access highways, approximating social marginal cost pricing, including return to capital. Most such services are now provided by private enterprises operating under contract with the public sector. Concerns about affordability, for example of drinking water, are addressed with direct subsidies to low-income households. Chile also respects the polluter pays principle in financing pollution control expenditure. Publicly traded companies have recently been responding to pressure from financial markets to report potential environmental effects of their operations as part of demonstrating "due diligence", a practice thought to lead to improved environmental performance.

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Box 5.2 Towards integrating environmental concerns in the electric power industry

The *electric power* industry comprises some 73 private generation, transmission and distribution companies. The National Energy Commission (CNE) is the regulatory and enforcement body and plays an indicative role in investment planning. Competitive markets are the norm in the various segments of the industry, though prices are regulated for small consumers (less than 2 000 kWh) and for distribution companies. In reforming the electricity sector, *little explicit attention has been given to environmental concerns*. In particular, there has been no strategic environmental assessment of the national programme of energy development, and the principle tool for meeting environmental norms is SEIA. In practice this has meant, for example, that proposed power plants for areas declared as "saturated", such as the Metropolitan Region, must buy offsets equal to 150% of their calculated TSP emissions, which encourages the use of relatively clean sources of power.

A number of other positive developments provide a basis on which future efforts could be built. Just over half of Chile's electricity (51%) is generated by *hydropower plants*; the rest comes from thermal plants, aside from a 2 MWh wind power installation in Aysén Province (Region XI). Availability of *natural gas* from Argentina led to relatively rapid growth in building of combined cycle gas turbine generators, which in 1998 began displacing plants fired by coal and fuel oil. Together with retrofitting of home heating systems, this shift led to substantial reductions in emissions of particulates and SO_2 as well as some decoupling of CO_2 from power generation. The positive trend is likely to continue, as the draft plan for the largest of the four autonomous grids, the central grid, envisages constructing hydroelectric plants with total generating capacity of 995 MW and natural gas thermal plants with combined capacity of 3 071 MW over the next ten years (Chapter 2).

Recent amendments to the General Electric Services Law incorporate detailed provisions that guarantee and reduce the cost of access to the grid for small generators, thus encouraging electricity based on *non-conventional renewable resources*. Moreover, in support of a government review of policy on renewables, the CNE has begun identifying any non-economic barriers (e.g. market characteristics and technical norms) in current regulation, with a view to removing them, and will improve information on the potential magnitude and location of renewable resources. The CNE is also assessing the social benefits and costs at national level of providing financial incentives for renewables-based generation.

Chile has had an *energy efficiency* policy since 1992, but it has focused mainly on voluntary energy audits in 40 industrial groups, along with energy audits and demonstration projects for public buildings, which have also been the subject of a lighting modernisation programme. Such efforts have been reduced in recent years. The CNE is preparing a new energy efficiency policy, including regulatory reform proposals to encourage co-generation; 38 energy efficiency labelling standards for electric appliances, along with proposals for accompanying legal and regulatory changes to augment their impact; and insulation standards to be incorporated in housing construction.

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Regarding tax policy, *no explicit use is made of taxes for environmental purposes*, but "environmentally related" taxes exist in the *energy and transport sectors* with differential taxation of diesel fuel and petrol. The current tax structure provides an incentive to use diesel, a fuel that leads to lower CO_2 emissions but is more harmful to human health than petrol because of its higher emissions of particulates.

Provisions in the tax code designed to encourage private investment, while formally neutral, may constitute de facto sectoral subsidies. Examples are accelerated depreciation for new investment and deduction of interest on loans paid by a subsidiary of a multinational enterprise to its parent company (a disguised form of investment). The latter provision is particularly important in large-scale mining, where tax revenue seems disappointingly low despite large production increases in recent years. This situation has given rise to a lively debate about *introducing a royalty tax or increasing licence fees in the mining sector*, as reflected by two draft laws sent to Congress in 2004 (Chapter 6).

Article 19 of the Chilean constitution prohibits *earmarking of tax revenue*, which has limited moves towards environmental taxation. Even revenue from entrance fees to national parks must be deposited with the Treasury as general revenue. A case could be made for partial self-financing of management and small-scale infrastructure improvements at national parks by allowing each unit in the park system to collect and use fees for agreed purposes. Indeed, an exception is already made with national parks or protected areas within the boundaries of lands managed by indigenous peoples, e.g. a project of the National Corporation for Indigenous Development (CONADI) and National Forest Corporation (CONAF) in Los Flamencos National Reserve (Box 4.2).

The *principal rationale for environmental taxes and charges is their incentive effect* when they are well-targeted at environmental externalities. This objective is more important than the question of how the revenue might be used; discussions on the pros and cons of such measures could usefully be pursued. A positive feature of the individual transferable fishing quota for deep sea cod and orange roughy is that 10% of the annual quotas are issued by *auction*, resulting in a revenue gain for the Treasury. The allocation of bus routes to private operators was also done by auctioning permits. Auctions have not yet been used in connection with the trading of emission permits for stationary sources of suspended particulates in the Metropolitan Region.

1.4 Environmental finance

Only since 1998 has CONAMA systematically compiled time series data on *public sector environmental expenditure* (USD 253 million in 2002). Environmental investment varies more than current expenditure, having decreased from 51% of total

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environmental expenditure in 2000 to only 19% in 2003. These data are not directly comparable with the environmental expenditure data collected by OECD concerning its member countries. For instance, CONAMA data *exclude* environmental expenditure by municipalities (mostly for solid waste management) and that of private (but concession-holding) companies providing water supply and waste water treatment. Fragmentary data suggest that *municipal* environmental spending for solid waste management comes to at least USD 30 million per year. Regarding *private water companies*, 2003 expenditure on water supply and waste water treatment by publicly traded private enterprises was reported at about USD 345 million.

Regarding companies, their environmental expenditure was estimated at USD 60 million (private companies) and USD 52 million (state-owned mining companies). Finally, *NGOs* are conduits for some environmental expenditure, such as funds provided by the Global Environment Facility and its Small Subsidies Programme, Fondo de las Americas (a debt-swap programme with the United States) and CONAMA's Environmental Protection Fund. Foreign sources provided USD 40.6 million over 1994-2004, or about USD 3.7 million per year, and NGOs themselves may have raised USD 1.8-3.7 million directly per year.

Overall, *total environmental expenditure* (i.e. pollution abatement and control expenditure plus nature protection and water supply expenditure) was close to *1.25% of GDP* in recent years, a figure in the lower middle range of OECD countries.

1.5 International competitiveness

Implementation of environmental policies does not seem to have harmed Chile's international competitiveness. The activity that bore the greatest costs for reducing air pollution was *copper refining*, but since this industry in Chile is highly efficient by world standards, and a major player internationally, the costs were absorbed with no apparent impact on companies' competitiveness in international markets. Costs of many other environmental policies (e.g. on waste management, water treatment and power generation) have fallen mainly on households as a result of a fairly consistent application of the polluter pays and user pays principles. The gradual improvement in environmental performance of *natural resource-based export industries*, through a combination of regulation and voluntary clean production agreements, is generally seen as an advantage since Chilean exporters have sought to establish a *reputation in their export markets* as environmentally sound. Nonetheless, there is a perception that the "low-hanging fruit" may have been harvested and that increasingly stringent environmental policies may involve trade-offs with profitability. It will thus become more important to employ cost-benefit analysis and communicate the results to the broader public to maintain political support for the evolving environmental policy agenda.

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2. Environmental Policy Implementation

2.1 Development of environmental policy

Chile's *constitution* (Box 5.3) contains three articles concerning environmental governance: the right to live in a pollution-free environment is among the list of fundamental rights the state must protect; property rights are linked to social and environmental cross-compliance requirements; and the right of appeal against any breach of these two provisions is included.

The National Ecology Commission (CONADE) was established in 1984, mainly to identify key environmental issues, formulate environmental policies and co-ordinate their implementation. In 1990 a Supreme Decree provided for the National Environment Commission (CONAMA) to replace CONADE, under the aegis of the Ministry of National Property. In 1994 the *General Environmental*

Box 5.3 **Institutional context**

Chile is a unitarian republic whose president is the head of state and government. The *constitution* (approved in 1980, in effect since 1981) sets out the separation of powers and provides the foundation on which the government implements and enforces environmental law. Since 1976 the republic has been divided administratively into 13 regions and 51 provinces. The Metropolitan Region encompasses Santiago, the capital (map of Chile).

The *National Congress* consists of two chambers. The Senate (38 elected seats and nine appointed) and the Chamber of Deputies (120 elected seats) have equal lawmaking functions. Congress and the president can both propose laws. Congress cannot initiate legislation that requires budgetary appropriations or affects the political or administrative division of the country; it can approve, or propose reductions in, budget provision. Environmental bills may be introduced by members of either chamber or by the executive branch. To become law, bills must be approved by both houses and the president, who has the right of veto.

Executive power lies with the president, acting on the advice of an appointed cabinet. The president, elected for a single six-year term, sets the agenda for Congress and thus determines the priority given to each piece of legislation. The government develops and implement policies for the entire country. The president appoints an *intendant* to administer each region and a *governor* for each province. They develop regional policies within a framework designed by the president. Each municipality is governed by an elected council and mayor (alcalde) and has certain areas of autonomy as regards the administration of its territory.

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Framework Law established a legal framework to which all other environmental legislation must refer, and provided CONAMA with extended powers, as a public body that operates as a decentralised service under a special regime (with a public legal personality and assets). These developments came in part as responses to *severe environmental problems causing health damage* and public concern.

CONAMA answers directly to the Ministry General Secretariat of the Presidency (SEGPRES). One of its tasks is to integrate environmental considerations into the work of ministries and other public entities. CONAMA has 13 Regional Environment Commissions (COREMAs), an annual budget of about USD 18 million and around 450 staff members (200 at central level, 50 in the Metropolitan Region and 200 in the other regions). CONAMA is an interministerial and multisectorial co-ordination organ with an Executive Council of ministers from different areas of national administration having environmental functions, a multisectorial Advisory Council and an Executive Directorate. The Executive Council supervises CONAMA's work. It is chaired by SEGPRES and includes representatives from the Ministries of Agriculture, Defence, Economy and Energy, Education, Foreign Affairs, Health, Housing and Urban Development, Mining, National Heritage, Planning and Co-operation, Public Works, and Transport and Telecommunications. The Advisory Council, also chaired by SEGPRES, is composed of academics, entrepreneurs, environmental NGO representatives, scientists and representatives of trade unions (with two seats each). The COREMAs are similarly structured.

Chile uses a range of *policy instruments*: environmental quality and emission standards, pollution prevention and clean-up plans, SEIA and such market-based instruments as water pricing, abstraction charges for irrigation, tradable emission permits and tradable water rights. There are no pollution charges for emissions into air and water. Measures concerning waste include a well-functioning deposit-refund system for containers but few charges for municipal waste service and no product charges. An increasing emphasis is being placed on voluntary approaches.

Environmental policy has been significantly influenced by the export orientation of the economy (particularly as regards Chile's OECD trading partners) and free trade agreements with environmental components (Chapter 8). These factors have prompted industry, since the late 1990s, to enter into voluntary clean production agreements and adopt international environmental standards, such as ISO 14001. Foreign direct investment has also had a key influence in developing a culture of corporate environmental management.

CONAMA's *Environmental Agenda 2002-06* addresses four main policy objectives and associated targets, relating to the urban environment, biodiversity, environmental management and social issues (Table 5.2).

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Table 5.2 **Environmental objectives and targets**[a]

1. To restore the urban environment:
   - increase sewage treatment coverage to 80% of the urban population and issue stringent regulations on industrial sewage discharges;
   - cease illegal waste dumping in the Metropolitan Region and set up a national waste recycling programme with targets and deadlines;
   - establish air monitoring networks in cities with population over 100 000.
2. To protect biodiversity:
   - create new wildlife protection areas;
   - assure at least 10% protection of key ecosystem areas;
   - enhance protection of endangered species.
3. To modernise environmental management:
   - reduce by 40% the time necessary to complete an EIA and increase CONAMA's assessment capacity to more than 90% of projects;
   - promote environmental management at the local level;
   - increase transparency in environmental policy setting and implementation.
4. To better address the social-environment interface:
   - include environmental policy in all compulsory education curricula;
   - eradicate environment-related public heath concerns, such as lead in Antofagasta and asbestos in Maipu.

a) CONAMA Environmental Agenda 2002-06.
Source: CONAMA.

2.2 Regulatory instruments

Standards

Regulatory instruments have been used in Chile, but less so than in many OECD countries. There has been a long process of developing *environmental quality standards*. The first "primary" quality standards (i.e. those aimed at protecting human health) were issued in 1978 for surface water and air, and dealt with total suspended particulates (TSP), SO_2, CO, ozone and NO_2. Other standards were issued for drinking water quality (1984), SO_2 and PM_{10} in areas surrounding large mining companies (1992), airborne lead (2001) and PM_{10} nationwide (2001). In 2003 new standards were released for CO, ozone, NO_2, SO_2 and TSP. New standards for surface water quality are about to be approved. For several air pollutants (e.g. VOCs, heavy metals) primary standards have not been defined yet. Secondary quality standards (those aimed at preserving ecosystems) for air have been issued only for SO_2 and iron. No secondary standards for water quality have yet been set. Standards for light pollution have been set in regions with astronomic activities. *Emission standards* have been set for discharges of industrial effluent into sewerage (1998) and into surface

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waters (2000) and groundwater (2002); and for motor vehicles, including diesel-fuelled vehicles (2000) and buses used as public transport in Santiago (2001). Emission standards have also been set, since 1999, for arsenic (for smelters) and, since 2000, for total reduced sulphur compounds (for cellulose plants).

Environmental impact assessment

Since 1992, CONAMA has administered SEIA, which is *funded by the ministries with environment-related responsibilities*. In 1997, SEIA became mandatory for new projects. SEIA is designed to incorporate the environmental dimension in the building, operation, closure and decommissioning of public and private projects or activities. CONAMA, often through the COREMAs, must give its opinion on an environmental impact statement (EID) within 60 days and on an EIA within 120 days. The period may be extended once, for 30 days and 60 days, respectively. The general public is invited to give its opinion via the Internet.

Close to 7 000 projects have undergone assessment. Some 92% submitted EIDs and 8% the more in-depth EIAs. Out of the total USD 70 billion in investment concerned, mining projects accounted for 33%, energy for 16%, housing development

Table 5.3 **SEIA activities**, 1992-2003

	Projects submitted			Projects approved			% approval[c]		
	EID[a]	EIA[b]	Total	EID	EIA	Total	EID	EIA	Total
1992	0	3	3	0	3	3	. .	*100*	*100*
1993	0	8	8	0	8	8	. .	*100*	*100*
1994	1	21	22	1	20	21	*100*	*95.2*	*95.5*
1995	1	41	42	1	36	37	*100*	*87.8*	*88.1*
1996	0	57	57	0	52	52	. .	*91.2*	*91.2*
1997	260	45	305	190	39	229	*73.1*	*86.7*	*75.1*
1998	694	59	753	565	45	610	*81.4*	*76.3*	*81.0*
1999	787	49	836	637	37	674	*80.9*	*75.5*	*80.6*
2000	818	55	873	690	37	727	*84.4*	*67.3*	*83.3*
2001	1 378	73	1 451	1 196	55	1 251	*86.8*	*75.3*	*86.2*
2002	1 112	53	1 165	896	34	930	*80.6*	*64.2*	*79.8*
2003	894	36	930	675	29	704	*75.5*	*80.6*	*75.7*
Total	5 945	500	6 445	4 851	395	5 246	*81.6*	*79.0*	*81.4*

a) Environmental impact statement.
b) Environmental impact assessment.
c) Ratio of projects approved to projects submitted.
Source: CONAMA.

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for 12%, industry for 10%, forestry for 7%, sewage treatment plants for 5% and transport infrastructure for 5%. About *19% of the projects submitted have not been approved* (Table 5.3). Since 2000, CONAMA, working with other public institutions, has assessed and approved all 40 projects presented for environmental evaluation *concerning the Antarctic*, in compliance with the Madrid Protocol of the Antarctic Treaty. CONAMA conducted field evaluations for one-third of these projects. Overall, SEIA is well established, plays an important part in the Chilean regulatory system and has proven active and influential.

Compliance and enforcement

Enforcement of environment-related legislation (Table 5.4) has long been conducted by a variety of public agencies (Table 5.5), which implies that a *sectoral focus has predominated*. While CONAMA oversees the adoption of environmental

Table 5.4 **Selected national environmental legislation**

Title	Objectives
1931 Forest Law	Regulate use of forest resources
1974 Decree Law 701	Regulate forestry activity
1967 Sanitary Code[a] (amended in 1990 by Ministry of Health decree)	Establish provisions for waste management and the functioning of landfills
1980 Plant Protection Law	Regulate production, import, distribution and use of pesticides
1981 Water Code[a]	Establish characteristics of water rights and requirements for obtaining them; set up the General Water Directorate to implement procedures for acquiring water rights
1983 Ministry of Finance Decree on Customs Service	Control movements at borders, ports and airports of goods that could have an effect on the environment or human health
1986 Law of the Sea	Outline conditions for human activities at sea; protect the marine environment
1991 General Law on Fishing and Aquaculture	Assure the conservation and rational use of fishing resources
1994 General Environmental Framework Law	
1996 Hunting Law	Assure consistency with the General Environmental Framework Law and the CITES Convention
1998 Supreme Decree 16 of the Ministry of Health	Develop the Air Pollution Prevention and Clean-up Plan for the Metropolitan Region, stressing the impact of air pollution in Santiago and the Metropolitan Region
2001 Supreme Decree 136 of SEGPRES	Establish primary quality standards for lead in the air
2001 Supreme Decree 150 of SEGPRES	Establish primary quality standards for total suspended particulates

a) Codes are extensive legislation and legally binding.
Source: CONAMA.

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regulations, it does not have enough inspectors to carry out all required on-site inspections. The Metropolitan Environmental Health Service (SESMA) supervises pollution control (air and waste) at stationary sources in the Metropolitan Region (Chapter 2). CONAMA is little involved in water and biodiversity compliance programmes of other public agencies, particularly as regards agriculture, forestry, fishing, fish farming and public works.

Table 5.5 **Selected public bodies with environmental enforcement responsibilities**

Agency	Parent ministry	Environmental enforcement responsibilities
AIR AND WASTE MANAGEMENT		
Public Health Services	Health	Air pollution and industrial waste (Sanitation Code) outside the Metropolitan Region
Metropolitan Environmental Health Service (SESMA)	Health	Air pollution and industrial waste (Sanitation Code) in the Metropolitan Region
Municipalities		Municipal waste management
National Geology and Mining Service (SERNAGEOMIN)	Mining	Mining waste and mining sewage (tailing dams)
Undersecretariat of Transport	Transport and Telecommunications	Vehicle inspection
Superintendency of Electricity and Fuels (SEC)		Fuel quality
WATER MANAGEMENT		
General Water Directorate (DGA)	Public Works	Water rights (Water Code)
Superintendency of Sanitation Services (SISS)	Public Works	Urban and industrial sewage
General Directorate of the Maritime Territory and Merchant Marine (DIRECTEMAR)	Defence	Sewage discharge into marine waters, marine pollution, navigation (Navigation Law)
BIODIVERSITY CONSERVATION		
National Forestry Corporation (CONAF)	Agriculture	Forest management plans
Agriculture and Livestock Service (SAG)	Agriculture	Pesticides (Plant Protection Law), hunting
National Police (Carabinero)	Interior	Forest harvesting and hunting
National Fisheries Service (SERNAPESCA)	Economy and Energy	Fishing (General Fishing and Aquaculture Law)
OTHER		
Customs Service		Trade and the environment
National Monuments Council	Education	Cultural heritage

Source: CONAMA.

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Since the late 1990s, CONAMA's responsibility for co-ordinating enforcement and establishing enforcement guidelines for other public agencies has increased under SEIA. This approach of *enforcement policy based on co-ordination* led to the setting up of national and regional Operative Committees for Environmental Enforcement in 1999. They meet periodically to co-ordinate enforcement of conditions attached to EIDs and EIAs, and, more generally, to encourage compliance with emission and quality standards. They also co-ordinate enforcement of environmentally relevant legal and regulatory provisions in fields such as water and biodiversity (e.g. hunting, fishing and forest regulations). For non-compliance with EID/EIA provisions, fines of up to 500 monthly tax units (UTM, an amount pegged to the cost of living) can be imposed, and a project can be postponed or have its approval revoked.

In practice, outside the SEIA process CONAMA has had little control over compliance with and enforcement of environmental regulations by sectoral agencies. Sectoral bodies have the staff and general technical capacity for on-site inspections but the environmental part of their enforcement activity may be overshadowed by other tasks and priorities. *The enforcement role of sectoral administrations should be increased at regional level*, where transaction costs and conflicts of interest are lower than at central and local level.

2.3 Economic instruments: prices, taxes, subsidies

Water and waste service pricing

The present water pricing regulatory framework was set up in 1989 with the Superintendency of Sanitation Services (SISS) as the supervisory body. This pricing system, put into effect gradually over 1990-98, allows *full cost recovery* for drinking water supply and sewage collection and treatment. A related *large rise in water prices* preceded the privatisation of water utilities, which began in 1998. In the process the water and sanitation industry went from a centralised public structure to a regionalised private one. The *privatisation/concession* programme for water and sanitation brought in USD 2.4 billion in foreign direct investment over 1998-2003 (Chapter 3). Mechanisms were established to transfer public funds (USD 35-40 million a year) to cover much of the water bill for the *urban poor* (615 000 families) and *rural poor* (61 500 families) (Chapter 3). The restructuring of the water service sector has been quite successful and can be regarded as a model case.

Progress has been made with *municipal waste management* (Box 5.4). Some 80% of municipalities with over 50 000 people have put their waste services under concession. User charges for municipal waste collection and disposal do not recover costs and are largely financed by the municipal budget. Real estate with a tax

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Box 5.4 **Waste management**

Generation of municipal waste has been increasing in line with GDP growth. Volumes have reached about 380 kg per person per year, though their environmental impact has been decreasing as unregulated dumps are closed and replaced by sanitary landfills. As of 2000, 11 of 246 surveyed final disposal sites (accounting for 37% of waste disposed of) met new higher standards. Efforts to ensure that at least half the solid waste generated in Chile is deposited in controlled sites were reinforced in 2002. The target now has been reached for the Metropolitan Region and the country as a whole, but not necessarily for each region.

In 1994 *Santiago* faced a municipal waste crisis, as its two dumps clearly jeopardised environmental safety and posed growing health risks to nearby residents and to the many scavengers who sifted through the waste as it was dumped. Santiago municipalities adopted a waste management plan to mitigate these problems, adopting regulations on solid waste management and building South America's first sanitary landfill (through public-private partnership). Santiago now has a hazardous waste processing centre (since 1996) and a disposal site for medical waste and non-treatable hazardous waste (since 2004). There are transfer stations throughout the city where waste is sorted and compacted, and a rail haul system to transport waste for disposal. Now nearly all municipal solid waste collected in Santiago is deposited in one of three authorised sanitary landfills. The Metropolitan Region aims to increase its recycling rate from 9% in 2004 to 20% by 2010.

Most *municipal waste handling* is managed by private companies, which sign contracts with municipalities based on the volumes managed. In Santiago waste management costs are estimated at USD 32 per tonne (USD 20 for collection and USD 12 for disposal). In some cases the contracts prevent the municipalities from developing recycling programmes that would tend to reduce waste haulers' revenue.

Chilean firms often used to subcontract waste disposal to private transporters without knowing the final destination. The lack of enforcement capacity resulted in *illegal dumping of industrial waste*, including hazardous waste. SESMA has taken steps in the Metropolitan Region to promote industrial waste disposal guidelines. Disposal of 60% of the *industrial waste* generated in the Metropolitan Region is still not controlled. A regulation on hazardous waste that will enter into force in June 2005 obliges firms to monitor waste production and report on final disposal. Only three companies in Chile are authorised to dispose of hospital waste.

A clean production agreement with the construction industry, concluded in 2001, led to considerable progress in controlling *inert construction waste*. Participating firms were given permits to deposit such waste in dry wells, one of which was designated as a recovery well to encourage recycling of construction materials. The use of dry wells is estimated to have resulted in about half of inert construction waste being controlled by 2002.

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valuation of less than USD 14 500 is exempt from property tax and has long had de facto exemption from waste charges (which are paid with the property tax). A 1995 amendment to the Law of Municipal Revenue made it possible for municipalities to collect waste charges on properties that are exempt from property tax but have a tax valuation between USD 1 300 and USD 14 000. The amendment significantly reduced exemptions, as some 60% of properties fall into this category. User charges are linked to weight: a flat fee covers collection and disposal services for up to a set amount of waste. In 2000, in an effort to increase cost recovery, the amount was reduced from 200 to 60 litres per household per day. Some municipalities apply the same fee for all households, other differentiate the fee according to the area and the frequency of service. Some lower the fee for the poorest households. The law provides for adjusting the fee according to the tax valuation of the property or electricity and water consumption, but this is rarely done. Considerable progress is still needed in *industrial waste management* (Box 5.4). Chile should consider introducing product charges to facilitate the handling of selected waste streams, in particular hazardous waste.

Fiscal measures

Taxation of road fuel includes a tax on petrol, which rose from 3.5 UTM/m^3 in 1998 to 6 UTM/m^3 in 2001 and has remained unchanged since, and a tax on diesel (1.5 UTM/m^3), unchanged since 1998. When applied to imported fuel these taxes are based on the CIF price plus import duty and 19% VAT; on domestic production they apply to the producer price including VAT. Since 2000 these taxes have increased the final price by about 20-35% for diesel and 40-60% for gasoline. *Road fuel prices in Chile are low by OECD Europe standards and closer to US and Canadian prices* (Figure 5.2). Taxation on road fuel is not related to environmental concerns. Taxes on diesel fuel, for instance, might be reviewed to better internalise external effects on human health. Suggestions concerning *green taxes* on road fuel and heavy fuel oil have met opposition.

Since 1974 a *registration tax has been imposed on imported new vehicles*, increasing with engine power and price. A surcharge levied on entry of luxury vehicles (price over USD 18 200) is to be phased out by 2007. Most new cars, whether imported or locally assembled, are also subject to the customary 19% VAT. As owners of sport utility vehicles and pickups were registering them as light commercial vehicles to avoid paying VAT, stringent controls were imposed in 2003. Used cars, which cannot be imported, are subject to a *one-off sales tax* equivalent to 0.5% of the selling price. Municipalities levy an *annual motor vehicle tax* starting at USD 30 and increasing with the market value of the vehicle, in a range of 2-4% of the vehicle price. It generates some USD 50 million a year. Vehicles are also subject

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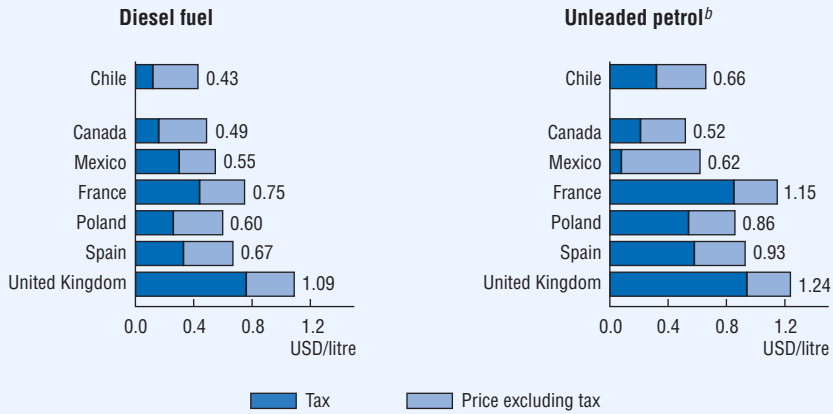
Figure 5.2 **Road fuel prices,**[a] 2003



a) In USD at current exchange rates.
b) Unleaded premium; Canada: unleaded regular.
Source: CNE; IEA-OECD.

to an annual inspection charge of USD 8 for vehicles equipped with catalytic converters and USD 4 for others. Overall, vehicle taxation is not related to environmental concerns. Overall taxation of vehicle ownership (as opposed to vehicle use) is likely to decrease with the implementation of free trade agreements.

To exploit natural resources, *concession holders must hold a patent*. Revenue from the acquisition of *mining patents* (USD 30 million a year) are divided between a regional development fund (70%) and the municipalities concerned (30%). *Fishery patents* increase with ship size and concession area. The 1991 Fishing Law sets the annual patent at between 0.5 UTM per gross weight tonne for ships with fishing capacity below 100 gwt and 1.5 UTM/gwt for ships with capacity over 1 200 gwt. A one-off patent applies to fish farming, based on the concession area. Since 1992 patent payments have been attributed to the Fisheries Research Fund rather than the general budget. They account for more than 60% of total patent payments. The fund's budget rose accordingly to USD 7 million a year. CONAF manages *tourism patents* for hotels and campsites in protected areas, which bring in USD 140 000 a year. In all sectors, patent rates have not been set high enough to capture all resource rents.

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Environment-related subsidies

Overall *agricultural support* is limited, though some commodity-specific support measures persist (Chapter 3). Chile has no policy to shift from market price support towards direct payments. No environmental payments are made to farmers. *Irrigation subsidies* involving budgetary transfers averaging USD 15 million a year have been paid since 1985. Concerning *forestry*, tree *planting subsidies* were introduced in 1974 to develop Chile's potential for highly productive tree plantations (Chapter 6). In 1998 the subsidy programme focus was shifted to small landowners and soil conservation objectives. The programme involves budgetary transfers of USD 9 million a year on average. A 1997 draft law on native forest provides for *incentives towards sustainable forest management* (Chapter 6). Concerning *protected areas*, the 1994 General Environmental Framework Law prescribes property *tax exemptions* for public and private protected areas.

Concerning *corporate environmental performance*, the *National Economic Development Agency* (CORFO) makes various financial instruments available to business, including *long-term credits and co-financing*. It offers its resources through private financial entities whose specialisation makes them particularly efficient at channelling and allocating resources. CORFO also co-ordinates support to *small and medium sized enterprises* (SMEs) through instruments including development funds (fondos de fomento). In one CORFO programme, several SMEs can form a Cooperative Development Project (PROFO) to seek joint solutions to common problems, including environmental ones. The programme can provide up to USD 250 000 over three years to finance consultants and equipment. This approach could foster the development of clusters or bubbles of firms deciding how to meet an overall environmental target, possibly through trading among emission sources. The Technical Assistance Fund (FAT) can grant up to USD 3 500 yearly to enables an SME to hire consultants or advisers in areas such as design, finance, production, marketing, quality assurance and environmental control. The fund has fostered development of *eco-auditing and environmental assessment*. The Provider Development Programme (PDP) seeks to establish mutually beneficial relationships between large companies and their smaller suppliers. In 2003 environmental funding from PROFO, FAT and PDP was, respectively, USD 1.4 million, USD 1.2 million and USD 0.5 million, accounting for 98% of *CORFO environmental support to SMEs*.

Other funds with much higher budgets, which could potentially promote technological innovation and the adoption by SMEs of cleaner production techniques, include: the Programme to Support Management of Exporting Companies (PREMEX), which finances 50% of private initiatives to introduce modern technology into exporter companies; Financing for Technological Innovation Projects (FONTEC), another CORFO financial instrument; and the Fund for Innovation and Development (FDI).

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Finally, subsidies have been granted for technological retrofitting to phase out *ozone-depleting substances* through the national programme for Montreal Protocol implementation, and to increase the share of *LPG buses* in the Metropolitan Region (USD 20 000/bus).

Other economic instruments

Road tolls have been charged since 1963. There are 165 tollbooths on main highways. The fee increases with vehicle weight and on weekends when traffic is higher. The revenue of USD 110 million a year goes to maintain and develop road infrastructure. Tolls are regulated for roads under concession (e.g. the Melón tunnel in Santiago), which has sometimes led to conflicts with users. Successive calls for *road pricing* and congestion pricing (i.e. higher tolls and taxes on car use in city centres) led to the introduction in Congress of a proposal in the mid-1990s but it was not approved. The municipality of Santiago charges *parking fees* at a rate across the city of around USD 1 per hour.

CONAF administers *entrance fees* for its SNAPSE network of protected areas (Chapter 4). The revenue of USD 1.8 million a year is significant, accounting for 90% of CONAF's total income (the remaining 10% come from tourism patents and timber harvesting).

A *deposit-refund programme* applies to glass and plastic containers for beer and other beverages. Producers charge distributors USD 0.36 per container, which distributors pass on to consumers. On average consumers return 80-85% of empty containers; 100% is not achievable, as some small retailers do not give refunds for empty containers (the programme is not compulsory) or accept empty containers only in exchange for beverage purchases.

2.4 Economic instruments: trading mechanisms

In Latin America, *Chile has been a leader* in conceiving and implementing trading mechanisms to achieve environmental objectives, acquiring experience in trading of permits for point sources of particulate matter in Santiago, water rights nationwide (with active trading in Region IV) and individual transferable fishing quotas for several species.

A *draft law on decontamination bonds* submitted recently to Congress would permit expansion of tradable emission permit programmes, increasing flexibility and effectiveness in addressing air and water pollution and soil contamination. The bill includes criteria for initial allocations, market regulations, and provisions for reporting and certifying emission reduction. Initially, emission permits would be

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awarded free of charge. They would be subject to periodic revision to bring them in line with emission reduction goals. The bill also provides for the awarding and banking of pollution control credits. Limitations and restrictions on the use of permits and credits would be used to minimise such undesired effects as development of hot spots. The bill provides for high fines for non-compliance.

The bill proposes *CONAMA as the oversight authority*. To assure transparency, security, liquidity and price continuity CONAMA would need to record transactions, emission control and enforcement, with separate registers for emission permits, clean-up credits and accredited emission certification agencies, along with sources, sinks and non-source participants.

Trading systems would be used only for *pollutants and areas for which clean-up plans exist*. They could involve air, water or soil pollutants. For example a trading system for PM_{10} and NO_x emissions could be established as part of the Metropolitan Region's Air Pollution Prevention and Clean-up Plan (PPDA), covering large stationary sources and public transportation.

Trading in air pollutant emission permits

A *tradable emission permit programme* was begun in 1992 to control TSP *from stationary sources in the Metropolitan Region*. In practice, coverage is confined to industrial and residential boilers, as it proved too difficult and expensive to include emissions from industrial processes, which accounted for 56% of the total for industry. The aggregate emission reduction goal was close to 80%. Existing sources already held *daily emission bonds* in perpetuity, based on the source's size and fuel type. New sources and additions to existing sources have to buy emission rights to cover their emission capacity.

In the early stages of implementation the programme was very effective in helping authorities *inventory sources and emissions*, since grandfathering permits instead of auctioning them created incentives for emitters to declare their emissions and claim the corresponding permits. Many firms did take advantage of the market by buying permits instead of making irreversible investments that would have proved uneconomical after the arrival of natural gas.

PM_{10} emissions by industry decreased from 9.1 tonnes per day in 1992 to 4.3 tonnes in 1998 while the share of boilers in total industrial emissions fell from 44% to 30%. The *programme affects only a small proportion of TSP emissions*, however, so its effect on overall performance is limited. The emission reduction objectives were not met until 1997. The sharp decline in TSP emissions from industrial sources that began that year and subsequently accelerated was mainly due to the arrival of low-price *natural gas from Argentina* displacing dirtier coal and oil in

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all economic sectors. Emission reduction was also due, to a lesser extent, to investments by industry to avoid having to shut down during emergency and pre-emergency air pollution episodes.

Trading water rights

Although water is considered a national asset, individuals can own perpetual and irreversible water rights. As these rights are independent of land use and land ownership, trade in them is fairly unrestricted. This is a real *free market*, in which water rights are traded without a government intermediary. Water trading in Chile thus differs fundamentally from the system in the western United States, where rights are defined by appropriation and trading is subject to many restrictions.

The 1981 Water Code provides the legal basis for trading of water rights (Box 3.2). In practice, most transactions are between irrigators. The most active market, in the Limarí Valley (Region IV) sees the rights to some 7.2 million m^3 of water change hands each year; in most other parts of the country, water markets are inactive. Rather than efficiency in water use, the greatest economic impact has been to boost private investment by hydropower companies due to increased legal security of property rights. Many water conflicts have gone to court. The debate continues on how to reform the Water Code and address such issues as *co-ordinating* multiple water uses, managing river basins, resolving conflicts between sectors or between consumptive and non-consumptive uses, protecting river ecosystems and assuring environmental flows (Chapter 3).

Individual transferable fishing quotas

Individual transferable quotas are allocated to fishers for squat lobster (since 1992), black hake or deep cod (since 1992), yellow prawn (since 1997) and orange roughy (since 1999). These species account for about *1% of total landings by volume* and 2% by value. For catch control, vessels under quota must accept the presence of scientific observers, and processing plants have to receive information about the catch.

Fishing permits are defined as *shares of total allowable catch* (TAC). Annual TAC is defined on the basis of biological criteria, with updated information. The system does not provide for any type of individual back payments if TAC diminishes.

Quotas are allocated through *open bidding at public auction*. When they are applied for the first time to a given fishery, 100% of the TAC for the coming year is auctioned. Each permit lasts ten years. To promote active trading, a divestment mechanism requires 10% of the TAC to be re-auctioned each year, so the initial permits are reduced accordingly. To maintain their quotas, operators have to keep

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re-entering the market. Fishers that do not consume their quota during the calendar year cannot carry the remaining portion forward; i.e. there is no possibility of banking. Though quotas by law are open to foreign investors, a barrier to new entrants is that fish can only be landed by Chilean vessels.

2.5 Other instruments

Land use planning

Land use planning in Chile focuses on *urban areas*. The Ministry of Housing and Urban Development (MINVU) has primary responsibility for establishing land use regulations and related guidelines, pursuant to the General Urbanism and Construction Law (Law 19.778). Efforts are being made to develop formal regional and local spatial planning. Indicative *regional urban development plans* (PRDUs) cover areas where urbanisation should be restricted for environmental reasons (e.g. natural protected areas) (Chapter 4). Municipal and intermunicipal regulatory land use plans are binding. There is no formal participatory mechanism in regional and local land use planning, though all plans are subject to EIA. Five of the 13 PRDUs have been or are about to be completed; those involving the main metropolitan areas (Santiago, Concepción and Valparaiso) are still in the initial phases. About 31% of municipalities have an operational municipal regulatory land use plan; 29% have an obsolete one and 40% have none. Intermunicipal regulatory planning has developed only in northern coastal areas. MINVU is preparing guidelines to support regional and local spatial planning.

Beyond MINVU, ministries and agencies dealing with transport, agriculture, energy, environment and public works, among other areas, have various roles in land use planning and use different spatial planning instruments. Current instruments have not been able to prevent environmental pressure from land use change; such issues as uncontrolled urban sprawl and siting of factories in environmentally sensitive areas or areas prone to natural disasters are still of concern. A more co-ordinated approach to land use planning is needed. Initiatives were taken recently to better address environmental sustainability and citizen participation in land use planning. In 2002 CONAMA and MINVU signed a technical co-operation agreement to *foster synergy between environmental management and land use planning*, building on a pilot project on environmentally sustainable spatial planning in the Metropolitan Region (the OTAS project). There is a need to integrate environmental concerns in land use planning and to develop related public participation. Such an approach would likely provide health benefits, enhance quality of life, contribute to nature and biodiversity protection and support tourism activities.

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Voluntary approaches

In addition to environmental commitments Chile has made in the context of trade liberalisation, joint private-public initiatives encourage high environmental standards in *export industries*. Chile's export markets are mainly in OECD countries, where consumers, producers and financial institutions are used to high environmental standards. Thus, *corporate social responsibility* efforts give Chile a reputation as a reliable supplier and an attractive investment destination.

Clean production agreements (APLs) have been reached in the last few years, co-ordinated by the Clean Production Council under CORFO's aegis. CONAMA participates in the review and approval of such agreements, through which a sector or industrial branch commits itself to meeting certain environmental objectives by a given time. The *major environmental issues covered* are liquid and solid waste management, occupational health, atmospheric emissions, discharges into water, early compliance with standards and voluntary adoption of projected standards. The first such agreements, involving 300 companies, were signed in 1999 and 2000. Sixteen are now in effect, in the agriculture, chemical, construction, fishing, forestry and mining industries, *covering more than 1 800 firms* that together account for about half of GDP (Table 5.6). Most of the sectors involved are export-oriented. About 80% of the signatories are SMEs. In the metal industry, some USD 5 million has been spent under the agreements on improving air pollutant emissions and solid waste technology at smelters in the Metropolitan Region. In addition, cross-sectoral *framework agreements* including strategic objectives have been signed for processed food exports (2000), large-scale mining (2000) and packaging waste (2002).

Chilean industry is progressing with *ISO 14001 certification*, though not as fast as Argentina or Brazil. Since 1997, more than 70 firms have been ISO 14001 certified in Chile, mainly in forestry, fruit growing, winemaking and mining. *Other environmental certification programmes* with a strong presence are those of the Forest Stewardship Council and the more recent national Sustainable Forest Management Standard (CERTFOR), which is recognised by the Programme for the Endorsement of Forest Certification Schemes (PEFC). Organic agriculture is also spreading rapidly, with certification processes dominated by foreign companies. Chile's chemical industry is promoting participation in the *Responsible Care programme* co-ordinated by the World Business Council for Sustainable Development. Formal *eco-labelling for CFC-free products* was begun in 1995 under the Montreal Protocol, which Chile ratified in 1990. Only one company applied for use of the label, however, so the programme was suspended.

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Table 5.6 **Selected clean production agreements**

Industry and branch		Regions	Number of signatories (firms)				
			Micro	Small	Medium	Large	Total
Agriculture							
Cheese producers	2003	X	–	–	1	11	12
Pig producers	1999	V to VII and Metropolitan	–	11	19	12	42
Fruit and vegetable growers	2002	V to X, Metropolitan		377	415	92	884
Winegrowers	2003	IV to VIII, Metropolitan	98	310	65	49	522
Chemicals							
Packaging waste	2000	II, V, VIII, XII and Metropolitan	–	–	12	30	42
Sewage	1999	Nationwide	–	–	8	20	28
Construction							
Bricklayers	2004	Metropolitan	39	–	–	–	39
Construction sector	2000	Metropolitan	–	–	4	47	51
Construction sector	2003	IX	–	1	5	4	10
Fish							
Salmon producers	2003	X	–	–	4	44	48
Scallop producers	2003	III and IV	6	11	9	–	26
Forestry							
Pulp production	1999	VII to IX	–	–	–	3	3
Sawmills	2004	VII to X	–	–	13	43	56
Metal							
Smelters	1999	Metropolitan	1	4	18	23	46
Total			144	714	573	378	1 809

Source: CONAMA.

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6

SECTORAL INTEGRATION: MINING, FORESTRY, AQUACULTURE*

Features

- Progress with sustainable mining
- Plantation forests
- Establishment of a sustainable forest management strategy
- Fostering of sustainable fish farming
- Salmon farming and OECD Guidelines for Multinational Enterprises

* This chapter reviews progress since 1990.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- further reduce the *environmental impact* of the mining sector (e.g. air pollution by SO_2 and arsenic, water pollution, abandoned sites and tailing dams);
- give special attention to *small and medium-sized mining enterprises* through technological, financial and consultancy assistance and improved relationships with the largest mining firms;
- increase the *financial contribution of the mining sector* to support long-term investment in human and social capital and to apply the polluter pays principle according to the General Environmental Framework Law; consider a mechanism for proper capture of resource rents associated with mineral exploitation;
- promote agreement among stakeholders on *strategic national orientations* concerning forest resources (protection, sustainable management, plantation);
- adopt and implement measures to assure *sustainable management of native forest*, including rewards for environmental services, cross-compliance mechanisms, partnerships and co-operation among stakeholders on overall management;
- strengthen the *enforcement capacities* of the National Forestry Corporation (CONAF);
- improve *environmental and health protection in aquaculture* (e.g. as regards eutrophication, salmon escapes, ecological balance of lakes, antibiotics, epidemiological vigilance, eradication of infectious disease), particularly through *strengthened enforcement* capacities;
- apply the *polluter pays principle* in the aquaculture industry in the context of the General Environmental Framework Law;
- complete a *precise aquaculture coastal zoning plan*; adopt integrated environmental management for coastal areas.

Conclusions

Mining

The mining sector accounts for *8.2% of GDP and 42% of export value.* Chile is the world's biggest copper producer. Mine output has increased by 265% since 1990. Copper production is capital-intensive and employs 1.2% of the total labour force. An environmental unit was created in the Ministry of Mining in 1991. Chile has reduced copper smelters' *SO_x emissions* by two-thirds, set standards for their arsenic

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emissions and improved their energy efficiency. Mining was an early user of *EIAs*. The country's 14 largest mining companies, including state-owned CODELCO (the world's largest single producer of copper), have ISO 14001 certification or apply their own systems of *corporate environmental management*. Large mining companies have engaged in a voluntary *clean production agreement*. Progress towards environmentally sustainable mining is well on its way.

Nevertheless, mining activities still cause the bulk of SO_x emissions in Chile and *arsenic emissions* in several regions. *Particulate emissions* need to be further reduced and water use efficiency increased in the sector. One-third of abandoned tailing dams are in unacceptable or deficient condition. Nearly half of mining sewage from large companies is not treated. *Small and medium-sized mining companies* often do not comply with regulations. Little is known about soil contamination by heavy metals and toxic contaminants generated by mining activities. Chile has no clean-up plans for *abandoned mines*. The environmental impact of transporting minerals has been evaluated only in the context of the EIA system. Progress towards sustainable mining will require an appropriate balance among its economic, environmental and social dimensions, including mechanisms to support investment in human and social capital, to apply the polluter pays principle and to capture resource rents associated with mineral exploitation.

Forestry

The forestry industry accounts for *3.5% of GDP and 12% of export value*. Chile is the world's third-largest exporter of wood chips and sixth-largest of pulp. Planting of trees, a renewable natural resource, has increased dramatically: at 2.2 million hectares, plantations make up 14% of forest cover. Harvest in plantation forests has increased by 180% since 1990, easing pressure for harvest in native forests, whose *cover has remained remarkably high* at 13.4 million hectares. Chile has adopted standards concerning deforestation, such as compulsory reforestation after forest harvesting, selective thinning on heavy slopes, and soil classification to avoid conversion to farming. Almost one-third of native forests are in *protected areas*. Since 1974, intensive tree planting (mainly Monterey pine) on coastal mountains has aided *restoration of eroded land* abandoned by farmers. A draft law on native forests seeks to introduce payments to farmers who own native forests and adopt sustainable forest management practices while diversifying their income. Progress towards *sustainable forest management* has begun. Pilot projects using sustainable management have been carried out in native forest since 1992. *Forest certification* has spread in recent years.

However, little attention has been given to the environmental effects, both beneficial and harmful, of tree planting (e.g. as regards soil and water conservation,

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water quality and biodiversity). Any forest harvest of more than 500 hectares a year is supposed to undergo EIA, but owners avoid this by segmenting the area cut; nor is EIA required for new planting. Though timber harvesting in native forest decreased as the use of plantation timber spread, *harvesting for fuel continues*. Tree plantations have *little genetic* diversity, and the growing reliance on clonal eucalypt plantations for pulp production increases the risk of epidemics. *Tree planting subsidies* (USD 225 million since 1974) have created an incentive for conversion of some native forest, though not on a major scale; subsidisation has been redirected to small landowners and soil conservation objectives. Little effort has been made to protect wooded river banks despite legal provisions to this effect. More attention could also be given to grouping forest owners for economies of scale in moving towards sustainable management of native forests.

Aquaculture

The volume of aquaculture production has grown by 825% since 1990, and Chile has become the *world's second-largest producer and exporter of salmonids* (after Norway). Under current plans production will double, particularly in the southern Regions X and XI, where aquaculture has become a capital-intensive industry with direct and indirect benefits for employment. The 2001 *environmental regulation for aquaculture* led to measures to safeguard the environment at cultivation sites and make aquaculture more sustainable. *Preliminary site characterisation* of new fish farms has become compulsory. The first reports on the state of the environment in the aquaculture sector are being prepared. Of about 1 400 aquaculture projects that have undergone EIAs, 60% were approved. In addition, 48 salmon producers (accounting for 80% of salmon exports) have signed a *clean production agreement*.

However, progress towards sustainable aquaculture is recent. Both the government and the fish farming industry have recognised the challenge and started addressing it. *Water pollution* by excess food and faeces can contribute to eutrophication of lakes, fjords and coastal areas. Controlling water quality in aquaculture areas also involves policies for other sectors, such as forestry (since the potential for salmon raising is higher in lakes surrounded by forested watersheds), agriculture (whose nutrient run-off affects water quality) and water services (given the effects of urban and industrial sewage treatment). Effective control of water quality thus requires comprehensive, intersectoral policies. Chilean aquaculture has made extensive use of *antibiotics*; regulations were established in 2003 to start controlling their use. Accidental escapes of adult salmon from sea cages in *aquatic ecosystems* have not been assessed. Particular attention should be paid to the rising demand for fishmeal in salmon farming, which could put pressure on some *sea fish stocks* (e.g. anchovy, mackerel, sardine), even though these stocks are under total allowable

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catch programmes. Local conflicts have arisen between industrial salmon farming and the tourism industry, though efforts are being made to complete delineation of areas deemed appropriate for aquaculture.

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1. Mining

1.1 Environmental policy objectives

Mining activities play a major role in the Chilean economy (Box 6.1). In 1991, prior to enactment of the 1994 General Environmental Framework Law (Law 19.300), an environmental unit was formed in the Ministry of Mining. In the context of the government's sustainable development policy, the ministry developed principles and practices to stimulate sustainable mining, contained in the 1998 *Environmental Policy for Mining*. The key objective is to "promote the sustainable development of the national mining sector to develop efficient and effective mining activity from both the economic and environmental perspectives".

Sulphur emissions from copper smelters have long been a high-priority environmental problem because of their consequences for human health and the natural environment, affecting not only surrounding natural ecosystems but also agricultural production.

1.2 Legal and regulatory framework

The state is the sole owner of all minerals regardless of who owns the surface land. Under the 1982 Constitutional Organic Law on Mining Concessions and the 1983 Mining Law, foreign and national companies are allowed to explore for or exploit minerals under a *system of concessions* whose prices are not linked to production.

The *approach to air pollution control* in the mining industry relies on meeting ambient air quality objectives rather than imposing uniform emission standards based on best available technology (Chapter 2). To enforce compliance with air quality standards, regional offices of the National Environment Commission (CONAMA), called COREMAs, request that the area where one or more standard has been exceeded be declared "saturated". The 1994 framework law requires that an air clean-up plan then be initiated within 90 days. Quality standards to control SO_2, particulate and arsenic emissions from large sources countrywide were established in 1991, and later revised and supplemented (Table 2.1). More than 90% of Chilean SO_2 emissions in 1990 came

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Box 6.1 **Key features of the mining sector**

With a wide variety of high-quality minerals and well over a century of mining experience, Chile has one of the world's largest, most developed mining industries. Chile is the *world's leading supplier of copper*, copper ores and concentrates, with 165 million tonnes of proven copper reserves. Between 1990 and 2002, copper production almost tripled, widening the gap between Chile and other copper-producing countries. Chile's main export markets for copper are China, Japan, Korea, the United States, Italy and France.

The mining and minerals sector accounted for *8.2% of GDP* in 2002, up from 6.7% in 1996. The sector comprises metals and non-metals (Table 6.1) and, to a much lesser extent, coal, crude oil and natural gas. Chile's mining exports amounted to USD 8.8 billion in 2003, equivalent to 46% of total exports. Foreign direct investment in mining is substantial, averaging USD 1.2 billion per year between 1990 and 2003. The sector's share in employment decreased from 1.8% to 1.3% over the same period, reflecting a strong productivity increase. For several regions, especially in the north, mining is the main source of growth and income.

After the nationalisation of Chile's copper industry (1970-73), the "mining boom" generated a major transformation of the ownership structure of Chile's large-scale mining companies. The significant increase in copper production since 1990 essentially resulted from *increased participation by private companies*, particularly in the opening of new mines (e.g. La Escondida). In 1990, 77% of Chile's copper production came from state-owned mines, but today 67% of output is in the private sector, though the state-owned *National Copper Corporation* (CODELCO) is still the world's largest single copper producer with 33% of national and 12.5% of world output. The *National Mining Company* (ENAMI), also state-owned, which provides services to SMEs, is the world's eighth exporter of copper products.

The *Chilean Copper Commission* (COCHILCO) advises the Ministry of Mining on policy, the performance of the state-owned enterprises and approvals of investment contracts. The National Geology and Mining Service (SERNAGEOMIN) carries out geological surveying, gathers data on mineral resources and keeps records of mining concessions. The *Mining Council*, founded in 1998, represents Chile's major mining companies, both private and state-owned; the National Mining Society, founded in 1883, is a federation of mining trade unions.

from copper smelters. All areas surrounding state-owned smelters were declared saturated, and air clean-up plans had to be developed, including schedules of emission reduction by pollutant and source (Table 2.2). In 1998, an *emission reduction timetable for arsenic* contained in particulate matter was set for the country's seven copper smelters and the roasting plant at El Indio mine.

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As regards *water contamination*, mining companies were given until September 2006 to bring their operations in line with emission standards issued in 2000 and 2002 for direct discharges of industrial sewage into surface waters and groundwater (Chapter 3). Water rights are regulated by the 1981 Water Code (Chapter 3). Construction of tailing dams has been regulated since 1970.

Construction of *waste disposal and treatment* facilities has been regulated since 1978 (Sanitary Code) and the dumping of solid waste since 1985 (MIN D.S. 72/85 on mining safety). The latter decree was revised in 2003 (MIN D.S. 132) to introduce provisions on mine closure plans.

The mining industry was a pioneer in the use of the *Environmental Impact Assessment System* (SEIA), applying it even before the system became compulsory in 1997. Over 1993-2004, mining companies accounted for 32% of investment registered under SEIA.

Table 6.1 **Production of minerals**

Types of minerals	Export value 2003 (USD million)	Production 2002			
		('000 tonnes)	Change (%) 1991-2002	World ranking	Regions
Metallic					
Copper	7 500	4 620	*154*	1	I to VI + RM; II (51%)
Molybdenum[a]	346	29	*104*	3	II to VI + RM; II + IV (71%)
Gold	301	0.04	*34*	12	II to VI + RM + XI; II + III (81%)
Iron	136	7 200	*–13*	. .	II + III; II (71%)
Silver	94	1.2	*78*	8	II to VI + RM + XI; II + III (75%)
Other[b]	63	51	*–33*	. .	III + XI
Non-metallic					
Nitrates and iodine	210	13	*136*	. .	I + II; I (62%)
Lithium carbonate	45	35	*311*	. .	II
Total	8 762		*265*[c]		

a) By-product of copper production.
b) Includes refined zinc (Region XI), mineral manganese (Region III) and refined lead (Region XI).
c) Index of mineral production.
Source: Central Bank of Chile; SERNAGEOMIN.

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1.3 Voluntary approaches

Chile's mining sector has made important progress in environmental management over the years as part of its efforts to strengthen competitiveness. Most large mining companies operating in Chile are either *ISO 14000 certified* or apply their own systems of corporate environmental management. Some 80% of copper exports are ISO 14001 certified. CODELCO obtained ISO 14001 certification for all its production units in 2003. In 2002 CODELCO began publishing, along with its annual report, an environment report conforming to Global Reporting Initiative standards.

The largest mining companies are also involved in *clean production agreements*. In 2000 the Mining Council established a framework agreement, including "good practices", which major mining companies have voluntarily agreed to follow. It covers mine closure, efficient use of energy and water, sewage and waste management, and acid water drainage. An agreement on mercury in small-scale mining is being considered, as is one on the development of pilot plants using new technology.

1.4 Environmental performance

Air management

Since the early 1990s air clean-up plans have set SO_2 and PM_{10} emission reduction targets for each of the five state-owned copper smelters (Table 2.2). As a result, SO_2 emissions were reduced by more than 70% in 1990-2002 (Table 7.2). Sulphur captured from state smelters rose from 0.14 million tonnes in 1990 to 1.0 million tonnes in 2002, an increase in average capture level from 19% to 80%. This translated into *strong decoupling of SO_2 emissions from smelters' copper output*. The ratio of tonnes of SO_2 emitted to tonnes of copper produced is now 0.38 for the country's seven smelters (0.42 for the five state smelters).

Yet, copper smelters still account for 76% of total SO_x emissions (Table 2.4), and *SO_x emissions per unit of GDP remain very high* by OECD standards (Figure 2.1). Most of the growth in copper production since 1990 is from foreign-owned operations (Box 6.1), which either export copper concentrate for smelting elsewhere, or use hydrometallurgical processing that does not require smelting. This means CODELCO is essentially the key to sulphur emission reduction efforts. Revision of the 1993 air clean-up plan for Chuquicamata (Region II), site of CODELCO's largest smelter, in 2000 tightened the emission reduction targets for SO_2 and arsenic.

Progress in curbing SO_2 emissions has brought ancillary environmental benefits. SO_2 recovered from smelter gas has been used to produce sulphuric acid, and arsenic contained in smelter dust or sulphuric acid plant effluents has been neutralised as

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ferric arsenite or calcium arsenite. As a result, over 1999-2002 the state smelters' total reductions in *particulate and arsenic emissions* came to 67% and 77%, respectively (Table 6.2). The two private smelters (Altonorte and Chagres) comply with all current air quality standards, both primary and secondary.

The country's natural conditions favour the *development of business clusters or "bubbles"*. Various studies in Chile have explored ways in which such clusters can increase competitiveness and strengthen links between large copper companies and their small and medium-sized suppliers. Within a given "bubble" firms could also determine how to meet an overall environmental target, possibly through air emission trading.

Table 6.2 **Trends in air emissions from mining**

('000 tonnes)

Air pollutant	1990	1995	1999	2002
SO_2	2 002	1 681	1 120	540
PM_{10}[a]	. .	. .	9.0	2.9
Arsenic[b]	. .	. .	5.7	1.3

a) Includes only the five state-owned smelters. The private smelters (Altonorte and Chagres) do not monitor their emissions.
b) Arsenic contained in particulate matter.
Source: COCHILCO.

Water management

Efforts have been made to address some extremely severe cases of water contamination from large-scale mining. For over 30 years, tailings (waste) from CODELCO's Salvador mine (Region III) was discharged directly into the Bay of Chañaral, causing the deposit of sand silt containing heavy metals and the accumulation of copper and other heavy metals in some marine species. In 1990 a court decision resulted in the mine installing a tailing dam and sewage treatment plant. Similarly, in the area of Diego de Almagro (Region III), where tailings from an ENAMI plant were discharged directly into the Salado River, a dam to contain sulphur waste was built in 1990. Another example is the Loa River (Region II), which consistently exceeded limits for arsenic and for which treatment efforts were undertaken in the early 1970s. In 2003, 56% of sewage from large-scale mining activity (including mining towns) was treated and 58% of the biggest mining companies complied with new emission standards for direct discharges into water bodies (full compliance is required by the end of 2006).

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According to studies in 1999 by the University of Chile, however, *mining still causes arsenic contamination* of the San José and Loa rivers (Region II), the Limarí and Cogoti (Region IV) and the Aconcagua, Chacabuquito and Rapel (Region V), as well as the Alhué marsh and the Pampa del Tamarugal (Region I). The impact of mining on water quality, in particular of water contamination by acid mine drainage, is not systematically monitored. One-third of the large mining companies do not measure their sewage quality.

The *pressures from mining activities on water use* can be locally or regionally significant, particularly in arid areas (for instance, mining accounts for 70% of consumptive water use in Region II and 60% in Region III). Mining sector water consumption rose by 23% from 1990 to 2002 (Table 3.1). This trend is expected to continue with an expected rise in copper output, which should translate into a price increase for water rights, particularly for aquifers, many of which already have low recharge rates (Chapter 3). The main copper mining companies recycle 60% of the water they use, on average. Water use efficiency should improve further with implementation of the clean production agreement that the big mining companies signed in 2002. Some mines use treated urban waste water (Chapter 3).

Contaminated sites

The country's mining history has resulted in a legacy of abandoned sites. Guidelines have been developed for *mining site closure plans* covering, among other issues, human health and environmental protection. So far, however, no public or private mining company has established a detailed official plan, and very few are prepared to try to restore the environmental conditions that prevailed before mining began. COCHILCO has started drafting a bill on mining site closure.

A key issue is *abandonment of tailing dams*, which puts both people and the environment at risk. If a tailing dam breaks the spill can contaminate surface water and groundwater, destroy farmland and constitute a threat to human life. Most of Chile's 658 tailing dams are in Region IV (57%) and Region III (24%). Between 28% and 40% of tailing dams have been abandoned; of the total, 8% are in unacceptable condition, 14% in unacceptable to deficient condition and 15% in deficient condition. Chilean regulations for dam construction are stringent, but do not provide for end-of-life management. Dams built with old techniques are still in operation and are exposed to seismic risk. Pollution generation from abandoned mining sites, including tailing dams, should be evaluated and a national remediation plan for contaminated sites elaborated.

1.5 Fiscal revenue and environmental investments

The Chilean *tax regime does not impose an excessive burden on mining companies*. Nor does mining receive special tax treatment, as Chile's single, deductible and transversal tax system applies in equal conditions to all productive sectors. Revenue from taxes on large private-sector copper mining operations amounted to USD 1.9 billion

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over 1991-2002, an average of USD 158 million a year. The total for 2003-10 is expected to be USD 2.8 billion. Mining licenses bring in around USD 30 million a year, which is transferred to a regional development fund (70%) and local municipalities (30%).

CODELCO is subject to three types of fiscal measure: i) 17% income tax and additional 40% public company tax, levied on total revenue; ii) customs duty on exports; and iii) a 10% levy on the value of external sales, allocated to the armed forces. The combined revenue from the three measures decreased from USD 1 billion in 1996 to USD 326 million in 2002 as the world copper price fell from 106 to 72 US cents per pound. The trend has reversed since 2003, with strong, steady demand (e.g. from China) keeping world copper prices high. CODELCO's net profit is paid into the general state budget. *Environmental investment* by CODELCO and ENAMI amounted to USD 2.1 billion in 1990-2004 (i.e. USD 140 million a year on average), largely for air clean-up measures.

To reduce the volatility of fiscal income from copper, which provides about 4% of total government revenue, the government has operated a *Copper Stabilisation Fund* since 1987. If world copper prices exceed an annually determined baseline price by USD 0.04 to USD 0.09, 50% of the difference is paid into the fund; if the copper price exceeds the baseline price by more than USD 0.10, all the surplus is paid into the fund. When world prices fall below the baseline by these amounts, resources from the fund supplement current fiscal income.

To attract mining investment, Chile's investment law of 1974 guaranteed tax stability for at least ten years for any new venture. Now, with world prices at their highest levels in a decade, mining companies are expected to pay more tax to cover the economic rent associated with exploitation of a non-renewable resource. In 2004 Congress rejected a *draft law on requiring payment of royalties* of up to 3% on new mining investments with operating margins of over 5%. A new bill in December 2004 proposes to levy a 5% tax on the operating profits (income before taxes, interest and extraordinary and financial costs) of mining companies with annual sales over 8 000 annual tax units (an amount pegged to the cost of living). The revenue could go into a special fund to promote innovation and possibly development of local communities and environmental management.

2. Forestry

2.1 Forest policy objectives

Since the mid-1970s Chile has experienced *high growth in the production and trade of wood products*: over 1990-2003 the wood harvest rose by 180% and wood trade volumes by 255% (Box 6.2). This growth is expected to continue until 2020, when most plantation forests will reach maturity.

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Box 6.2 **Key features of the forestry sector**

The *four main native forest ecosystems* in Chile are the Valdivian forests of heterogeneous mixed hardwood, between Valdivia and Region XI; homogeneous hardwood forests (coigue and lenga) in the southern regions; araucaria softwood forests in the central Andean foothills; and Mediterranean forests. These ecosystems were relatively untouched until the mid-19th century, when settlers cleared large tracts in the south for agriculture. The alerce tree, a native redwood species, may reach 3 000 to 4 000 years of age (Box 4.1).

The first *large plantations* were established in the 1940s. In the mid-1970s, both forest product exports and the area planted with fast-growing species began to increase rapidly. Today most planting is carried out directly by the forest industry. Two large paper and board manufacturing conglomerates, CMPC and Arauco, own more than half of the plantations and accounting for 60% of forestry exports.

The forest and forest industry sector accounts for *3.5% of GDP and 13% of exports*, the latter totalling USD 2.5 billion a year. It is Chile's third largest export sector, after mining and the food and food products industry. Chile is the world's *third largest exporter of wood chips* (raw material for paper) and also exports nearly half of its sawn wood, panels and softwood pulp production. Initially the industry focused on low-cost sawn wood and pulp wood, but products and export markets have since widely diversified, with trends towards more value added (Table 6.3). The main forestry exports in volume are wood chips (2.8 million m^3), bleached cellulose (2.1 million tonnes) and sawn wood (2.1 million m^3). In value terms the leading exports are pulp (35%), sawn wood (11%) and moulding (11%).

Pulp production is expected to double in the next few years as more plantations reach maturity. Industrial capacity is being expanded accordingly. By 2006, Arauco, the world's third largest wood pulp producer, plans to produce 856 000 tonnes of pulp annually at a new mill for which it presented an environmental impact study. The mill is the second phase of a USD 1.4 billion lumber and pulp complex in the Itata Valley. The first phase, due to be completed soon, includes a new sawmill with capacity of 300 000 m^3 per year, a plywood plant with capacity of 210 000 m^3 and a power plant. The Itata project also includes USD 400 million of investment in plantations, already established.

Chile's forestry sector is regulated by the *National Forest Corporation* (CONAF) of the Ministry of Agriculture. CONAF is mainly responsible for overseeing the management and harvesting plans that private operators must submit for every activity in plantations. It also administers the natural forests and the tree-planting subsidy programme. The Forest Institute (INFOR) of the Ministry of Agriculture undertakes research with a view to promoting sustainable use of Chile's forests. The Chilean Timber Corporation (CORMA) is composed of the leading companies in pulp and paper, wood based panels, saw milling, remanufacturing and forestry, accounting for around 90% of the country's forestry exports. In 2000 a Forestry Round Table was formed to foster a forest policy dialogue involving the public and private sectors and NGOs, in the context of discussion on the draft law on native forests.

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Harvest from plantations grew by 180% over 1990-2002, and growth is expected to reach 314% over 1990-2020, as a result not only of favourable climate and soils but also a proactive development policy for the sector, including introduction of tree planting subsidies in 1974 (Table 6.4). Other factors behind the dramatic expansion of

Table 6.3 **Trends in exports of forest products**

(USD million)

	1990		1995		2003	
	Value	(%)	Value	(%)	Value	(%)
Pulp	320	*37*	1 270	*54*	882	*35*
Sawn wood	136	*16*	223	*9*	275	*11*
Secondary products[a]	76	*9*	190	*8*	569	*22*
Wood chips	109	*13*	233[b]	*10*	130	*5*
Plywood and boards	22	*3*	81	*3*	199	*8*
Paper and paperboard	64	*7*	191	*8*	311	*12*
Roundwood	74	*9*	144	*6*	13	*1*
Other	54	*6*	38	*2*	145	*6*
Total	855	*100*	2 370	*100*	2 524	*100*

a) Includes moulding, processed sawn wood, doors and other construction materials.
b) Includes harvest from native forests.
Source: INFOR.

Table 6.4 **Trends in tree planting**

(hectares per year)

Legal framework	Period	Tree planting
	Until 1930	150
Forest Law	1931-73	16 000
Decree Law 701	1974-95	90 000[a]
Law 19.561	1996-2002	91 000[b]

a) Mostly afforestation.
b) Mostly reforestation after plantation harvest.
Source: CORMA.

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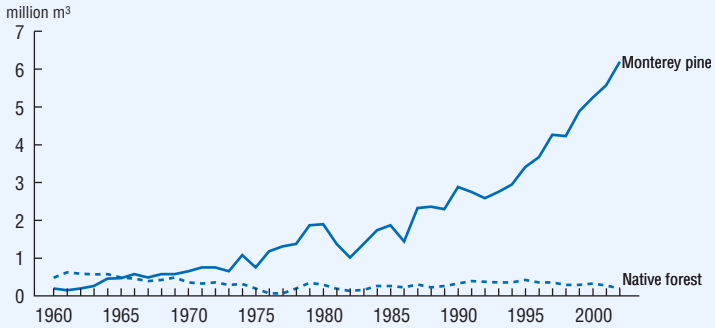
Figure 6.1 **Trends in sawn wood production,** 1960-2002



Source: INFOR.

commercial forestry include availability of land at low price (initially); low labour costs (relative to OECD countries); security of land tenure (as land expropriation is unconstitutional); modernisation following privatisation (notably of the two main pulp factories) and foreign direct investment; and financial support for exports, education and research. Exotic plantation forests surpassed native forests in sawn wood production volumes in the mid-1960s, and have captured markets formerly supplied by Chile's native hardwoods (Figure 6.1). A clear dichotomy exists between tree planting and native forest management policies (Table 6.5). Overall, the 2.2 million hectares of plantation forest represent 14% of Chile's forested area.

Through active participation in the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (the *Montreal Process*), Chile has demonstrated its commitment to sustainable management of both native and planted forests. In 1995 in Santiago, the ten countries participating in the Montreal Process endorsed a comprehensive set of criteria and indicators for forest conservation and sustainable management for use by policy makers. The statement of endorsement is known as the Santiago Declaration. In 1999 Chile hosted an international expert meeting on the role of planted forests in sustainable forest management.

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Table 6.5 **Chilean forestry at a glance**

		Tree planting	Native forests
Location	Latitude	Regions V-XI (mainly Regions VIII, IX and X)	Regions V-XII (mainly Regions X and XI)
	Altitude	Originally in coastal mountain ranges; more recently lower Andes; central valley for eucalypts	Andes Mountains
Ownership		Pulp mills own 73%, mainly large plantations (more than 1 000 hectares)	Medium-sized farms (200 to 1 000 hectares of farmland) own 59% and the state 29% (protected area network)
Supervision		CORMA	CONAF
Harvest		95% industrial wood (25 million m^3 roundwood equivalent/year), mainly for pulp	5% industrial wood (mainly sawn wood) plus 8 million m^3 fuel wood
Coverage	Current area	2.2 million hectares (74% Monterey pine, 18% eucalypts)	13.4 million hectares, of which 5.8 million productive forest (3.4 million primary forests and 2.4 million secondary forests)
	Trends[a]	+45 000 hectares/year in 1974-98; +30 000 hectares/year since 1998	–160 000 hectares replaced by plantations; area stable since the mid-1990s
Incentives		Planting of 1 million hectares subsidised since 1974	Bill on native forests proposes to support sustainable forest management
Key environmental services		Reclamation of eroded land Carbon sink	Biodiversity Soil and water conservation Carbon reservoir

a) Excluding reforestation after tree harvest.
Source: CONAF.

2.2 Plantation forests

Tree planting subsidies

Tree planting subsidies have *evolved over the years*. They were introduced in 1974 (Decree Law 701) to develop Chile's potential for highly productive plantation forests. Subsidies (from USD 150/hectare in the early 1980s to USD 400/hectare in recent years) cover 75-90% of plantation and maintenance costs for the first rotation. Initially subsidies mainly benefited big landowners (those owning more than 1 000 hectares). In 1998 the subsidy programme was reformed (Law 19.561) to increase participation of

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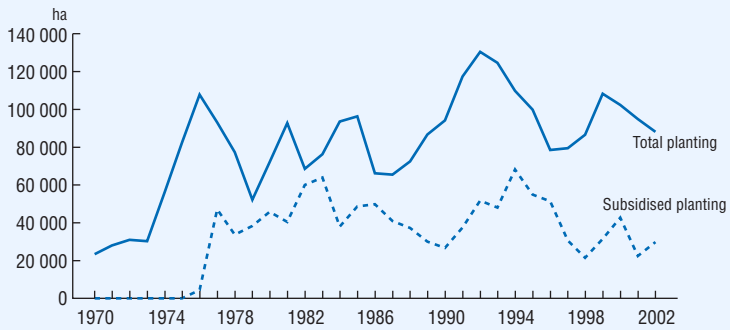
small landowners and strengthen the focus on soil conservation. Land prices have dramatically increased, and large tracts suitable for plantation are scarce. Despite higher per-hectare incentives for afforestation, the industry has shifted its plantation programmes and pulp mill investments to countries such as Argentina where cheap land is still widely available. The *new challenge* is to develop farm forestry in Chile, encouraging farmers to plant trees on land that is marginal for crops. In 2004 small landowners were the main beneficiaries, with 40 000 hectares planted (compared to 5 000 hectares in 1997). Since 2002, smallholders been received technical assistance and been encouraged to form associations to seek economies of scale.

Since the support programme began, *about 50% of afforestation has been subsidised* (Figure 6.2). Over 1974-2002 some USD 225 million in budgetary transfers were made. Even though subsidy rates are higher for native species, most of the payments have been used to plant exotic species, especially Monterey pine (Pinus radiata). More recently, eucalypts have been favoured because of their short maturation (generally no more than 15 years), higher end-product prices and Asian consumer preference.

Environmental benefits of tree planting

Some 84% of the subsidised plantation area up to 1994 (i.e. 684 000 hectares) included *soil conservation activities*. Soil conservation objectives were reinforced by the 1998 subsidy reform, with the subsidy rate now varying according to area, species, property size and degree of soil degradation.

Figure 6.2 **Forest tree planting**, 1970-2002



Source: CONAF.

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Over half of Chile's tree plantations carry some type of *forestry certification*; similarly, more than half have ISO 14001 certification. Close to 1 million hectares are certified under the Sustainable Forest Management Standard (CERTFOR), in operation since mid-2003 and recognised by the Programme for the Endorsement of Forest Certification Schemes (PEFC) since 2004. An additional 530 000 hectares have Forest Stewardship Council (FSC) certification.

Chile has actively taken part in negotiations under the *UN Framework Convention on Climate Change* (UNFCCC) since the fourth meeting of the Conference of the Parties (COP4) in 1998 and supports including forestry activities and reforestation as part of the Clean Development Mechanism (CDM), which was established in the Marrakech Accords in 2001 and whose forms and procedures were approved at COP9 in December 2003. Potential CDM-eligible forestation and reforestation projects in Chile are estimated at 20 000 hectares per year. Pending UNFCCC approval of methodology and procedures for forestation and reforestation projects, three forestation projects covering 17 000 hectares were initiated in 2003 to aim for CDM eligibility. All consist of Monterey pine and eucalypt on degraded land of small and medium-sized farms or Mapuche communities.

Negative environmental impact of tree planting

CONAF estimates that between the mid-1970s and the mid-1990s around *160 000 hectares of native forest were replaced by plantation forest*. More recent monitoring revealed that some 2 300 hectares a year were converted to plantation forest in the north of Region X over 1995-98 and 1 900 hectares a year in Region VIII over 1994-98. The decrease in afforestation in recent years (Table 6.5) has reduced pressure on native forests.

The subsidy programme has created an *incentive for such substitution*. Until 1998 land with "preferably forest potential" (i.e. in the three lower of eight agricultural soil classes) and without "forest cover with commercial potential" was eligible for subsidies. In effect this meant any area recently affected by forest fire was eligible. In 1998 eligibility was extended to all eight agricultural soil classes, thereby including areas marginal for crops, but only on land with "erosion risk or affected by past erosion".

The number of *forest fires* has increased from around 5 000 in the early 1990s to about 6 000 in recent years. The area affected has also increased, from 45 000 hectares to 55 000 hectares a year. Fires mostly affect prairie and scrubland, followed by native forest. In the latter case, most are thought to be arson fires to convert forest to crop land, grassland or tree plantations. Forest fires in plantations cost USD 14 million a year, twice the CONAF fire control budget, but are better controlled and affect an average of only 7 000 hectares per year, or 8% of the tree planting effort.

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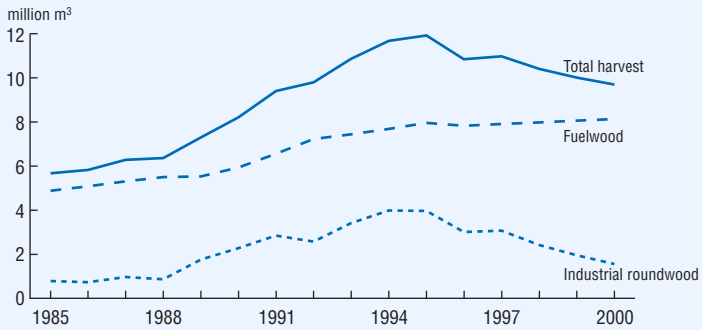
Pine plantations have been affected by the European pine shoot moth and, recently, the wood wasp, an invasive species native to Eurasia and North Africa. Generally, however, no epidemic *spread of pests and diseases* has occurred in the plantations so far, and thus pesticide spraying seems to be rare. Eucalypt plantations are often on better soil than pine plantations and receive more chemical fertiliser and herbicides.

2.3 Management of native forests

Less than half (43%) of Chile's 13.4 million hectares of native woodland are accessible, including much of the second-growth forest (renovales). In addition, many native "production forests" are too old and of insufficient quality to be of much commercial value. The annual harvest is less than 1 million m^3, an *intensity of use* (harvest as percentage of annual growth) of 5%, which compares very favourably to the OECD average of 55%, especially as it excludes unproductive native forest. The intensity of use was 10% in the mid-1990s, when native forests were logged to meet international (mainly Japanese) demand for short-fiber wood chips (Table 6.3). In the late 1990s, however, the first eucalypt plantations became mature and were able to provide the same type of chip at lower cost.

The intensity of use of native forests for *fuel extraction* is much higher than it is for industrial harvest, and it is increasing (Figure 6.3). Fuel wood is harvested, often on a subsistence basis, by small landowners and sharecroppers, sold to urban dwellers

Figure 6.3 **Trends in harvesting native forests**, 1985-2000



Source: State of the Environment report 2002.

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in the south or, to a lesser extent, made into charcoal and taken to Santiago. Many homes in the south use wood for heating. Some efforts have been made to address smoke pollution, in particular by promoting the use of cleaner wood burners and conversion to natural gas for public buildings (Chapter 2). No proactive policy exists to promote biomass as a renewable energy resource despite the difficulty Chile faces in meeting growing energy demand (Chapter 2). Such a policy could involve the development of more efficient biomass technology that would not markedly increase harvest levels from native forests and make better use of residue from tree plantations. There have been attempts to certify fuel wood extraction; only wood from sustainable thinning would be certified.

In 1996 a Permanent Working Group for *Sustainable Forest Management* was created to raise public awareness and develop criteria and indicators. The group includes representation from state agencies, business organisations, NGOs and small farmers' associations. In 1997, CONAF (in co-operation with the German development agency GTZ) launched the Native Forest Conservation and Sustainable Management project to help small forest owners, including indigenous communities, better manage native forests from economic and environmental perspectives. This project has benefited 1 360 small forest owners over 40 000 hectares. By 2006 close to 4 000 owners should have been incorporated, accounting for some 100 000 hectares. A "model forest" was established as part of Canada's International Model Forest Programme. Its goal is to test and demonstrate new approaches to sound forest management based on local partnerships. As of April 2004, 48 000 hectares of native forests had been FSC certified.

2.4 Towards a sustainable forest management strategy

Chile's forested area consists of *preservation forests* (those in the National System of State-protected Wilderness Areas or SNASPE), *protection forests* (which provide soil and water conservation, including forests adjacent to permanent watercourses and on steep slopes) and *production forests*, each accounting for about one-third of the total wooded area. In preservation forests, logging is prohibited. For the two other types, logging is subject to a management plan (for stands of more than 10 hectares) and permitting by CONAF. A proposed new planning tool, sustainable forest management plans, would apply to 50 000 hectares a year. The end goal is to help owners of native forests produce 4 million $m^3$of industrial wood, thereby creating 35 000 direct jobs.

Advocates of plantation forestry assert that tree farms relieve the pressure on natural forests and that expanding "replacement forests" will help preserve native forest ecosystems. In Chile, however, a key objective of the *draft law on native forest*

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restoration and forest development, under discussion since 1992, is to prevent further replacement of native forests by tree plantations to supply raw material to the rapidly growing pulp industry (Box 6.2). The main approach is not to expand the area of preservation forests (i.e. not to enlarge SNASPE) but rather to improve management of protection forests and production forests. One proposal is to *tighten restrictions on logging*, prohibiting it in native forests in the vicinity of springs, next to water bodies and on slopes steeper than 45%. Logging of native forests that are a habitat for endangered species would require reforestation with identical species. The right to introduce exotic species would apply only to sites with degraded native forests.

However, the *rather vague legal definition of degraded forest land* makes it unclear for the industry how much land can be used for plantation, and raises concerns among NGOs that passage of the bill would result in replacement of large areas. The bill also raises broader definitional issues, such as what is meant by "native forest" (e.g. should it include second-growth forest less than a metre high or forests of less than half a hectare) or by "replacement". Another key (and more pragmatic) issue is whether CONAF will be able to perform extended permit granting (for forest management plans) and enforcement, given its current level of staffing and budget. CONAF already lacks the resources to police illegal activities in protected areas (Chapter 4). More importantly, the bill does not address the issue of fuel wood extraction, which is an increasing pressure on native forests (Figure 6.3).

The bill also envisages *incentives* that would focus either on forests with high biological diversity or on those that are most vulnerable to replacement by tree plantations. The incentives would consist of up to 10 "monthly tax units" (inflation-adjusted amounts) per hectare of properly managed forest. The payments, to cover a large share of the forest management cost, would be intended especially, though not exclusively, for owners of small and medium-sized forests. An early proposal to tax the clearing or replacement of native forests was dropped.

There is a *clear need to strike a balance* between preserving all native forests (including degraded ones) from any encroachment by plantation, and developing plantation at any environmental cost, including the loss of old-growth native forests. Collective efforts are needed to reconcile the often complementary objectives of the forest industry and owners of native forests. Close to one-third of native forests are already covered by SNASPE or private protection (Chapter 4). For native forests outside protected areas, innovative instruments could be introduced to promote sustainable management and address both timber and biomass production objectives. Such measures could include promotion of economies of scale (and therefore higher profitability) in forest management; enhanced fiscal incentives for forest owners, such as property and inheritance tax concessions; and well-targeted economic incentives to

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reward provision of environmental services. A national target for replacement of native forest, agreed between the industry and forest owners and including delineation of potential locations, could be set to regulate conversion to plantation forest.

3. Aquaculture

3.1 Policy objectives

Aquaculture experienced *spectacular development* over the review period to become one of the most dynamic and important sectors of the Chilean economy (Box 6.3). Total aquaculture production increased from around 71 000 tonnes in 1990

Box 6.3 **Key features of fish farming**

Aquaculture became commercially viable in the 1960s with the cultivation of oysters and mussels. *The salmon industry took off in the 1980s.* Chile is now second only to Norway in production of salmonids (mainly salmon, plus sea trout to a much lesser extent). Aquaculture output has increased by 825% since 1990 (Table 6.6) and is expected to continue growing, based on salmonids and new species like turbot. Current plans call for production to double. Foreign direct investment in the fishing and aquaculture sector amounts to around USD 30 million a year.

Salmon is not native to Chile but was introduced at the end of the 19th century for recreational fishing. Chilean *fish farms are mainly in coastal areas*. Juveniles are reared in freshwater tanks (as parr), then put to sea (as smolts) in cages housing 5 000 to 50 000 fish. Overstocking contributes to the spread of diseases such as infectious salmon anaemia. The young salmon are mainly fed with fishmeal, of which Chile is the world's *second largest producer* (after Peru).

Salmon farming has been carried out *almost exclusively in Regions X and XI*. In Region XI it takes place mostly in old national reserves and forest reserves (those created before 1975), which include huge coastal areas. In other coastal areas (between 80 metres over high tide mark and two miles from the coastline), aquaculture in cages requires a *permit and concession* from the Ministry of Defence's Coastal Zone Office. In inland waters, permits are built into water rights. Fish farming in ponds does not require a permit. Procedures for granting fish farming concessions were amended in 1997 when SEIA began.

The Ministry of the Economy and Energy's Undersecretariat for Fisheries (SUBPESCA) oversees fishery policy. The *National Fisheries Service* (SERNAPESCA) is in charge of applying and enforcing fishing standards.

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to nearly 600 000 tonnes in 2003 (Table 6.6). Its share of total fisheries and processed fish exports, in value terms, rose from 28% to 56% over the period and came to USD 1.3 billion in 2003. This growth was made possible by Chile's abundance of inland and coastal waters; the size of its fishing industry (it accounts for nearly 3% of GDP, including aquaculture) and its traditional orientation towards fishmeal, the main feed in fish farming; comparatively low operating costs; growing world demand for fish; and public support in the initial stages of development.

The key objective of the 2003 *national aquaculture policy* is to promote "the highest possible level of economic growth within a context of environmental sustainability and equal access rights". The policy has three short-term priorities: i) establishment of a National Aquaculture Commission; ii) coastal area zoning; and iii) enforcement of environmental and sanitary regulations.

Table 6.6 **Trends in aquaculture production**[a]

('000 tonnes)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fish	29 *(41)*	141	199	248	260	230	343	505	483	489 *(84)*
Molluscs	4 *(5)*	16	19	24	33	44	49	61	63	78 *(13)*
Algae	38 *(54)*	49	105	103	68	31	33	65	71	15 *(3)*
Total	71 *(100)*	206	323	375	361	305	425	631	617	582 *(100)*

a) Rounded figures. Figures in brackets are % of total.
Source: SERNAPESCA.

3.2 Legal and regulatory framework

The aquaculture industry is subject to general sanitary, environmental, fishing, maritime and labour regulations. The 1991 *General Fishing and Aquaculture Law* provides for the conservation of fish resources. Imports of fish species for aquaculture require sanitary certificates. In the case of first-time imports a more detailed sanitary assessment is required to diminish the risk of a species becoming invasive or introducing new diseases. The fish farming industry is preparing in-depth studies for 13 new species that could be introduced. Regulations have been enacted establishing protection and control measures for high-risk diseases, and specific programmes are in place for fish and molluscs. Regulations on invasive species are still under discussion.

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The 1991 law limits fish farming at sea to defined areas deemed *appropriate for aquaculture*, to ensure that it does not conflict with other activities (fishing, navigation, tourism and nature protection). Concessions cannot be authorised in marine reserves (reproduction areas for fish stocks) and in the recently created marine protected area. Aquaculture areas in marine waters have been delineated by decree in eight regions. No aquaculture areas can be authorised in Chilean lakes, to protect them from further environmental degradation (Chapter 3). This restriction has contributed to the spread of inland aquaculture in fish ponds, which must comply with sewage emission standards under the 1994 General Environmental Framework Law.

The 2001 *Environmental Regulation for Aquaculture* (RAMA) requires each fish farm to have an emergency plan addressing the risks of massive fish mortality, massive fish escape and accidental feedstuff spills. Operators have to recapture escaped fish within 400 metres and five days (up to 5 kilometres and 30 days in extreme cases), and each escape must be reported to local harbour masters and SERNPESCA. To prevent eutrophication and the spread of diseases, the Ministry of Economy and Energy sets minimum distances between farms (200 metres for extensive production, 2 778 metres for intensive production). RAMA introduces the concept of preliminary site characterisation, which requires any new project subject to EIA, whether inland or marine, to provide evidence of aerobic conditions in the projected sedimentation area. All existing farms must undertake annual environmental monitoring as part of an environmental information programme (INFA). If anaerobic conditions prevail in top sediments under cages for two consecutive years, the centre must reduce by 30% the number of fish or the biomass amount in the third year, and every year thereafter until the aerobic conditions improve. Since 1991, intensive production in inland waters (lakes) can be carried out only up to production of smolts.

The 2001 *sanitary regulation* on prevention and control of high-risk diseases in aquatic species provides for sanitary control, epidemiologic monitoring and eradication of infectious diseases in fish farms.

3.3 Environmental performance

There is *not much official information yet* on the environmental performance of the fish farming industry. The first annual reports to INFA from the 2 000 operating fish farms are under preparation. SUBPESCA is to use these reports as the basis for biannual reports on the state of the environment in the aquaculture sector.

Positive developments

Some 3 000 shellfish, fish and seaweed farms have been authorised, of which 2 000 are in operation. Since 1997, under the General Environmental Framework Law, new

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aquaculture projects have had to undergo *EIA*. By the end of 2003, 1 338 aquaculture projects had submitted EIA documentation. Of these, 853 were approved, 90 rejected and 38 withdrawn by the applicant, while 357 are still under scrutiny.

Because growth in the industry has been largely export-driven, *corporate environmental responsibility* is improving, particularly among the largest farms and companies. *Clean production agreements* have been signed with large producers of salmon (2002) and northern scallop (2003), and one is being prepared for small-scale salmon producers. The 2002 agreement set two-year targets for sewage treatment and solid waste management in fish farms and processing plants, to bring producers into compliance with current environmental standards. It also addressed the control and eradication of high-risk fish diseases. *Environmental certification* of salmon farming has spread since 1998. All the largest farms are ISO 14001 certified. The certification process led to the elaboration of a Code of Good Environmental Practices that includes sustainability criteria for all stages of salmon farming. The *OECD Guidelines for Multinational Enterprises* have been instrumental in improving corporate environmental responsibility, at the initiative of Dutch and Chilean NGOs. Chile is applying the guidelines in a dispute that arose in the salmon industry (Box 6.4).

Box 6.4 **Salmon farming and the OECD Guidelines for Multinational Enterprises**

Chile adhered to the 2000 Declaration and Decision of the Council of OECD Ministers, which contains the text of the OECD Guidelines for Multinational Enterprises, the establishment of and procedures for national contact points and their supervision by the Committee on International Investments and Multinational Enterprises. The guidelines contain recommendations in the areas of general policies, transparency, employment and labour relations, environment, combating corruption, consumer interests, science and technology, competition and tax-related issues. Compliance by enterprises is voluntary. The national contact point in Chile is at the OECD Department of the General Directorate of International Economic Affairs (DIRECON) of the Ministry of Foreign Affairs.

Pursuant to these guidelines, in 2002 the Chilean authorities initiated proceedings to respond to allegations by one Chilean and one Dutch NGO against a Dutch multinational in the Chilean salmon export industry. Among the allegations were that the salmon industry had negative environmental effects, including algae bloom and red tide resulting from excess feedstuff and faeces. A round table organised between the parties led to a *protocol signed in Puerto Montt in June 2004* in which the Chilean authorities agreed to evaluate these environmental issues, through SERNAPESCA, once RAMA has been fully implemented.

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Areas for progress

There are so many *salmon escapes* from cages (about 1 million per year, according to the Chilean government) that fishers have urged the government to allow salmon fishery outside concession areas. The worst single incident to date was the escape of about 1 million salmon during a heavy storm on 1 July 2004. Such mass escapes can have serious impacts on wild species, particularly given the already very high share of freshwater fish species classified as threatened (93%) (Figure 4.1), largely due to introduction of salmonids. While aquaculture companies are insured against the losses resulting from escapes, no mechanism exists by which the industry can investigate, mitigate and ultimately eliminate the impact of mass escapes of carnivorous fish on marine and freshwater biodiversity, on the interests of coastal communities and on small-scale and recreational fishing in southern Chile. Salmon escapes also involve risks of spreading infectious diseases to other salmonids, not to mention human health concerns. RAMA limits environmental liability for fish escapes to the recapture of escaped fish. A system of fines could help finance restoration of ecosystems affected by fish escapes.

Another key environmental issue associated with fish farming is *controlling excess use of antibiotics*, which carry risks for human and environmental health. Antibiotics have been widely used in salmon farms, particularly to control salmonid rickettsia septicaemia (SRS), which accounts for 80% of the antibiotics used. Despite the huge market growth of the industry, Chile's government keeps no statistics on the quantities of antibiotics used in raising salmon, nor is there controlled veterinary oversight. In August 2003, the Japanese authorities suspended a shipment of Chilean salmon, claiming it contained greater amounts of antibiotics than authorised by Japan's health code. Following the July 2004 salmon escape, the Aysén Regional Health Service recommended that people not eat the escaped salmon because they might contain oxolinic acid residues that could provoke a reaction in people allergic to antibiotics. There have been recent advances in developing an SRS vaccine. A retail tax on antibiotics used in salmon production could be introduced as an incentive to reduce their use. SERNAPESCA is revising three general sanitary programmes (disease management, feed management and vaccination) to establish compulsory reporting on the use of antibiotics in salmon farms.

Used at an early stage of salmon development, *fungicides in excess concentration* can contaminate water and sediment in lakes. The fungicide malachite green, a carcinogen, was banned in 2002. *Colourings* are used to make salmon flesh pinker: Chile essentially relies on astaxanthin, a carotenoid pigment naturally occurring in some algae and fed through algae meal. However, it still does not regulate concentrations of the pigment enhancer canthaxanthin (E161g) despite its links with retina troubles in humans.

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Progress is expected from *full implementation of the 2001 sanitary regulation*. To prevent new health-related incidents, SERNAPESCA's residue control programme has been given more resources, and the number of SERNAPESCA site inspections to control the use of prohibited substances is increasing; 239 of the 2 000 fish farms had been inspected by mid-2004.

As regards *water quality*, the chemical emamectin benzoate (used to treat sea lice), together with faecal waste, pollutes the sea. Some of the feed used at salmon farms, along with faeces, winds up in the waters below offshore pens, depleting oxygen necessary for the survival of surrounding marine life. The Fishery Research Fund, to which the fishing and aquaculture industries contribute USD 3 million per year through corporate taxes, has financed innovative research in the area of aquaculture and water quality. For example, Austral University in Puerto Montt recently demonstrated how forest management on watersheds surrounding lakes affects water quality (and thus salmon farm productivity).

Because fishmeal and oil from Chilean sea fish make up some 60% of the feedstuff used at fish farms, increased salmon cultivation could potentially *accentuate overexploitation of fish stocks*. In fresh weight equivalent, 3-5 kg of sea fish is needed to produce 1 kg of salmon. Catches of anchovy, jack mackerel and sardine, the main species used for fishmeal, have decreased since the mid-1990s (e.g. from 2.9 million tonnes in 1997 to 1.6 million tonnes in 2001 for jack mackerel), as have fishmeal exports. Salmon farms now buy one-third of the domestic fishmeal output, and forecasts indicate fish farming could consume all fishmeal produced by Chile as early as 2010. Pressure on fish stocks could be reduced by avoiding excess feeding and increasing the proportion of soya, wheat and lupin flour in salmon feedstuff, a growing trend given the rise in fishmeal prices.

Increasing levels of *sea lion mortality* are associated with expansion of salmon farming. Sea lions become entangled in the protective nets around the farms or are shot by fish farmers to protect their stocks. The government imposed a five-year moratorium on the killing of South American sea lions in 1994 and later extended it for an additional five years. SUBPESCA commissioned research on the impact of marine mammals in fisheries and aquaculture, through grants from the Fishery Research Fund.

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7

ENVIRONMENTAL-SOCIAL INTERFACE*

Features

- Environmental democracy: information, participation, access to courts
- Environmental health
- Environmental education
- Social context
- Poverty reduction

* This chapter reviews progress since 1990.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- consolidate efforts to produce environmental *data, state of the environment reports and environmental indicators* so as to strengthen decision making and public information, taking into account international methodologies;
- continue to develop *public participation* in processes such as project-based environmental impact assessments and strategic environmental assessments of public policies, plans and programmes;
- continue efforts to improve *health* through targeted environmental progress, with special attention to the poor; review the health impacts of *pesticide* use on agricultural workers and rural communities and implement risk reduction strategies and measures;
- strengthen *environmental education and awareness* through a long-term strategy of environmental learning and a national environmental education plan, including: i) further integration of environmental material in primary and secondary school curricula, and ii) development of environmental knowledge through professional associations and environmental management systems within enterprises;
- develop *environmental employment*, with specific attention to the material and cultural heritage as a base for tourism development and to biofood production for agriculture development.

Conclusions

Chile made *outstanding progress* over the review period in reducing the share of the population living in poverty, from nearly 39% to 19%. More than 50% of the income of the poorest decile is derived from national social policies addressing: i) *basic income* needs, through transfers such as assistance pensions, family subsidies and water subsidies; ii) slums and other *housing* problems, through measures such as the Chile Barrio programme; iii) *education*, by providing primary education for all; iv) *health*, through a universal access plan (AUGE) covering 56 costly and common diseases; v) *labour* issues, by raising the minimum wage and introducing unemployment insurance; and vi) *extreme poverty* affecting people not covered by social networks, notably through the Chile Solidario programme. Although further progress is needed, improvement in these areas is impressive. Poverty indicators are also taken into account in the distribution of regional funds and in municipal financing.

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Regarding *environmental democracy*, progress has been made in the provision of environmental information (e.g. production of environmental statistics and publication of state of the environment reports) and legal bases for access to information, along with public participation and access to justice, and actions such as the establishment of a National Environmental Information System (SINIA). The National Statistics Institute has published environmental data each year since 1990. In 2001 it carried out the first survey on firms' environmental management. Improving participation and access to information have been clear goals of environmental policy in Chile. For instance, the General Environmental Framework Law establishes the principle of participation, while legislation on public transparency and integrity establishes the obligation to inform the public. The large number of environmental disputes treated in court shows that access to justice is exercised in practice. *Health concerns* drove many of the environmental improvements made by Chile in the review period. Remarkable results have been achieved in this respect. Air pollution abatement (e.g. of SO_x and particulates in the Metropolitan Region and of arsenic in Antofagasta Region II) and expansion of environmental infrastructure (drinking water supply, waste water treatment, solid waste disposal in sanitary landfills) have helped reduce and prevent ailments such as respiratory diseases, cancers, cholera, typhoid fever and hepatitis A. Some progress has also been made in *environmental education*, e.g. with the introduction of environmental material in primary and high school, the environmental certification of 132 schools and the environmental scout movement.

However, concerning *environmental information*, work on environmental data, environmental reporting and environmental indicators needs to be consolidated and regularly carried out. SINIA is to be further developed to integrate sectoral information, improve the quality of physical environmental information and include economic information on the environment (e.g. environmental expenditure, environmental employment, water prices). Public participation mechanisms and practice, which progressed over the review period, should be made more effective and systematic, both at national and territorial level, particularly in association with project-based EIAs and strategic environmental assessments (SEAs) of public policies, plans and programmes. Despite remarkable *environmental health* progress, much remains to be done. Health problems that have emerged or remain on the health-environment agenda include those related to outdoor air pollution from NO_x, ozone and fine particulates; to indoor pollution, which especially affects the poor; and to lack of access to safe water supply and sanitation services, also for the poor (in line with United Nations goals). For instance, 900 000 people still lack drinking water supply and sanitation. Continuous efforts are needed to combat respiratory diseases (particularly in children), cancer and emerging allergies. Environmental improvements should result in further health progress and related benefits in terms of

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reduced health costs, improved well-being and increased productivity in the Chilean economy. Regarding *environmental education and awareness*, much remains to be done concerning formal school curricula, as well as in the private sector (e.g. involving staff more in certification and corporate social responsibility, and promoting environmental training through professional associations) and the public sector (e.g. in association with sustainable development initiatives, project-related EIAs and SEAs of *public policies, plans and programmes*, and use of environmental performance indicators). Education and environmental campaigns increase acceptance of environmental policies and help prevent illegal dumping, energy inefficiency, water wastage, overuse of private transport and unhealthy behaviour.

♦ ♦ ♦

This chapter focuses on progress made and needed concerning environmental democracy, environmental health and environmental education, within the context of broader social conditions in Chile (Box 7.1), poverty reduction (Box 7.2) and decentralisation efforts (Box 7.3).

1. Environmental Democracy

1.1 Provision of and access to environmental information

Pursuant to the 1994 General Environmental Framework Law, a *National Environmental Information System (SINIA)* was established in 1998 to provide input for decision making and public information and to enhance public access to environmental information. The National Environment Commission (CONAMA) is responsible for managing SINIA. Other bodies dealing with environmental matters are also expected to provide information. The National Statistics Institute has compiled and published *environmental statistics* since 1990. In 2001 it carried out Chile's first survey on firms' environmental management. The government commissioned independent academic organisations to prepare country reports on the state of the environment, published in 1999 and 2002. A national Pollutant Release and Transfer Register is being developed for 2006 through the Chile-Canada co-operation agreement on the environment and the Chile-US free trade agreement.

This work provides an institutional basis for increased progress on environmental information in Chile. *SINIA* is to be further developed to better integrate sectoral information, improve the quality of physical information and include economic information on the environment (e.g. on environmental expenditure,

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environmental employment and prices). *Environmental data* should be improved in terms of policy relevance, measurability (e.g. as regards periodicity, country-wide coverage and international comparability) and analytical quality, particularly concerning pollution monitoring, material flows and natural resource accounting. *Environmental sustainability indicators* were developed in a pilot programme for several regions to support decision making and contribute to SINIA. Following on this, a national programme should be developed to contribute to periodic state of the *environment reports*.

The constitution states (Article 19, Section 14) that all people have the right to request information from public bodies. This right is reinforced and elaborated upon by the Law on Administrative Procedures for Public Administrative Bodies (Law 19.880) and the Law on Probity (Law 19.653), which refer to the state's responsibilities regarding transparency and citizen access to information, establish time frames for providing information and set non-compliance sanctions. This general right of *access to information* has only recently come into prominence. Concerning environmental information, the General Environmental Framework Law (Law 19.300) upholds the right of access to documents needed in developing environmental quality and emission standards, pollution prevention and control plans and environmental impact studies. Documentation on environmental standards and projects under the Environmental Impact Assessment System is available on CONAMA's Web site. In practice, the right of access to environmental information should be further reinforced in terms of implementation.

1.2 Public participation

The 1994 General Environmental Framework Law establishes the principle of *participation* and mechanisms to involve civil society in consultation on the design and use of environmental management instruments: setting environmental quality and emission standards, establishing pollution prevention and control plans, and developing environmental impact assessments (EIAs) for projects. In 2003, all EIAs supervised by CONAMA involved public participation.

In addition, a range of bodies advises government on environmental matters, and they include civil society representatives. CONAMA's *Advisory Council*, which advises the Executive Council and executive director, has 11 members and is chaired by the Ministry General Secretariat of the Presidency. Regional advisory councils similarly advise CONAMA regional structures and are chaired by the regional intendant. The *Sustainable Development Council* has advised the president since 1998 and conducts studies and supports actions to promote sustainable development.

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Non-governmental organisations (NGOs) carry out a variety of environmental activities. They participate, for instance, in environmental policy discussions and help carry out community projects (e.g. restoration of polluted sites, environmental education, reforestation), as well as supplying training and technical assistance, facilitating public access to information and participation, and strengthening environmental awareness. As environmental NGOs face financial and technical constraints, they may receive government and/or international support. Chile's Environmental Protection Fund, for example, funnels 13% of its technical support for community projects to NGOs. The Las Americas Fund financed 2 649 projects presented by NGOs between 1995 and 2002. The Global Environment Facility has financed projects submitted by 39 Chilean environmental NGOs. Support is usually project-specific and donor-oriented.

1.3 Access to justice

Even before the 1994 General Environmental Framework Law was passed, mechanisms existed to guarantee *environmental rights*, most of them provided by the constitution and legislation such as the Municipal Constitutional Charter Law. The General Environmental Framework Law includes the right to file court complaints concerning supreme decrees, claims challenging administrative decisions and claims for compensation for environmental damage. In exceptional cases the State Defence Council may respond to individuals' demands concerning environmental cases, independently of judicial procedures.

Many *environmental cases* are treated in the courts, showing that access to courts is exercised but also that many environmental disputes are not resolved through administrative procedures. Moreover, the judicial system lacks the capacity to deal adequately with many environmental matters, for instance when it comes to obtaining evidence or estimating environmental damage and compensation values. There is no ombudsman or other independent institution acting as advocate of last resort to guarantee the defence of citizens' rights.

2. Environmental Health

2.1 Chilean health system and its performance

The Chilean health system has both *public and private components*. The public insurance covers 68% of the population, principally the poor, the lower middle class and retirees. It is administered by the National Health Fund and the Municipal

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Box 7.1 **Social context**

Chile's *population* is around 15 million. The 2002 census shows population growth slowing; over 1992-2002 it grew 1.2% per year. The population is ageing, with a median age of about 31. Eight *indigenous groups* make up 4.6% of the total population: Aymara, Atacameño, Colla, Quechua, Rapa Nui (Polynesian), Mapuche, Kawashkar and Yagán. The Mapuches, who live in south-central Chile, are the largest of these groups (87% of the indigenous population).

The average *population density* is 20 inhabitants per square kilometre. About 85% of the population lives in urban areas. The three largest urban areas are the Metropolitan Region of Santiago (6.06 million), the Concepción area (912 000) and the Valparaiso area (876 000). The *Metropolitan Region* contains 40% of the country's population and accounts for 50% of GDP. It attracts significant internal immigration. One million motor vehicles operate in the Metropolitan Region.

Since 1990 the number of people in work has grown by 2.1% annually. More than one million jobs have been created, reducing the *unemployment rate* to 8.5% (compared with an average of 18% in the 1980s). In 2002 an unemployment insurance mechanism was introduced. The unemployment differential and wage gap between *men and women* have decreased in recent years, although disparities continue: while men's labour participation rate is 70%, women's is 35.6%, and they earn 72% of the average wage for males. *Regional disparities* in unemployment rates also exist: the rates range from more than 10% in Valparaiso Region V and about 9% in Maule Region VII to less than 5% in Aysén Region XI. *Informal employment* is high, at around 35% of total employment, with negative effects on contributions to the social welfare system. Primary industry based on natural resources (e.g. agriculture, forestry and fishing) represents about 30% of employment in Coquimbo Region IV, Libertador Region VI, Maule Region VII, La Araucania Region IX and Los Lagos Region X. Mining, although an important job provider in Antofagasta Region II and Atacama Region III, is more capital-intensive. The natural heritage of Chile is a major asset for tourism-related employment.

Several *health* indicators are in line with rates in OECD member countries. Life expectancy at birth is 73 years for men and 79 years for women. Child mortality, which was 16.8 deaths per 1 000 births in 1990, has been roughly halved. Total expenditure on health is around 7.2% of GDP. Overall, *much progress* was made in the review period (1990-2004).

Literacy rates are 99.0% for men and 99.2% for women. The share of population with *basic education* (eight years) is 98%, up from 91.3% in 1990. The population with upper secondary or higher education has doubled in percentage terms from 1990, to 29%. Total expenditure on education grew from 3.8% of GDP in 1990 to 7.4% in 2003. Overall *much progress* has been achieved with increasing education coverage. However, improving educational quality and equity remains a challenge.

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Primary Health Care System. The private component serves around 18% of the population, mostly the upper middle class, through Health Insurance Institutions. The rest of the population is covered by other systems (defence forces, universities, etc.) or has no formal health insurance. For occupational injuries and diseases, three private, not-for-profit mutual plans insure and provide health services to more than 2.5 million workers.

Total health expenditure grew during the 1990s and now accounts for more than 7.2% of GDP, of which the public component of the health system accounts for 40%. Per capita health expenditure is 60% lower than the OECD average. A wide-ranging health care reform recently carried out includes a *universal access plan* (AUGE) guaranteeing good-quality treatment of 56 common and costly pathologies. The health reform also included the establishment of new institutions: a Sanitary Authority, responsible for health promotion and vigilance and disease prevention and control, and an authority to manage the hospital network. Specific programmes protect vulnerable groups.

Pollution is recognised as a cause of major public health problems. The Ministry of Health has two environment-related departments: the Environmental Health Department (protecting the general public health from environmental risks) and the Occupational Health Department (focusing on working conditions).

Since 1990, *primary health performance* indicators for nutrition, morbidity, the maternal-infant mortality rate and life expectancy have all improved. For instance, the mortality rate has fallen from 6.0 to 5.3 per 1 000 population and the infant mortality rate from 16.8 to 8.3. The maternal-infant mortality rate has dropped from 4.0 per 10 000 infants to 1.7.

Chile is free from malaria, poliomyelitis and yellow fever, and dengue is present only on Easter Island. Tuberculosis been successfully controlled, as have cholera and other infectious intestinal diseases. Cardiovascular diseases (27.9%), tumours (24.2%) and respiratory infections (10.4%) are the chief causes of death. Mortality from *cancer* has increased by 10.4% since 1990, lung cancer being the number two cause of death for men and number four for women. Pneumonia is the top cause of mortality in children and its incidence has increased. *Acute respiratory insufficiency* is the main cause of hospitalisation and morbidity in children, accounting for 60% of child hospitalisations per year (80% in winter, 45% in spring). Bronchial obstructive syndrome represents 23% of paediatric treatments in Santiago and affects 25% of all children less than 12 months old.

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Box 7.2 **Reducing poverty**

Poverty in Chile was dramatically reduced during the 1990s: 18.8% of the population was living below the poverty line in 2003, compared to 38.6% in 1990, with 730 000 people (4.7%) living in extreme poverty (using the definitions in the CASEN survey). Poverty is unevenly distributed geographically: in Regions VIII and IX, where a large share of the indigenous population lives, the poverty and extreme poverty rates are significantly higher than the country average. Government efforts to reduce poverty rely on economic growth, with part of the public revenue generated by growth being devoted to social expenditure (Table 7.1). The emphasis is on social benefits (pensions, family support and unemployment), health, education, housing and infrastructure (e.g. access to water and electricity). Poverty reduction was a major achievement of Chile during the review period (1990-2004). National government social expenditure represents 70% of total government expenditure and 16% of GDP.

Income distribution, however, continues to display serious inequality (Table 7.2). The Gini coefficient has been unchanged since 1990, at 0.58. The richest decile represents 41% of private earnings while the poorest one accounts for 1.2% (which rises to 2.9% when public support is included).

Progress has been made in policies on *housing* for the poor. In 1990 almost a million Chileans lived in peri-urban squatter camps, on illegally occupied land and in substandard housing with inadequate access to basic services such as electricity, drinking water and sewerage. Through the 1990s, social housing policies led to programmes such as the Neighbourhood Improvement Programme and Chile Barrio Programme for extremely poor settlements. In 1998 Chile set a goal of resettling 108 588 families living in 972 camps nationwide. By 2003, 85 069 families had been provided with housing solutions. Despite this progress, and the decrease of the housing deficit index from 53% to 42%, much remains to be done.

Regarding *access to water services*, which is related to two major UN goals (halving the population without access to safe water supply and lacking access to sanitation), progress has been made. Nevertheless, about 900 000 people still lack *drinking water* and/or *sanitation provision*. They are generally in enclaves of poverty in dispersed, remote communities, often of indigenous people. Drinking water programmes have focused on settlements of more than 80 inhabitants and eight houses. In Antofagasta Region II, significant efforts have been made to reduce the arsenic content of drinking water.

Regarding access to *electricity*, the National Programme for Electric Power Coverage for Rural Housing subsidises electricity distribution in isolated areas where it is not profitable for private investment. Coverage rose from 53% of rural housing to 86% in ten years, and the target is 90% by 2005. Regions IX and X, with Chile's largest populations of farmers and other rural dwellers, as well as larger shares of indigenous people, show the greatest progress.

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Table 7.1 **Central government social expenditure,** 1990-2002

(% of GDP)

	1990	1992	1994	1996	1998	2000	2002
Total social expenditure	12.4	12.5	12.8	12.9	14.0	15.6	16.0
of which:							
Health	1.9	2.2	2.4	2.3	2.5	2.7	2.9
Housing	0.9	1.0	1.0	1.0	1.0	0.9	0.9
Social benefits[a]	6.1	5.6	5.5	5.4	5.7	6.4	6.4
Education	2.4	2.6	2.7	3.0	3.5	3.9	4.3
Other	1.1	1.1	1.2	1.2	1.4	1.6	1.6
Total government expenditure	20.2	20.3	19.9	19.6	21.3	22.4	22.9
Ratio of social to total (%)	*61.4*	*61.7*	*64.2*	*66.0*	*65.9*	*69.5*	*69.9*

a) Pensions, family support, water subsidy and unemployment benefits.
Source: Ministry of Finance.

Table 7.2 **Impact of social spending on income distribution by income decile,**[a] 2003

(%)

	1	2	3	4	5	6	7	8	9	10	Total
Private earnings[b]	1.2	2.7	3.6	4.7	5.5	6.6	8.3	10.8	15.3	41.2	100
Social benefits[c]	29.7	18.0	14.4	11.5	8.8	6.7	5.1	3.3	1.7	0.6	100
Disposable income[d]	1.6	2.9	3.8	4.8	5.6	6.6	8.2	10.7	15.2	40.6	100
Subsidised health care	33.0	28.9	18.6	13.1	10.9	7.1	6.9	–2.8	–5.3	–10.5	100
Subsidised education	18.4	17.0	14.2	13.0	10.4	8.2	7.3	5.7	4.2	1.6	100
Corrected disposable income[e]	2.9	4.0	4.5	5.4	5.9	6.7	8.2	10.2	14.3	38.0	100

a) Deciles of household income per capita.
b) Earnings from individuals' economic activities.
c) Pensions, family support, water subsidy and unemployment benefits.
d) Private earning corrected for social benefits.
e) Disposable income corrected for health and education subsidies.
Source: Ministry of Planning and Co-operation.

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2.2 Air pollution and health

Air pollution from fine *particulate matter* and *other pollutants (e.g. NO_x and ozone*) has damaging effects on the respiratory and cardiovascular systems of individuals exposed to it. In Santiago, episodes of severe air pollution affect 6 million people. Some of these episodes involve very high concentrations, especially during winter.

Concerning *mortality and PM_{10}*, studies carried out for the Metropolitan Region of Santiago concur with international findings. An increase of 10 µg/m^3 of PM_{10} corresponds to a 0.6% rise in daily mortality *from respiratory causes*, with a stronger response above 90 µg/m^3. Premature deaths attributable to PM_{10} are estimated at 542 to 602 a year in the Metropolitan Region. Concerning *morbidity and PM_{10}*, there is a significant statistical relationship between short-term exposure and hospitalisation for diseases such as emphysema, bronchitis, asthma, pneumonia and chronic obstructive pulmonary disease. In general, increases of 10 µg/m^3 correspond to a 0.8% increase in respiratory illness hospitalisations.

In Santiago, studies have shown the presence in *fine particulates* of mutagenic and carcinogenic compounds such as polycyclic aromatic hydrocarbons and nitro-arenes. Annual deaths attributable to long-term exposure to $PM_{2.5}$ in Santiago were recently estimated at 4 000, mainly due to lung cancer and cardiopulmonary diseases. In Antofagasta, children exposed to *lead pollution* show higher lead content in the blood than those not exposed. *Indoor pollution*, especially in the poorest areas of the Metropolitan Region, is associated with heating using coal (producing means of 250 µg/m^3 for PM_{10}, 42 ppm for CO and 192 ppb for SO_2) or firewood (means: PM_{10} 489 µg/m^3, CO 57 ppm, SO_2 295 ppb). Indoor-generated polycyclic aromatic hydrocarbons were also detected. In southern cities, such as Temuco, wood heating is the main cause of indoor pollution. Concerning *asbestos*, in 2000 the Ministry of Health issued a nationwide ban on its production, import, distribution and sale, including all materials and products containing asbestos.

In Antofagasta Region II, naturally high levels of *arsenic* in water and soil are associated with copper ore components such as enargite. In addition, copper mining and smelting have emitted large amounts of arsenic into the air. From 1955 to 1970 the region experienced arsenic concentrations in drinking water of 580 µg/litre (population-weighted average), compared to 10 µg/l for the rest of Chile. The installation of arsenic treatment plants has reduced arsenic concentrations in drinking water to less than 50 µg/l. Over 1989-93 mortality from bladder, skin, lung and kidney cancer was markedly higher in Region II than in the rest of Chile, and it was estimated that arsenic accounted for 7% of deaths among those aged 30 and over.

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Box 7.3 **Decentralisation efforts**

Chile is a highly centralised country. Regions and municipalities depend largely on central government decisions and funds. Efforts are being made, however, to decentralise, promote regional development and increase municipal equity.

In 2003 around 50% of public investment resulted from regional decisions, up from 14% in 1990. The *Regional Development Fund* (USD 266 million in 2003) is the main instrument through which the central government transfers resources to the regions, taking into account indicators on economic, social and environmental conditions. Projects financed through this fund are subject to EIA.

Total municipal income was USD 1.37 billion in 2002, some 176% higher in real terms than in 1990. Municipal income is composed of local revenue and transfers from higher levels of government. The *Common Municipal Fund* is the main instrument to promote equity among municipalities. It showed real growth of 207% from 1990 to 2002. Allocations from the fund increased more for low-income municipalities over that period than for richer ones, but the wealthiest 10% of municipalities still have 5.4 times the resources of the poorest 10%. More than half of Chile's municipalities depend on the fund for more than 60% of their income, or even higher for smaller municipalities.

Local Agenda 21 has not been a major instrument for reinforcing local capacity for environmental management. A variety of isolated and pilot local initiatives have been carried out since 1992, but they are not part of a national policy to promote integration of the environmental, social and economic dimensions of sustainability. At local level, efforts to introduce environmental management capacity have mainly been driven by the Chilean Association of Municipalities, which supports programmes to promote the establishment of technical environmental units in municipalities. Most local initiatives depend on funding availability, particularly from international development assistance funds.

2.3 Water pollution and health

Environmental policies related to water resources have led to noticeable positive health effects (Chapter 3). Safe drinking water is supplied to 99.8% of urban dwellers and 60% of the rural population. The Rural Potable Water Programme of the Ministry of Public Works aims to extend service to 98% of the concentrated rural population. Waste water treatment rose from 8% in 1990 to 71% in 2004 in urban areas (the target is 98% by 2010). This progress, together with an epidemiological surveillance system covering both contagious and non-contagious diseases, and a programme of food inspection and hygiene, has led to the elimination of *cholera* and a 90% decrease in the morbidity rate for *typhoid*. The incidence of *hepatitis A* fluctuates.

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2.4 Other environmental issues and health

In urban areas, all *municipal solid waste* is collected, and disposal in sanitary landfills has risen from 15% in 1996 to 70%. Most of the progress has been in the Metropolitan Region. *Other environmental factors* affect the health of urban populations (e.g. noise, odour, vibration, smoke). In particular, informal *food distribution* may not meet hygiene standards.

In rural areas, *chemical products* used in intensive agriculture and forestry can also have a significant impact on people's health. Acute pesticide poisoning remains a problem, with rates of 5.2 per 100 000 people. In the early 1980s a study detected DDT residue at levels above the limits in all analysed samples of breast milk, human adipose tissue and cows' milk. As a result, Chile has banned the import, manufacture, sale, distribution and use of DDT since 1984. Similar bans were applied to aldrin in 1988 and to chlordane, dieldrin, endrin and heptachlor in 1987. However, studies in the late 1980s in areas where pesticides are used intensively in agriculture showed inhabitants' health deteriorating, with increases in congenital malformation and cardiopathy, spontaneous abortion and cancer, among other pathologies. The use of antibiotics in farming (e.g. salmon farming), and related bacterial resistance that could affect human health, also poses a concern.

3. Environmental Education

In 1990, Chile's *basic education indicators* were positive, with very low illiteracy rates and around 80% of children completing primary and high school education. After efforts in the 1990s the indicators further improved: by the early 2000s, 97% of children completed basic education (eight years), 85% got a high school education and 29% went on to upper secondary or higher education. Educational efforts over the decade focused on *quality and equity* issues. Measures to improve quality included changes in the education system structure, curriculum reforms, increases in the number of hours of schooling per day, improvements in textbook quality and increased use of computers (including the Internet) in schools. To address equity issues, several programmes targeted children of low-income families, minorities and those living in remote areas. Most of the increase in attendance in upper secondary school and higher education reflects improved access for students from low- and middle-income families. Total public and private expenditure on education was *7.4% of GDP* in 2003, compared with 3.8% in 1990. Reducing the quality gap between public and private schools remains a major challenge.

The 1994 General Environmental Framework Law recognises the aim of integrating an *environmental dimension into education*. The main government initiatives in this area, however, are more recent. Material on the environment was

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introduced in the primary and high school curricula within existing subjects, rather than separately. In 2001 such material began to be introduced in kindergarten.

Specific programmes include outdoor education through the *Open Air School* (supported by the Ministry of Education, CONAMA and CONAF, the National Forestry Corporation); the environmental scout movement, which has 50 000 registered members nationwide (supported by CONAMA and the Ministry of Education); and the Environmental Certification System for Educational Establishments, which promotes environmental management systems in schools and has enrolled 132 institutions (supported by the Ministry of Education, CONAMA, CONAF, UNESCO-Santiago and the Chilean Association of Municipalities). NGOs play an important role, sometimes jointly with public bodies like the Environmental Education Network. They provide technical support for the environmental certification of schools, help train community leaders and participate in many other projects.

Despite all this progress, environmental education programmes appear somewhat dispersed, and their degree of implementation varies. Their existence and continuity depend on the priorities and funds of different government bodies. The adoption and implementation of a *national environmental education plan* could help strengthen multi-disciplinary approaches, integrate non-formal activities, link the different environmental education programmes and assure the necessary financial resources. This plan should include or be associated with the development of environmental knowledge in the private sector and government. In the private sector such involvement could take advantage of progress in environmental certification and corporate social responsibility, as well as training programmes sponsored by professional associations (e.g. engineers, architects, farmers). In the public sector, at all levels, environmental training and awareness could be promoted through initiatives in the area of sustainable development and related participation processes. NGOs and other social forces could play a significant role in many efforts to strengthen environmental education and awareness.

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8

INTERNATIONAL CO-OPERATION*

Features

- Trade and environment
- Implementation of multilateral environmental agreements
- Marine and maritime issues

* This chapter reviews progress since 1990. International commitments related to nature conservation and biodiversity are discussed in Chapter 4.

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Recommendations

The following recommendations are part of the overall conclusions and recommendations of the Environmental Performance Review of Chile:

- continue efforts leading to *ratification and implementation of international agreements* and, as appropriate, OECD legal instruments, and publish periodic reviews of actions taken to meet international environmental commitments;
- continue to promote *mutually supportive trade and environment policies* through effective implementation and strengthening of the environmental regulatory framework and promotion of corporate social responsibility;
- ensure that co-operative activities associated with *trade agreements* are targeted to mitigate any adverse environmental impacts from large-scale natural resource exportation;
- strengthen *chemical and hazardous waste management* according to international agreements, notably the Stockholm, Rotterdam and Basel Conventions; complete and implement national plans for persistent organic pollutants and hazardous waste; strengthen enforcement activities, develop pollutant release and transfer registers and improve the regulatory framework to better manage chemicals throughout their life cycle;
- continue national and bilateral efforts in the areas of research, monitoring and sustainable management of *marine ecosystems* (e.g. sustainable fisheries, prevention of marine pollution); strengthen oil spill prevention and mitigation capacities;
- develop a balanced, scheduled strategy concerning *climate change* issues; strengthen *energy efficiency and greenhouse gas mitigation* policies, including through a cleaner energy mix, and promote the use of clean development mechanisms in the context of the UNFCCC and the Kyoto Protocol;
- develop further *international environmental policies* reflecting potential OECD membership, and an increasing role in Latin America and the world.

Conclusions

Over the review period, Chile concluded a number of trade agreements incorporating environmental dimensions and participated in global efforts to address environmental challenges. In the context of *trade agreements*, Chile has taken on significant obligations to promote high standards of environmental protection, to enforce environmental laws effectively and to not derogate such laws to attract investment. It has also promoted corporate social responsibility, with particular

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attention to environmental management in key export sectors. Chile has been a strong participant in the global environmental agenda as well, signing and ratifying most major *multilateral environmental agreements* and taking an active role in efforts to address ozone layer depletion as well as marine and maritime issues, especially as regards potential oil spills in its southern seaways, which receive heavy international traffic. At *regional level* Chile has been active in work to preserve the Antarctic, to reverse the vicuña's endangered status (efforts involve Argentina, Bolivia, Ecuador and Peru), to combat desertification of the Altiplano-Puna ecosystem shared with Peru, Argentina and Bolivia, and to preserve Ramsar Convention wetlands.

Chile's *trade and environment* agenda is influenced by market access concerns and treaty negotiating dynamics vis-à-vis its trade partners, as well as efforts to identify and address possible environmental effects of very rapid growth in natural resource-based export sectors. Chilean export companies have made progress in product certification and environmental management, improving Chile's reputation as a reliable supplier and securing access to foreign markets, but this has not always prevented local environmental damage from rapidly expanding export sectors. Regarding *multilateral environmental agreements* ratified by Chile, some lack follow-up implementation: legislation may be pending (e.g. on native forests and persistent organic pollutants), national action plans may not be in place (e.g. on biodiversity) or enforcement may be too weak (e.g. regarding endangered species).

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1. Objectives

Over the review period (1990-2004), Chile pursued mutually beneficial relationships with countries across the globe and proved to be a committed partner in multilateral initiatives. In this context, Chile's international environmental objectives can be outlined as follows.

First, Chile participates in and contributes to an open international economic system by signing bilateral, intraregional and multilateral trade agreements and developing a proactive position on *trade and environment* issues. Its international trade strategy is based on recognition that its small domestic market could not sustain the country's required economic growth. After unilateral opening in the 1980s did not prove sufficient, in the 1990s Chile began pursuing negotiation of bilateral and regional trade agreements with several partners. The pursuit of free trade agreements and willingness to take on environmental obligations in the context of economic integration were consistent with Chile's broad objective of pursuing *economic growth*

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with equity. Throughout the review period Chile became increasingly convinced that trade and environment policies could be mutually supportive, and recognised the importance of environmental attributes in competing in and expanding into international markets.

Second, Chile participates in international environmental negotiations, subscribes to *global environmental agreements* and fulfils related commitments. Its 1998 environmental policy identifies *responsibility to the international community* as one of ten principles underlying the environmental agenda. This principle notes the importance of meeting commitments made in international environmental agreements and further confirms that Chile's goal is to be an active party to agreements and to assume its "common but differentiated responsibility" for efforts to respond to global environmental challenges.

Third, Chile is committed to improving *environmental co-operation with neighbouring countries*. It has signed several environmental co-operation agreements with its neighbours, most notably on fishing and ocean rights with Peru, on shared forest ecosystems and water resources with Argentina and on protection of South American camelid species with Argentina, Bolivia, Ecuador and Peru.

2. Trade and Environment

The key feature of Chilean trade policy in the 1990s was the search for new export markets. At the beginning of the decade Chile began developing a trade policy based on three main points: first, across-the-board unilateral reduction of *import tariffs* (the rate was 11% from 1991 to 1999, when it began to be reduced, reaching 6% in 2003); second, participation in *multilateral trade negotiations*, including those of the World Trade Organization (WTO) and the Free Trade Area of the Americas; third, bilateral negotiations and related *trade agreements* (Box 8.1).

As a result, export volumes grew strongly from 1990 to 2004, at an annual average of 10.1%. This expansion was mainly due to non-traditional exports, which grew by 13% a year, while shipments of copper grew by 10.7% and non-copper traditional exports (e.g. fresh fruit, fishmeal, cellulose and paper) grew by 5.6%. Exports now account for *36% of GDP*.

Natural resources and their derivatives play an important role: *mining* represents 46% of exports, *agriculture* 17%, *fishing* 9% and *forestry* 13%, for a total of 85%, compared to 15% from industry. The country's top ten export products, representing nearly USD 9.7 billion, are directly derived from natural resources. Dependence on natural resource exports has encouraged Chile to promote mutually supportive trade

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Box 8.1 **Selected trade agreements to which Chile is a party**

Free trade agreements (with 38 countries)

- Chile-Canada: entered into force in July 1997 with parallel agreements on environment and labour; agreement to avoid double taxation and property tax evasion, 1998.
- Chile-Central America: entered into force in October 1999.
- Chile-Mexico: entered into force in November 2000, replacing the 1991 Economic Complementarity Agreement; agreement to avoid double taxation also signed.
- Chile-EU: Association Agreement, entered into force in February 2003; encompasses political and security affairs, economic and social co-operation and establishment of a free trade area.
- Chile-European Free Trade Association: entered into force in March 2003.
- Chile-US: entered into force in January 2004; includes an environment chapter.
- Chile-South Korea: entered into force in February 2004.

Economic complementarity agreements (with 11 countries)

- Chile-Venezuela: entered into force in July 1993; investment promotion and protection protocol, 1994.
- Chile-Bolivia: entered into force in July 1993; protocols include investment promotion and protection and more preferential tariffs.
- Chile-Colombia: entered into force in January 1994.
- Chile-Ecuador: entered into force in January 1995; includes agreement to promote development and technology transfers; investment promotion and protection agreement signed in 1996.
- Chile-MERCOSUR: entered into force in October 1996.
- Chile-Mexico: entered into force in 1991.
- Chile-Peru: entered into force in July 1998.
- Chile-Cuba: entered into force in August 1998.

Multilateral co-operation

- Latin American Integration Association: 1980.
- Asia-Pacific Economic Co-operation Forum: Chile became full member in 1994 and hosted the 2004 Summit.
- World Trade Organization: 1995.

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and environmental policies and to develop an open and proactive position on trade and environment issues. Chile participates actively in the WTO Trade and Environment Committee and argues that eliminating subsidies on agricultural exports and fishing is beneficial both for environmental protection and for international trade. Chile has proved that it not only places environmental concerns in the context of trade liberalisation but is also willing to take on environmental obligations in the context of bilateral free trade negotiations. To date it has signed three trade agreements that include environmental dimensions.

Chile-Canada Agreement on Environmental Cooperation

The first Chilean trade agreement to incorporate an environmental dimension was the Chile-Canada Free Trade Agreement, which entered into force in July 1997 together with the Chile-Canada Agreement on Environmental Cooperation. The latter was negotiated as an interim agreement pending Chilean accession to the North American Free Trade Agreement (NAFTA), and hence mirrors the North American Agreement on Environmental Cooperation. In the event, Chile did not accede to NAFTA; the agreement remains *actively implemented by Canada and Chile*. It reaffirms each country's right to set its own policies, priorities and levels of environmental protection, and obliges both to maintain high levels of environmental protection and to enforce their own environmental laws effectively, setting fines for non-compliance. This obligation prompted Chile to begin a *review of over 1 200 pieces of legislation* fitting the definition of environmental law, with a view to ensuring that they complement and are consistent with the General Environmental Framework Law (Law 19.300). Additional work is required on this review and to clarify *enforcement responsibilities* of the National Environment Commission (CONAMA) and other environment-related services. Key to implementation of the agreement is its work programme, approved by a council composed of Canada's environment minister and the executive director of CONAMA. The current *fourth work programme* includes several mutually defined co-operative activities related to enforcement, public participation, trade and environment and health and environment issues. Chile and Canada both provide in-kind and financial resources for these activities.

Chile-EU Association Agreement

The Chile-EU Association Agreement (2003) also includes an environmental dimension. *Not merely a trade agreement*, it is a political and economic association based upon trade, political dialogue and co-operation. The agreement includes provisions on trade in goods, antidumping, border measures, rules of origin, sanitary and phytosanitary measures, wines and spirits, trade in services (including telecommunications), maritime transport, financial services, government procurement, competition, dispute settlement

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and intellectual property rights. *Environmental co-operation* is one of over 30 co-operation areas identified in the agreement. In addition, the other areas include energy, mining, fishing and agriculture, which are environment-related. No specific resources are identified to support environmental co-operation, but the parties commit themselves to providing, within the limits of their capacities, the resources needed. A sustainability impact assessment study by the European Commission on the trade part of the agreement concluded that it should increase Chile's GDP by 0.5% and help raise the standard of living. Key parts of the agreement, including trade provisions, have been applied since February 2003, but the agreement as a whole will not enter into force until all EU countries' parliaments ratify it.

The section on co-operation emphasises the need to work together on social development, economic growth and environmental protection. Article 28 states that the purpose of the environmental co-operation is to promote conservation and improvement of the environment, to prevent pollution and the degradation of natural resources and ecosystems and to promote rational resource use, in the interest of *sustainable development*. Essential points include the relationship between poverty and environment; the environmental impact of economic activities; development of environmental projects; exchange of information, technology and experience; environmental education and citizen participation; and technical assistance and regional research programmes.

Chile-US Free Trade Agreement and Environmental Cooperation Agreement

The Chile-US Free Trade Agreement (FTA), which entered into force in January 2004, includes an environment chapter. Like the Canada-Chile environmental agreement, this chapter reaffirms each country's right to set its own policies, priorities and levels of environmental protection, and obliges both to maintain *high levels of environmental protection*. The provision on effective enforcement focuses on enforcement failures that result in a trade advantage, and allows for trade sanctions if agreed remedial actions are not carried out. An environmental review by the US administration concluded that the agreement would not have significant environmental impacts in the US, but identifies issues of concern related to the dependence of Chile's economy on natural resources for exports. Although the economic and environmental impact on these resources are considered minimal, the US administration recommended *eight projects* to respond to the concerns: developing a Pollutant Release and Transfer Register (PRTR); reducing mining pollution; improving environmental enforcement and compliance assurance; sharing private sector expertise; improving agricultural practices; reducing methyl bromide emissions; improving wildlife protection and management; and increasing the use of cleaner fuels. The Environmental Cooperation Agreement, negotiated following the FTA and not yet in force, will help guide future co-operative projects between the two countries.

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Strategic environmental assessment of trade agreements

While Chile recognises the importance of strengthening environmental management given an export-led development strategy dependent on natural resources, it lacks a policy of conducting *strategic environmental assessments* or *sustainability assessments* of trade agreements or economic policies. Such assessments would help identify environmental pressures that could arise if productive sectors expand, particularly pressures that cannot be identified through project-focused environmental impact assessments (EIAs). As mentioned above, the EU conducted a sustainability assessment of the Chile-EU Association Agreement and the US performed an environmental review of the Chile-US FTA. Chile has some experience in this field; it employed a computable general equilibrium model to assess the potential effects of the Chile-US and Chile-EU FTAs. More in-depth assessments of the potential impact in various sectors could assist Chile in anticipating and responding to environmental pressures and identifying co-operative activities.

3. Multilateral Environmental Co-operation

3.1 Chile and MEAs

Chile is a *party to most multilateral environmental agreements* (MEAs) concluded since 1990 and has actively participated in the global agenda for sustainable development that began in Rio and was reinforced at the Millennium Development Summit and the World Summit on Sustainable Development.

Under the constitution the National Congress must approve or reject international agreements brought before it by the president, in a procedure similar to that for approving national law. Once approved by Congress and ratified by the president, such instruments effectively become laws to be implemented nationwide. Many MEAs ratified by Chile still lack the required follow-up legislation and regulations, however. Overall, *implementation of MEA commitments could be strengthened* by specific legislation and regulations, additional resources for implementation and enforcement, and additional efforts to focus international assistance on key MEA priorities. This is the case, for example, regarding the Convention on Biological Diversity (signed 1992, ratified 1994) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; signed 1974, ratified 1975) (Chapter 4).

Over the last decade several *national advisory committees* have been established by presidential decree to enhance follow-up on international conventions and accords. Committees exist for Global Climate Change, Conventions on Natural Resources and

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Wildlife, the International Chemical Agenda, Biosafety Issues and International Environmental Policy. They are presided over by CONAMA's executive director, with the Ministry of Foreign Relations providing the vice president. International environmental policy is further supported by an environmental unit in the Department of Trade and Sustainable Development in the Ministry of Foreign Relations.

Chile is eligible for international assistance to support the implementation of MEAs. It has significant internal *capacity for absorbing assistance and translating it into results*. Over the years it has developed an explicit government policy encouraging international co-operation. Its Agency for International Co-operation was established in 1990 to co-ordinate most international technical assistance. As of 2004, the Global Environment Facility (GEF) had approved USD 16 million in projects for Chile on biodiversity conservation, urban transport, renewable rural energy and private protected areas. In recent years Chile has increased its emphasis on co-operation within the developing world.

3.2 Convention for the Protection of the Ozone Layer (signed 1985, ratified 1990) and Montreal Protocol (signed 1988, ratified 1990)

For a few days in 2000, Punta Arenas (population 120 000) in southern Chile bore the ominous distinction of being the first populated area where the hole in the ozone layer exposed residents to high levels of ultraviolet radiation. Chile recognises its *vulnerability to the effects of ozone layer depletion* and has ratified all amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer: London (1990), Copenhagen (1992), Montreal (1997) and Beijing (1999). CONAMA is the Chilean focal point for implementation of the protocol and has housed the National Ozone Unit since 1994. Chile has mobilised funding from multilateral and bilateral sources (e.g. World Bank, United Nations Development Programme, United Nations Environment Programme, Environment Canada, US Environmental Protection Agency) for activities under the convention and protocol, including those to reduce and eliminate controlled substances in its *Country Programme for the Protection of the Ozone Layer*. A key part of this programme was the establishment of the Ozone Seal in 1996. The government has funded more than 40 conversion projects for companies in the *refrigeration and plastic foam insulation industries* and three technology demonstration and transfer projects to eliminate *methyl bromide in agriculture*. Chile thus reduced its consumption of ozone-depleting substances (ODS) from 830 tonnes in 1995-97 to around 500 tonnes in 1999-2004, more than meeting its commitments under the Montreal Protocol. Progress for CFC-12 was notable in the aerosol and commercial refrigeration industries and the flexible and rigid foam industry. Amounts of other *ODS* (e.g. halons, methyl chloroform and carbon tetrachloride) also exhibited a downward trend over the same period.

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A *draft national regulatory framework* to establish mechanisms for protection of the ozone layer and assessment of the effects of its deterioration is still being discussed in Congress, as is a bill to prohibit *imports of ODS*. The fact that Chile does not view itself as a key source of ODS may account for this situation. Without a regulatory framework and adequate subsidies, Chile is unlikely to be able to meet the phase-out targets for 2005. Given Chile's high vulnerability to ozone layer depletion, efforts should be made to improve *public awareness* of its impact on human health and the environment. The country should also seek out all regional and multilateral opportunities to strengthen *global implementation* of the convention and protocol.

3.3 Framework Convention on Climate Change (signed 1992, ratified 1995) and Kyoto Protocol (signed 1998, ratified 2002)

In 1996, Chile established a National Advisory Committee for Global Change, which prepared the country's first national communication to the UNFCCC Secretariat (February 2000). This involved developing a *national inventory* of greenhouse gas (GHG) emissions and identifying *mitigation options* as well as vulnerability and *adaptation measures* (Table 8.1). The inventory was updated for 2001 for the energy sector only (Table 8.2). Chile recognises its vulnerability to climate change, given its low-lying coasts; arid and semiarid zones; areas exposed to drought, desertification and forestry deterioration; and urban areas with high pollution. There are concerns about the links between climate change and the El Niño Southern Oscillation, and related impacts on atmospheric and oceanic conditions in and around Chile.

A second national communication, in preparation since 2000, includes an estimate of national GHG emissions over 1984-98. Its submission to the UNFCCC Secretariat is pending. Meanwhile, CONAMA has made available data on the estimated GHG emissions and energy consumption (Table 8.3). Over the 1990s, as Chile's economy rapidly expanded, its *CO_2 emissions and energy consumption nearly doubled*. These trends underscore the need for Chile to develop a balanced *national climate change strategy* and emission mitigation schedule, strengthen its *energy efficiency and emission mitigation policies* and continue efforts to use *cleaner fuels* in power generation and to promote renewable energy sources. Chile has plans for the evaluation of potential climate change effects and identification of adaptation measures. However, it is not sure that GHG and air emission concerns have been fully integrated in recent developments and plans to influence Chile's energy outlook (Box 2.3).

The government has actively promoted and endorsed the participation of Chilean project developers in the Clean Development Mechanism and the international market for GHG reduction credits. CONAMA and Chile's economic development and export promotion agencies, CORFO and ProChile, along with the Federation of Chilean

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Table 8.1 **GHG emissions inventory,**[a] 1994

(Gg)

	CO_2	CH_4	N_2O	CO	NO_x	NMVOCs	SO_2
Energy sector							
Fuel combustion	35 227.0	74.2	1.8	885.3	162.1	147.5	153.0
Industrial processes	1 870.0	2.1	0.8	11.0	3.7	7.8	1 815.1
Solvent use	0.0	0.0	0.0	0.0	0.0	28.4	0.0
Subtotal for energy sector	37 097.0	76.3	2.6	896.3	165.8	253.7	1 968.1
Other sectors							
Agriculture	0.0	321.8	20.6	50.4	2.9	2.6	–
Land use change and forestry	–29 709.3	111.3	0.8	974.2	27.7	50.6	–
Waste management	0.0	84.0	0.7	0.0	0.0		
Subtotal for other sectors	–29 709.3	517.1	22.1	1 024.6	30.6	53.2	–
Total	7 387.3	593.4	24.7	1 920.9	196.4	306.9	1 968.1

a) All sectors.
Source: CONAMA.

Table 8.2 **GHG emissions inventory in energy sector,** 2001

(Gg)

	CO_2	CH_4	N_2O	CO	NO_x	NMVOCs	SO_2
Fuel combustion	56 067	123	2	1 533	320	257	205
Industrial processes	4 224	6	0	15	3	27	614
Solvent use	0	0	0			29	0
International bunkers	–2 110			–7	–10	–1	–4
Total	58 281	129	2	1 541	313	312	815

Source: CONAMA.

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Industry, have undertaken activities to that end since 2002. Several GHG emission reduction projects have produced credits sold in the international market. The Chacabuquito power plant project was one of the first GHG reduction projects funded by the World Bank's *Prototype Carbon Fund*.

Table 8.3 **CO_2 emissions and energy consumption**, 1990-2001

	1990	1994	1998	2001
CO_2 emissions by end use (000 Gg)				
Energy sector (power generation)	10.8	9.7	17.6	20.2
Manufacturing and construction	7.2	9.0	11.9	11.6
Transport	9.0	12.3	16.3	19.1
Commercial, institutional and residential	2.9	4.0	3.7	4.1
Agriculture and fishing	0.5	0.7	0.8	0.8
Total CO_2 emissions	30.7	35.9	50.4	56.0
Energy consumption ('000 TJ)				
Energy sector (power generation)	129.7	114.7	215.0	301.6
Manufacturing and construction	87.3	108.9	149.7	150.4
Transport	124.8	170.3	225.0	266.9
Commercial, institutional and residential	45.0	60.6	57.2	66.4
Agriculture and fishing	6.8	9.9	10.5	10.4
Total energy consumption	393.8	464.6	657.7	795.9
Ratios of CO_2 emissions to energy consumption (Gg/TJ)				
Energy sector (power generation)	0.084	0.085	0.082	0.067
Manufacturing and construction	0.083	0.083	0.080	0.077
Transport	0.073	0.073	0.073	0.072
Commercial, institutional and residential	0.067	0.067	0.065	0.063
Agriculture and fishing	0.080	0.079	0.077	0.085
Total[a]	0.078	0.077	0.077	0.070

a) Ratio of total CO_2 emissions to total energy consumption.
Source: CONAMA.

3.4 Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (signed 1990, ratified 1992)

After ratifying the Basel Convention in 1992 Chile adopted a policy of not accepting imports of hazardous waste. Congress has *not yet approved legislation* prohibiting the entry of hazardous waste into Chile, however, and is still considering a health regulation on the handling of hazardous waste. Approval of the legislation is

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said to be overdue, as Chile does not have the capacity to treat or dispose of hazardous waste. The Ministry of Health is the key authority for implementation of the convention. Co-ordination among it, CONAMA and the Customs Service is crucial for *effective implementation*. In the context of Basel negotiations, Chile supports the Ban Amendment and the Protocol on Liability and Compensation.

3.5 Convention on Persistent Organic Pollutants (signed 2001) and Convention on Prior Informed Consent (signed 1998)

The Stockholm and Rotterdam conventions have been signed but *await approval by Congress*. The Ministries of Agriculture and Health regulate persistent organic pollutants (POPs). Despite prohibitions adopted in the 80s, high levels of residues of these pesticides continue to exist, and some observers believe the substances are still being used. In 1990 DDT and lindane were detected in all samples of breast milk collected. Chile is one of 12 countries participating in a UNEP/GEF project to develop national management plans for POPs. The PRTR now being developed could help monitor international transfers of controlled chemicals. Chile has a National Programme for the Control and Safe Management of Chemicals, and CONAMA is working on a safe management policy and on an inventory of sites with the potential for accidents and emergencies. New activities involving toxic or other chemicals must undergo EIA.

3.6 Convention to Combat Desertification (signed 1994, ratified 1998)

With 63% of its territory *affected by desertification and erosion*, Chile has a direct interest in this convention, but nevertheless remained a non-party for four years. The main regions affected are in the north, in areas where rural poverty is widespread. The National Forestry Corporation (CONAF) is the key focal point for the convention and is responsible for implementing the National Action Programme against the Desertification of Chile, which CONAMA approved in 1997. The programme closely integrates deforestation and biodiversity issues. It includes measures and subsidies to mitigate and/or control desertification through forest recovery in rural areas prone to erosion, along with appropriate irrigation and agricultural practices.

4. Bilateral and Regional Issues

As mainland Chile is surrounded by the Pacific Ocean and the Andes, it has limited environmental interdependencies with neighbouring countries. It has taken a proactive stance in engaging neighbouring countries in environmental agreements both bilaterally and regionally, particularly since 1990.

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4.1 Bilateral co-operation

Chile shares with Argentina a border of about 4 000 km. In 1990 the two countries signed the Treaty of Peace, Friendship and Physical Integration. It established a high-level bilateral commission with a *sub-commission on the environment*, which meets annually and is co-ordinated by the Foreign Ministries. Other agreements include the Chile-Argentina Convention to Combat Forest Fires (1961) and the Chile-Argentina Environment Treaty (1991), with protocols on shared water resources (1991), protection of the Antarctic environment (1991), forest issues (1997) and flora and fauna (2002), all implemented by specialised national agencies.

Following the 1879-84 war in which the Atacama coastal region of Bolivia became part of Chile, Chile and *Bolivia* signed a peace treaty in 1904, granting Bolivia preferential access rights to the Chilean ports of Arica and Antofagasta. The terms of the treaty prevent Chilean authorities from applying Chilean environmental law to Bolivian shipments. This *complicates enforcement of trade-related MEAs* (notably the Montreal Protocol, the Basel Convention, CITES and the Stockholm and Rotterdam conventions). Chile and Bolivia work together in a border committee and efforts are under way to develop a bilateral framework for shared implementation of MEA commitments in the two Chilean ports.

With *Peru*, Chile has signed the Technical Cooperation Convention on South American Camelidae (1994) and the Bilateral Consultation Mechanism on Fishing and Ocean Rights (2003).

With *Ecuador*, Chile has signed the Convention for Cooperation and Exchange on Fishing (2002).

4.2 Regional co-operation

Along with Argentina, Bolivia, Ecuador and Peru, Chile signed the *Subregional Action Programme to Combat Desertification* (Puna, 2001) involving co-ordinated national action plans within the framework of the UN Convention to Combat Desertification.

With Colombia, Ecuador, Panama and Peru, Chile signed the *Action Plan and Convention for the Protection of the Southeast Pacific Marine Environment and Coastal Areas* (1981) and its Protocol for the Protection of the Southeast Pacific against Pollution from Land-based Sources (1983). Actions to date include capacity building and research activities on ocean pollution; publications on the state of the marine and coastal environment (2000) and on the activities exerting pressure on it (1999); preparation of a GEF project for preventing, reducing and controlling

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pollution in the East Equatorial Pacific; creation of a protected marine and coastal area in Easter Island (1999); and establishment of a protected marine area and park around Carlos III Island in Magallanes Region XII (2003).

Argentina, Bolivia, Chile, Ecuador and Peru have been remarkably successful in their regional co-operation under the *Convention on Vicuñas* (Lima, 1979). Actions under this convention have gone a long way towards restoring vicuña populations. As a result, this species, formerly endangered, now has populations sizable enough for commercial exploitation in Region I. CONAF implements the convention in Chile through a national action plan.

4.3 Maritime issues

Despite the modest size of its fleet, Chile is a *significant player in the maritime industry*, with 6 000 km of coastline, 30% of its GDP dependent on trade and 90% of its international trade going through its ports. Its liberal maritime transport regime is widely recognised. Chile is a member of the WTO and the International Maritime Organization (IMO). It ranks 35th in the world in terms of deadweight tonnage, and handles 1.2 million container movements per year.

Concerning *marine pollution*, Chile has ratified the marine pollution IMO agreements (MARPOL, 1973/78) and the International Convention on Oil Pollution Preparedness, Response and Co-operation (1990) (Box 8.2). Between 1970 and 1990, four major tanker accidents affected Chile: Napier (1973, 35 000 tonnes), Metula (1974, 52 000 tonnes), Cabo Tamar (1978, 8 000 tonnes) and Cabo Pilar (1987, 5 000 tonnes). Since 1990 the amounts released have significantly decreased (Table 8.4).

In 1997 Chile signed the UN Convention on *Law of the Sea* (1982). In compliance, Chile has initiated consultation with countries operating on the high seas and established annual consultation mechanisms on *fishing activities* with Argentina and Peru (through border committees) and Ecuador (through a co-operation agreement). Chile also signed and ratified the Galapagos Agreement, aimed at protecting marine ecosystems in the south-eastern Pacific. The US and Chilean fishing authorities have signed a memorandum of understanding to develop information exchange on activities such as regulation, integrated management, sustainable approaches to exploitation of marine resources and protection of internationally significant marine species. Internationally, Chile has advocated adoption of regulations and principles compatible with the sustainable use of marine resources. Among these are three measures administered by the UN Food and Agriculture Organization (FAO): the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the

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Box 8.2 **Marine pollution and accidents: monitoring, prevention and response**

Since 1989 Chile's Maritime Authority has operated the Observation Plan for the Coastal Environment (POAL) to *monitor pollutant concentrations* and environmental quality trends in coastal waters. POAL covers *37 water bodies* in which 20 water, sediment and biota parameters are measured twice a year. The plan generates information enabling Chile to establish and enforce environmental quality standards for certain economic activities that affect environmental and water quality in coastal areas. It also covers *394 land–based sources of marine pollution*, which are subject to sanctions and corrective measures if monitoring results so indicate. The principal land-based sources are the *aquaculture industry* and *waste water treatment plants*. Expenditure to date on POAL is USD 1.65 million.

The Maritime Authority has in addition spent some USD 4 million to upgrade its *equipment and response capacity* for oil spills, including a 10% annual repositioning of equipment. It implements a *national contingency plan* through five pollution combat centres. The plan includes sub-plans on port contingency facilities and vessel emergency, all in line with IMO directives and guidelines ratified by Chile. The effort has also included improvement of shipping routes and maritime signalling, and an increase in preventive measures such as *port state control* (75% of inspections conforming to the Tokyo memorandum of understanding). These and other efforts have reduced the quantity of oil released in accidents in Chile (Table 8.4).

Table 8.4 **Oil spill accidents,** 1990-2003

(tonnes)

1990	17.2
1991	191.1
1992	10.1
1993	32.4
1994	30.6
1995	110.2
1996	9.8
1997	40.3
1998	63.7
1999	97.3
2000	543.9
2001	477.5
2002	41.5
2003	24.1

Source: DIRECTEMAR.

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High Seas (in force since 2003), the FAO Code of Conduct for Responsible Fisheries and the International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing. Chile is preparing a *national action plan* to contribute to implementation of the International Plan of Action. The country's fishing policy incorporates conservation and management measures aimed at conserving live marine resources within its exclusive economic zone and on the high seas. Chile has taken actions aimed at *recovery of collapsed fish populations*, with varying degrees of success.

Chile participates in the International *Whaling* Commission established under the Convention for the Regulation of Whaling, which it ratified in 1979. In 1995 Chile declared a 30-year ban on whaling in its waters, issuing a list of protected resources that includes whales and other native cetaceans. In 2003 the country established an Advisory Working Group on Whales with members from the public and private sector.

4.4 Antarctic affairs

Chile is a member of the *Antarctic Treaty System* (in force since 1961) and participates actively in the associated international instruments establishing the parameters for regulation of activities in Antarctica. It is one of seven signatories making territorial claims on Antarctica (the others are Argentina, Australia, France, Norway, New Zealand and the United Kingdom). Chilean claims overlap with those of Argentina and the UK.

As a signatory to the Protocol to the Antarctic Environmental Protection Treaty (Madrid, 1991; in effect since 1998), Chile has committed to the global protection for *Antarctica as a nature reserve devoted to scientific and non-military uses*, and meets annually with other parties in the Environmental Protection Committee before the Consultative Meeting of the Antarctic Treaty System. Environmental issues include environmental management at scientific stations, pressures from tourism, climate change effects and risks of maritime accidents.

Chile has pursued several *scientific co-operation efforts* on Antarctic affairs. For example, the Antarctic Presidential Declarations of 1999 and 2003 support Argentine-Chilean research on the protection of Antarctic ecosystems and the effects of climate change and ozone depletion in Patagonia and Antarctica. Chile and Peru have an agreement on scientific and technological co-operation in Antarctica, and Chile is also involved in a co-operation agreement for medical auditing and assistance in Antarctica, along with the European Union and German, Italian and Argentine institutions.

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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 Web sites

I.A: SELECTED ENVIRONMENTAL DATA (1)

		CHL	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK
LAND													
Total area (1000 km^2)		**739**	9971	1958	9629	378	99	7713	270	84	31	79	43
Major protected areas (% of total area)	*2*	**19.9**	8.7	9.2	25.1	17.0	7.1	18.5	32.4	28.0	3.4	15.8	11.1
Nitrogenous fertiliser use (t/km^2 of arable land)		**12.0**	4.0	4.3	6.1	9.6	19.2	1.9	57.2	8.0	17.8	8.7	8.8
Pesticide use (t/km^2 of arable land)		**0.46**	0.10	0.14	0.18	1.36	1.47	0.07	0.63	0.21	1.11	0.14	0.13
FOREST													
Forest area (% of land area)		**38.8**	45.3	33.9	32.6	68.9	63.8	21.4	34.7	41.6	22.4	34.1	12.7
Use of forest resources (harvest/growth)		**..**	0.4	0.2	0.6	0.4	0.1	0.6	..	0.7	0.9	0.7	0.7
Tropical wood imports (USD/cap.)	*3*	**..**	1.6	0.2	2.2	10.7	6.1	4.0	3.4	0.4	24.2	0.3	3.8
THREATENED SPECIES													
Mammals (% of species known)		**16.8**	33.7	33.2	15.9	24.0	17.0	27.0	15.2	22.0	26.5	18.9	22.0
Birds (% of species known)		**10.1**	13.6	16.9	8.4	12.9	14.1	13.0	25.3	26.0	12.8	49.5	14.5
Fish (% of species known)		**93.2**	7.6	23.7	4.4	25.3	1.3	0.8	0.8	41.7	51.2	40.0	15.8
WATER													
Water withdrawal (% of gross annual availability)		**1.9**	1.5	15.5	19.2	20.3	35.6	6.2	..	4.2	45.1	11.9	4.4
Public waste water treatment (% of population served)		**66**	72	25	71	64	70	..	80	86	38	70	89
Fish catches (% of world catches)		**4.1**	1.1	1.5	5.4	5.1	2.2	0.2	0.6	-	-	-	1.6
AIR													
Emissions of sulphur oxides (kg/cap.)		**52.8**	76.3	12.2	49.4	6.7	20.4	142.6	17.2	4.5	14.7	22.2	4.5
(kg/1000 USD GDP)	*4*	**6.1**	2.7	1.6	1.5	0.3	1.6	5.7	0.9	0.2	0.6	1.5	0.2
% change (1990-early 2000s)		**-64**	-27	..	-31	-14	-41	71	10	-55	-57	-88	-86
Emissions of nitrogen oxides (kg/cap.)		**19.0**	78.4	12.0	63.9	15.8	24.4	86.0	51.8	24.8	28.1	32.3	35.5
(kg/1000 USD GDP)	*4*	**2.2**	2.8	1.6	2.0	0.6	1.9	3.4	2.7	1.0	1.1	2.2	1.4
% change (1990-early 2000s)		**100**	-6	18	-19	-2	23	20	48	-3	-20	-40	-31
Emissions of carbon dioxide (t./cap.)	*5*	**3.0**	16.2	3.8	19.8	9.2	9.9	17.0	8.4	8.4	11.0	11.8	9.5
(t./1000 USD GDP)	*4*	**0.34**	0.58	0.47	0.62	0.37	0.66	0.68	0.43	0.33	0.44	0.85	0.36
% change (1990-2002)		**52**	20	28	18	12	99	28	42	16	7	-20	3
WASTE GENERATED													
Industrial waste (kg/1000 USD GDP)	*4, 6*	**20**	..	50	..	40	60	..	10	80	60	60	20
Municipal waste (kg/cap.)	*7*	**360**	350	320	730	410	380	690	400	510	480	280	660
Nuclear waste (t./Mtoe of TPES)	*8*	**-**	4.9	0.1	0.9	1.8	2.8	-	-	-	1.9	0.9	-

.. 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) IUCN management categories I-VI and protected areas without IUCN category assignment; national classifications may differ.

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.

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OECD EPR / SECOND CYCLE

FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD*	OECD*
338	549	357	132	93	103	70	301	3	42	324	313	92	49	506	450	41	779	245	35042
9.1	13.3	31.5	5.2	8.9	9.5	1.2	19.0	17.1	18.9	6.4	29.0	8.5	25.2	9.5	9.5	28.7	4.3	30.1	16.4
6.3	12.3	14.9	6.6	7.6	7.9	33.4	8.1	x	27.3	11.4	5.8	4.1	5.6	6.0	7.0	12.1	4.6	20.0	6.3
0.06	0.44	0.25	0.31	0.17	-	0.20	0.79	0.67	0.77	0.09	0.07	0.63	0.25	0.23	0.06	0.35	0.09	*0.58*	*0.21*
75.5	31.6	30.2	22.8	19.5	1.3	9.4	23.3	34.5	9.5	39.2	30.0	36.9	41.6	33.3	73.5	30.8	27.0	11.6	34.4
0.7	0.6	0.5	0.6	0.5	-	0.7	0.5	0.5	0.6	0.5	0.6	0.8	0.5	0.5	0.7	0.8	0.5	0.6	0.6
1.4	6.8	1.8	2.8	0.1	2.8	11.2	7.1	-	15.6	3.6	0.3	17.6	0.1	6.2	2.2	0.6	0.5	2.7	4.0
11.9	19.0	41.8	36.4	71.1	-	6.5	40.7	51.6	15.6	3.4	15.7	17.7	22.2	26.3	22.4	33.8	22.2	*21.9*	..
13.3	19.2	29.2	13.0	18.8	42.7	21.8	18.4	50.0	26.2	7.7	14.5	13.7	14.4	25.5	19.1	42.6	6.7	*14.2*	..
11.8	7.6	31.3	24.3	32.1	-	33.3	29.0	27.9	31.1	-	14.5	22.9	24.1	52.9	16.4	44.7	9.9	*11.1*	..
2.1	17.5	20.2	12.1	4.7	0.1	..	32.1	3.7	9.9	0.7	18.6	15.1	1.4	34.7	1.5	4.8	17.0	*20.8*	*11.5*
81	79	93	56	32	33	73	63	95	98	73	55	42	53	55	86	96	17	*95*	*64*
0.2	0.7	0.2	0.1	-	2.1	0.4	0.3	-	0.6	2.9	0.2	0.2	-	1.2	0.3	-	0.6	0.8	28.6
16.4	9.0	7.4	46.2	35.3	35.0	24.5	11.5	6.8	5.3	4.9	38.1	28.4	19.0	37.4	6.5	2.6	31.3	16.6	28.4
0.7	0.4	0.3	3.0	3.0	1.3	0.8	0.5	0.2	0.2	0.2	4.1	1.7	1.6	2.0	0.3	0.1	5.0	0.8	1.3
-64	-60	-89	4	-64	22	-48	-63	-80	-58	-58	-55	-9	-81	-29	-45	-58	33	-73	-40
40.5	22.7	17.2	28.9	17.7	90.5	31.0	21.8	38.3	26.6	46.9	20.8	27.8	19.0	34.8	27.1	12.4	14.1	26.3	34.3
1.7	1.0	0.7	1.8	1.5	3.4	1.0	1.0	0.9	1.1	1.7	2.2	1.7	1.6	1.9	1.1	0.5	2.3	1.2	1.5
-32	-29	-48	11	-24	-2	5	-34	-27	-28	-5	-38	13	-53	14	-25	-46	48	-43	-17
12.6	6.2	10.3	8.0	5.5	7.7	10.8	7.4	20.9	10.9	7.8	7.6	6.1	7.2	7.4	5.8	5.9	2.8	8.8	11.0
0.52	0.26	0.44	0.51	0.46	0.29	0.36	0.33	0.48	0.44	0.28	0.82	0.37	0.62	0.40	0.23	0.21	0.46	0.40	0.50
22	1	-12	27	-17	11	32	8	-11	13	25	-17	58	-30	43	6	-	40	-7	13
140	70	20	50	20	2	60	30	130	50	30	160	80	40	30	100	10	30	30	60
480	540	590	420	460	730	700	510	650	620	620	270	440	320	650	470	660	370	580	550
1.9	4.3	1.2	-	1.8	-	-	-	-	0.2	-	-	-	3.2	1.1	4.5	2.4	-	5.1	1.6

UKD: pesticides and threatened species: Great Britain; water withdrawal and public waste water treatment plants: England and Wales.

5) CO_2 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.

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I.B: SELECTED ECONOMIC DATA (1)

		CHL	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE
GROSS DOMESTIC PRODUCT												
GDP, 2003 (billion USD at 1995 prices and PPPs)		**140**	897	836	9487	3202	755	507	79	203	261	147
% change (1990-2003)		**103.5**	42.6	44.9	44.2	17.5	109.5	54.1	45.0	30.3	27.3	9.6
per capita, 2003 (1000 USD/cap.)		**8.9**	28.4	8.1	32.6	25.1	15.8	25.5	19.7	25.2	25.2	14.4
Exports, 2003 (% of GDP)		**34.5**	37.8	28.4	9.5	11.8	38.1	18.1	29.8	51.8	82.1	66.0
INDUSTRY	*2*											
Value added in industry (% of GDP)		**34**	32	27	23	31	43	26	25	32	27	40
Industrial production: % change (1990-2002)		**..**	37.3	42.5	42.6	-7.7	152.4	30.3	24.4	46.6	14.1	-11.1
AGRICULTURE												
Value added in agriculture (% of GDP)	*3*	**9**	3	4	2	1	4	4	7	2	1	4
Agricultural production: % change (1990-2002)		**41.4**	9.7	34.7	18.5	-9.8	32.7	10.7	35.2	6.5	20.2	..
Livestock population, 2003 (million head of sheep eq.)		**40**	108	281	786	54	27	272	99	17	27	13
ENERGY												
Total supply, 2002 (Mtoe)		**25**	250	157	2290	517	203	113	18	30	57	42
% change (1990-2002)		**81.3**	19.6	26.8	18.8	15.9	119.6	28.8	29.5	20.5	16.8	-11.9
Energy intensity, 2002 (toe/1000 USD GDP)		**0.18**	0.29	0.19	0.25	0.16	0.28	0.23	0.24	0.15	0.22	0.29
% change (1990-2002)		**-8.0**	-13.8	-10.2	-15.6	-0.3	10.3	-13.8	-8.1	-6.5	-7.0	-17.2
Structure of energy supply, 2002 (%)	*4*											
Solid fuels		**11.0**	11.7	4.8	23.7	19.3	22.6	43.4	6.9	11.9	11.9	48.0
Oil		**38.4**	34.1	59.6	39.3	49.4	50.1	30.8	34.9	43.6	40.7	20.0
Gas		**25.1**	29.9	24.5	23.5	12.8	10.4	18.3	28.1	21.8	23.8	18.2
Nuclear		**-**	7.8	1.6	9.2	14.9	15.3	-	-	-	21.9	11.4
Hydro, etc.		**25.4**	16.5	9.5	4.3	3.5	1.6	7.5	30.1	22.8	1.7	2.4
ROAD TRANSPORT	*5*											
Road traffic volumes per capita, 2002 (1000 veh.-km/cap.)		**..**	10.1	0.7	15.9	6.2	2.3	9.8	10.7	8.3	8.8	4.4
Road vehicle stock, 2002 (10 000 vehicles)		**210**	1891	1953	23457	7226	1395	1280	265	542	539	402
% change (1990-2002)		**..**	14.2	97.7	24.2	27.9	310.9	30.9	43.6	46.8	26.5	54.9
per capita (veh./100 inh.)		**14**	60	19	81	57	29	65	67	67	52	39

.. 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.

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OECD EPR / SECOND CYCLE

DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
143	128	1434	1932	178	125	8	121	1310	19	403	127	364	169	64	770	224	201	431	1347	25873
31.9	27.8	25.5	22.3	41.1	19.4	34.8	132.4	21.1	71.2	36.3	49.3	49.7	35.0	27.4	39.1	27.0	10.7	45.3	33.6	35.6
26.6	24.5	24.0	23.4	16.1	12.3	26.8	30.6	22.6	42.9	24.8	27.9	9.5	16.2	11.9	18.4	25.0	27.3	6.1	22.3	22.4
43.5	37.0	25.9	35.7	20.2	61.8	35.3	82.9	25.4	142.5	61.3	41.2	33.9	30.7	78.0	27.9	43.9	43.7	27.4	25.1	21.9
27	32	25	30	23	31	27	42	29	20	26	38	30	29	32	30	28	27	31	26	29
35.8	68.5	18.0	12.7	14.6	67.8	..	284.4	12.6	30.1	20.3	40.7	66.6	22.3	8.1	21.5	36.2	19.1	52.6	6.2	24.0
3	4	3	1	7	4	9	3	3	1	3	2	3	4	5	3	2	1	12	1	3
2.2	-9.9	5.4	-5.9	13.6	-22.6	9.5	4.1	5.3	x	-4.9	-14.3	-14.3	0.7	..	15.0	-10.4	-6.0	12.9	-7.9	..
25	8	157	121	20	13	1	53	67	x	42	7	57	19	5	98	13	12	111	114	2630
20	36	266	346	29	25	3	15	173	4	78	27	89	26	19	132	51	27	75	227	5346
12.3	22.1	17.0	-2.8	30.9	-10.9	56.7	44.7	13.2	13.2	17.2	23.4	-10.7	48.7	-13.4	44.2	9.4	8.1	42.3	6.8	18.1
0.14	0.28	0.19	0.18	0.17	0.21	0.45	0.13	0.13	0.21	0.19	0.21	0.25	0.16	0.30	0.17	0.23	0.14	0.18	0.17	0.21
-13.4	-2.4	-5.7	-20.2	-4.0	-23.0	18.6	-35.7	-5.5	-33.7	-13.5	-16.5	-39.0	10.5	-29.6	5.9	-12.5	-1.8	0.4	-18.4	-11.2
21.0	19.0	4.9	24.7	31.2	14.4	2.8	16.8	8.2	2.5	11.0	3.0	61.2	13.3	22.4	16.5	5.7	0.5	26.3	15.8	20.5
42.8	30.4	33.5	37.3	57.6	25.9	24.9	57.2	51.9	67.9	38.9	28.6	22.4	62.5	17.3	51.3	29.7	47.1	40.6	34.8	40.5
23.2	10.6	13.8	21.9	6.3	43.1	-	24.1	34.3	28.1	46.8	22.5	11.3	10.4	31.0	14.3	1.6	9.0	19.6	37.9	21.9
-	16.8	41.8	12.4	-	14.6	-	-	-	-	1.3	-	-	-	25.0	12.5	35.1	25.9	-	10.2	11.1
13.0	23.2	6.1	3.7	5.0	2.1	72.3	1.9	5.7	1.5	1.9	46.0	5.2	13.9	4.2	5.4	28.1	17.5	13.4	1.3	5.9
9.0	9.4	8.7	7.2	7.5	2.3	10.4	8.5	8.3	9.0	7.1	7.5	3.6	6.3	2.4	4.5	8.6	7.9	0.8	8.0	8.2
246	254	3514	4728	480	314	18	171	3768	34	778	237	1328	514	148	2288	447	401	624	3135	62375
26.8	13.7	23.5	26.7	90.3	..	37.1	79.9	26.0	55.8	35.9	21.7	107.5	133.8	50.3	58.4	13.8	23.3	164.3	24.3	32.8
46	49	59	57	44	31	64	44	65	77	48	52	35	49	27	56	50	55	9	52	54

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.

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I.C: SELECTED SOCIAL DATA (1)

		CHL	CAN	MEX	USA	JPN	KOR	AUS	NZL	AUT	BEL	CZE
POPULATION												
Total population, 2003 (100 000 inh.)		**158**	316	1027	2910	1276	479	199	40	81	104	102
% change (1990-2003)		**20.4**	14.2	26.4	16.4	3.4	11.8	16.5	19.2	4.5	4.1	-1.5
Population density, 2003 (inh./km^2)		**21.3**	3.2	52.5	30.2	337.8	482.8	2.6	14.8	96.2	339.8	129.4
Ageing index, 2003 (over 64/under 15)		**..**	70.2	18.8	59.1	135.8	40.8	64.0	54.0	93.7	97.2	90.4
HEALTH												
Women life expectancy at birth, 2002 (years)		**..**	82.2	77.4	79.8	85.2	80.0	82.6	80.9	81.7	81.1	78.7
Infant mortality, 2002 (deaths /1 000 live births)		**8.3**	5.2	20.1	6.8	3.0	6.2	5.0	6.3	4.1	4.9	4.2
Expenditure, 2002 (% of GDP)		**7.0**	9.6	6.1	14.6	7.8	5.9	9.1	8.5	7.7	9.1	7.4
INCOME AND POVERTY												
GDP per capita, 2003 (1000 USD/cap.)		**8.9**	28.4	8.1	32.6	25.1	15.8	25.5	19.7	25.2	25.2	14.4
Poverty (% pop. < 50% median income)		**..**	10.3	21.9	17.0	8.1	..	9.3	..	7.4	7.8	..
Inequality (Gini levels)	*2*	**57.0**	28.5	52.6	34.4	26.0	..	30.5	25.6	26.1	27.2	..
Minimum to median wages, 2000	*3*	**x**	42.5	21.1	36.4	32.7	25.2	57.7	46.3	x	49.2	32.3
EMPLOYMENT												
Unemployment rate, 2003 (% of total labour force)		**8.5**	7.6	3.3	6.0	5.3	3.4	5.9	4.7	5.7	8.1	7.8
Labour force participation rate, 2003 (% 15-64 year-olds)		**..**	79.4	55.5	76.0	77.5	66.9	76.1	76.5	78.8	66.9	70.9
Employment in agriculture, 2003 (%)	*4*	**14.0**	2.8	16.3	1.7	4.6	8.8	4.0	8.2	5.6	2.2	4.5
EDUCATION												
Education, 2002 (% 25-64 year-olds)	*5*	**47.2**	82.6	12.6	87.3	83.7	70.8	60.9	76.2	77.9	60.8	87.9
Expenditure, 2001 (% of GDP)	*6*	**7.5**	6.1	5.9	7.3	4.6	8.2	6.0	5.8	5.8	6.4	4.6
OFFICIAL DEVELOPMENT ASSISTANCE	*7*											
ODA, 2003 (% of GNI)		**..**	0.24	..	0.15	0.20	..	0.25	0.23	0.20	0.60	..
ODA, 2003 (USD/cap.)		**..**	64	..	56	70	..	61	41	63	179	..

.. 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.

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OECD EPR / SECOND CYCLE

DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SLO	ESP	SWE	CHE	TUR	UKD	OECD
54	52	598	825	110	101	3	40	581	5	162	46	382	104	54	419	90	73	707	605	11545
4.8	4.6	5.4	4.0	9.4	-2.4	13.5	12.8	2.4	17.5	8.5	7.6	0.2	5.8	1.5	7.8	4.7	9.4	25.9	5.1	10.8
125.0	15.4	108.8	231.1	83.6	108.8	2.8	56.2	192.8	174.6	390.7	14.1	122.2	113.6	109.7	82.8	19.9	177.9	90.7	247.0	32.9
79.1	87.2	87.1	126.6	111.9	94.5	51.5	53.0	126.2	74.6	74.2	74.1	73.4	102.0	62.2	116.3	95.8	98.9	19.0	82.3	68.5
79.5	81.5	82.9	81.3	80.7	76.7	82.3	80.3	82.9	81.5	80.7	81.5	78.7	80.5	77.8	83.1	82.1	83.0	71.0	80.4	..
4.4	3.0	4.1	4.3	5.9	7.2	2.2	5.1	4.7	5.1	5.0	3.9	7.5	5.0	7.6	3.4	2.8	4.5	38.3	5.3	..
8.8	7.3	9.7	10.9	9.5	7.8	9.9	7.3	8.5	6.2	9.1	9.1	6.1	9.3	5.7	7.6	9.2	11.2	6.6	7.7	..
26.6	24.5	24.0	23.4	16.1	12.3	26.8	30.6	22.6	42.9	24.8	27.9	9.5	16.2	11.9	18.4	25.0	27.3	6.1	22.3	22.4
5.0	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	..
21.7	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	x	60.8	x	51.3	37.2	x	55.8	x	48.9	47.1	x	35.5	38.2	..	31.8	x	x	..	41.7	..
5.6	9.1	9.7	8.7	9.5	5.9	3.3	4.7	8.8	3.8	3.5	4.5	19.6	6.4	17.4	11.3	4.9	4.0	10.5	5.0	7.1
80.3	74.4	70.2	75.9	64.8	60.1	86.1	69.9	61.7	67.0	67.2	80.2	62.9	76.0	69.8	69.0	76.5	87.6	51.8	76.2	71.1
3.1	5.1	3.6	2.5	16.5	5.5	7.3	6.4	4.9	1.3	3.0	3.7	18.4	12.7	5.8	5.7	2.1	4.1	33.9	1.2	6.2
80.0	74.8	64.8	83.0	50.5	71.4	59.0	60.3	44.4	56.6	66.5	86.3	47.0	20.4	85.9	41.3	81.6	82.4	25.2	64.3	64.9
7.1	5.8	6.0	5.3	4.1	5.2	6.7	4.5	5.3	3.6	4.9	6.4	5.2	5.9	4.1	4.9	6.5	5.7	3.5	5.5	5.6
0.84	0.35	0.41	0.28	0.21	..	..	0.39	0.17	0.81	0.80	0.92	..	0.22	..	0.23	0.79	0.39	..	0.34	0.25
325	107	121	82	33	..	..	127	42	429	245	447	..	31	..	47	268	177	..	104	79

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.

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II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE)

Y = in force S = signed R = ratified D = denounced

				CHL	CAN	MEX	USA
1946	Washington	Conv. - Regulation of whaling	Y	**R**	D	R	R
1956	Washington	Protocol	Y	**R**	D	R	R
1949	Geneva	Conv. - Road traffic	Y	**R**	R		R
1957	Brussels	Conv. - Limitation of the liability of owners of sea-going ships	Y		S		
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**		R	
1988	Vienna	Joint protocol relating to the application of the Vienna Convention and the Paris Convention	Y	**R**			
1997	Vienna	Protocol to amend the Vienna convention	Y				
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	R
1969	Brussels	Conv. - Civil liability for oil pollution damage (CLC)	Y	**R**	D	D	S
1976	London	Protocol	Y		R	R	
1992	London	Protocol	Y	**R**	R	R	
1970	Bern	Conv. - Transport of goods by rail (CIM)	Y				
1971	Brussels	Conv. - International fund for compensation for oil pollution damage (FUND)	Y		D	D	S
1976	London	Protocol	Y		R	R	
1992	London	Protocol (replaces the 1971 Convention)	Y		R	R	
2000	London	Amendment to protocol (limits of compensation)	Y		R	R	
2003	London	Protocol (supplementary fund)					
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
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	**R**			
1972	London, Mexico, Moscow, Washington	Conv. - Prevention of marine pollution by dumping of wastes and other matter (LC)	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

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OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	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	S	R	R	
D		D			D		D	D	D	D			R		S		D	D	R	R		R	D	R		D	
		R			R			S		S						R			R	R		R		R		D	
		R	S		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	
	S				S					S				S			R			R							
						R						R							R		R	S				S	
					S	R	R	R	S	R	R	R			R		R	R	R	S	R	S	R	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	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	S	R	R		R		R	R	R	R	S		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	
D	D	D	D		D		D	D	D	D	D		D	D	D	R	D	D	D	R		D	D	D		D	
R	R	R			R		R	R	R	R	R		R	D	R	R	R	R	R	R		R	R	R		D	
R	R	R	R		R		R	R	R	R	R		R	R	R		R	R	R	R		R	R	R	R	R	
				R	R	R	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	
D	D	D	D		D		D	D	D	D	D		D	D	D		D	D	D	R		D	D	D		D	
R		R			R		R	R	R	R	R		R	D	R		R	R	R	R		R	R			D	
R	R	R	R		R		R	R	R	R	R		R	R	R		R	R	R	R		R	R		R	R	
R	R	R	R		R		R	R	R	R	R		R	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			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		S		R	S	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	R			R	

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II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

Y = in force S = signed R = ratified D = denounced

				CHL	CAN	MEX	USA
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				
1976	London	Conv. - Limitation of liability for maritime claims (LLMC)	Y			R	
1996	London	Amendment to convention	Y		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
1978	London	Annex III	Y	**R**	R		R
1978	London	Annex IV	Y	**R**			
1978	London	Annex V	Y			R	R
1997	London	Annex VI	Y				S
1979	Bonn	Conv. - Conservation of migratory species of wild animals	Y	**R**			
1991	London	Agreem. - Conservation of bats in Europe	Y				
1992	New York	Agreem. - Conservation of small cetaceans of the Baltic and the North Seas (ASCOBANS)	Y				
1996	Monaco	Agreem. - Conservation of cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	Y				
1996	The Hague	Agreem. - Conservation of African-Eurasian migratory waterbirds	Y				
2001	Canberra	Agreem. - Conservation of albatrosses and petrels (ACAP)	Y	**S**			
1982	Montego Bay	Conv. - Law of the sea	Y	**R**	R	R	
1994	New York	Agreem. - relating to the implementation of part XI of the convention	Y	**R**	R	R	S
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
1983	Geneva	Agreem. - Tropical timber	Y		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**	R		R
1999	Beijing	Amendment to protocol	Y	**R**	R		R

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Y = in force S = signed R = ratified D = denounced

JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	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	S	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	R	R	R	R	
R					R	R	R	R	R	R		R	R	R	R			R		R	R		R	R			
R		R	R		R		D	D	R	D	R			R			R	R	R			R	D	R	R	R	
		R					R	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		R	R	R	R	R	R	R	R	R			R	R		R	R	R	R	R	R	R		R	
R	R	R	R	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
					S	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		R				
					S		R	R	R	R	S	R		R		R	R					R	R	R	R		R	S
		R	R						S														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	S		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	S		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			R	R	R	R	R		R		R	R	R		R	R
R	R	R	R	R	R		R	R	R	R	R			R	R	R	R	R		R		R	R	R		R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	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

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II.A: SELECTED MULTILATERAL AGREEMENTS (WORLDWIDE) (cont.)

Y = in force S = signed R = ratified D = denounced

				CHL	CAN	MEX	USA
1986	Vienna	Conv. - Early notification of a nuclear accident	Y	**S**	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	R	S
1995	Geneva	Amendment					
1999	Basel	Prot. - Liability and compensation for damage		**S**			
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
2000	London	Protocol - Pollution incidents by hazardous and noxious substances (OPRC-HNS)					
1992	Rio de Janeiro	Conv. - Biological diversity	Y	**R**	R	R	S
2000	Montreal	Prot. - Biosafety (Cartagena)	Y	**S**	S	R	
1992	New York	Conv. - Framework convention on climate change	Y	**R**	R	R	R
1997	Kyoto	Protocol	Y	**R**	R	R	S
1993	Paris	Conv. - Prohibition of the development, production, stockpiling and use of chemical weapons and their destruction	Y	**R**	R	R	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	Y	**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
1996	London	Conv. - Liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea (HNS)			S		
2000	London	Protocol - Pollution incidents by hazardous and noxious substances (OPRC-HNS)					
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		R
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)	Y	**S**	R		S
2001	London	Conv. - Civil liability for bunker oil pollution damage					
2001	London	Conv. - Control of harmful anti-fouling systems on ships					S
2001	Stockholm	Conv. - Persistent organic pollutants	Y	**S**	R	R	S

Source: IUCN; OECD.

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OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	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	S	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	S	S			S				S							S	S		S	
		R	R		R		R	S	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	
							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	R	R	R	R	R
R	S		S	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	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	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
							S	S		S							S	S					S			S	
							S	S	S	S	R						R		R				R				
		S				S									S												
R	R	R		R	R	R	R	R	R	R	R	R		R	S	R	R	R	R		R	R	R	R		R	
								R		S		R				S	R	R		S			R				
R	R	R	R	R	R	R	R	R	R	R	R	R			R	R	R	R		S		R	R	R	S	R	R
															S							R	S				
R		S					R	S										R	R			R	R				
R	S	R	R	R	S	R	R	R	R	R	S	S	R	S	S	R	R	R	S	R	R	R	R	R	S	S	S

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II.B: SELECTED MULTILATERAL AGREEMENTS (REGIONAL)

Y = in force S = signed R = ratified D = denounced

				CHL	CAN	MEX	USA
1940	Washington	Conv. - Nature protection and wild life preservation in the Western Hemisphere	Y	**R**		R	R
1959	Washington	Treaty - Antarctic	Y	**R**	R		R
1991	Madrid	Protocol to the Antarctic treaty (environmental protection)	Y	**R**	R		R
1964	Brussels	Agreem. - Measures for the conservation of Antarctic Fauna and Flora	Y				R
1967	Mexico	Treaty - Prohibition of nuclear weapons in Latin America	Y	**R**		R	
1972	London	Conv. - Conservation of Antarctic seals	Y	**R**	R		R
1979	Lima	Conv. - Conservation and management of the Vicuña	Y	**R**			
1980	Canberra	Conv. - Conservation of Antarctic marine living resources	Y	**R**	R		R
1981	Lima	Conv. - Protection of the marine environment and coastal areas of the South-East Pacific	Y	**R**			
1981	Lima	Agreem. - Regional co-operation in combating pollution by hydrocarbons or other harmful substances in cases of emergency	Y	**R**			
1983	Quito	Supplementary protocol to the agreement	Y	**R**			
1983	Quito	Prot. - Protection of the South-East Pacific against pollution from land-based sources	Y	**R**			
1989	Paipa	Prot. - Conservation and management of protected marine and coastal areas of the South-East Pacific	Y	**R**			
1989	Paipa	Protocol - Protection of the South-East Pacific against radioactive contamination	Y	**R**			
1992	Viña del Mar	Memorandum of understanding on port state control in Latin America	Y	**R**		R	
1993	Tokyo	Memorandum of understanding on port state control in the Asia-Pacific region	Y	**R**	R		
2000	Santiago	Agreem. - Conservation of living marine resources on the high seas of the south Pacific (the Galapagos agreement)		**S**			

Source: IUCN; OECD.

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OECD EPR / SECOND CYCLE

Y = in force S = signed R = ratified D = denounced

JPN	KOR	AUS	NZL	AUT	BEL	CZE	DNK	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ITA	LUX	NLD	NOR	POL	PRT	SVK	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	S	R	S	S	R	R	R	R	S			R		R	R	R		S	R	R	S		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																								

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Reference III

ABBREVIATIONS

APL	Clean production agreement
AUGE	Universal Access Plan
BATNEEC	Best available technologies not entailing excessive costs
CDM	Clean Development Mechanism
CEDRM	Commission for Decontamination of the Metropolitan Region
CFC	Chlorofluorocarbon
CNE	National Energy Commission
CNG	Compressed natural gas
CODELCO	National Copper Corporation
CONAF	National Forestry Corporation
CONAMA	National Environment Commission
COREMA	Regional Environment Commission
CORFO	National Economic Development Agency
CORMA	Chilean Timber Corporation
DGA	General Water Directorate
DIRECTEMAR	General Directorate of the Maritime Territory and Merchant Marine
EIA	Environmental impact assessment
EID	Environmental impact statement
ENAMI	National Mining Company
ENAP	State oil company
FAO	UN Food and Agriculture Organization
FSC	Forest Stewardship Council
FTA	Free trade agreement
GEF	Global Environment Facility
GHG	Greenhouse gas
IMO	International Maritime Organization
INE	National Statistics Institute
INFA	Environmental information programme
INFOR	Forest Institute
IUCN	International Union for Conservation of Nature and Natural Resources
MEA	Multilateral environmental agreement

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MIDEPLAN	Ministry of Planning and Co-operation
MIN	Ministry of Mining
MINVU	Ministry of Housing and Urban Development
NGO	Non governmental organisation
NMHC	Non-methane hydrocarbon
(NM)VOC	(Non-methane) volatile organic compound
ODS	Ozone depleting substance(s)
PEFC	Programme for the Endorsement of Forest Certification Schemes
POP	Persistent organic pollutant
PPDA	Air Pollution Prevention and Clean-up Plan (RM)
RAMA	Environmental Regulation for Aquaculture
RAPP	Network of Privately Protected Areas
SAG	Agriculture and Livestock Service
SEC	Superintendency of Electricity and Fuels
SEGPRES	Ministry General Secretariat of the Presidency
SEF	Socio-economic Evaluation Form
SEIA	Environmental Impact Assessment System
SERNAPESCA	National Fisheries Service
SESMA	Metropolitan Environmental Health Service
SINIA	National Environmental Information System
SISS	Superintendency of Sanitation Services
SMEs	Small and medium-sized enterprises
SNASPE	National system of State-protected wilderness areas
SUBPESCA	Undersecretariat for Fisheries
TAC	Total allowable catch
THC	Total hydrocarbons
TPES	Total primary energy supply
TSP	Total suspended particulates
UNFCCC	UN Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
WTO	World Trade Organization

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Reference IV

PHYSICAL CONTEXT

Chile *covers 756 950 km*^{2} in South America and Oceania (Easter Island). It has borders with Bolivia and Argentina to the east (861 kilometres and 5 150 kilometres, respectively) and Peru to the north (160 kilometres). Its Pacific Ocean coastline measures 6 435 kilometres. The distance from the northern border to the southern polar ice cap is around 4 300 kilometres and the country is 445 kilometres at its widest point.

The *terrain* is mountainous, with the Andes Mountains to the east covering 4 600 kilometres of Chilean territory and reaching their highest point at *Nevado Ojos del Salado* (6 880 metres). Coastal mountain ranges run from the far north to the south of the country. Between the Andes and the coastal ranges are a series of valleys. Many rivers flow from the Andes, cross the country through the valleys and empty into the Pacific Ocean. In the north is the *Atacama* Desert. The extremely diverse terrain of the far south, north of the Magellan Strait, includes channels, archipelagos, numerous small islands, gulfs and peninsulas, which hinder land transport. Parts of this area are ice-covered year-round, and icebergs calve off the *Campo de Hielo Sur*, which is more than 300 kilometres long. The country is subject to *natural hazards*, mainly earthquakes and floods.

Chile's length and altitude determine its *climate*. There are arid conditions in much of the north, a temperate Mediterranean climate in the centre and south and areas of heavy precipitation in the extreme south. Chile has a *wide range of vegetation zones*. In the north, vegetation consists of small bushes and scarce tree species. Central Chile's shrub and chaparral communities form extensive, varied bush land. The south has still richer vegetation: many indigenous species are concentrated near the coast and mountains, forming mixed forests benefiting from intense rainfall. The Humboldt Current in the southeast Pacific is also an important determinant of climate.

In central Chile the climate and river valleys are ideal for vineyards, and the fertile soil of the central valley encourages farming and, at higher altitudes, extensive forestry. The fjords in the far south provide excellent conditions for fishing and tourism. The Andes offer abundant, if irregular, water resources with considerable hydropower potential, particularly in the south. The extensive coastline features rich fishing grounds and a variety of other marine resources. *El Niño* episodes affect marine resources as well as climate.

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Natural resources include abundant mineral reserves in the north, particularly copper. Chile is the world's main copper producer, with around 45% of world copper reserves. Its output in 2003, 4.6 million tonnes, represented USD 7.5 billion in revenue. The reserves are mainly concentrated along the Andes. Chile is also the largest world producer of natural nitrate, iodine and lithium (it has virtually all of the world's mineral nitrate deposits, 62% of world reserves of mineral iodine and 12% of the lithium reserves) and a major exporter of molybdenum, among other minerals. Its main energy resource is hydropower from the Andean rivers. Since 1997 it has imported natural gas from Argentina. In 2000 natural gas imports reached 2.8 billion cubic metres.

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Reference V
SELECTED ENVIRONMENTAL WEB SITES

Web site	Host institution
www.gobiernodechile.cl	Government of Chile
www.presidencia.gob.cl	Presidency
www.conama.cl	National Environment Commission
www.sinia.cl	National Environmental Information System
www.e-seia.cl	Environmental Impact Assessment System
www.minagri.cl	Ministry of Agriculture
www.conaf.cl	National Forestry Corporation
www.minecom.cl	Ministry of Economy and Energy
www.subpesca.cl	Undersecretariat for Fisheries
www.cne.cl	National Energy Commission
www.pl.cl	Clean Production Council
www.eclac.org	UN Economic Commission for Latin America and the Caribbean

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