A REPORT ON

ENVIRONMENTAL ISSUES IN CHILE

PREPARED BY:

RAMIRO G. TRUCCO, Ph. D.
GILDA BELLOLIO, M. Sc.

JANUARY, 1991

A REPORT ON

ENVIRONMENTAL ISSUES IN CHILE

PREPARED BY:

RAMIRO G. TRUCCO, Ph. D.
GILDA BELLOLIO, M. Sc.

JANUARY, 1991

A REPORT ON

ENVIRONMENTAL ISSUES IN CHILE

PREPARED BY:

RAMIRO E. TRUCCO, Ph. D.
GILDA BELLUZZO, M. Sc.

JANUARY 1991

THIS DOCUMENT WAS PREPARED UNDER CONTRACT BY:

RAMIRO G. TRUCCO, Ph.D.
&
GILDA BELLOLIO, M.Sc.

January, 1991.

THIS DOCUMENT WAS PREPARED UNDER CONTRACT BY:

RAMIRO G. TRUCCO, Ph.D.
&
GILDA BELLOLIO, M.Sc.

January, 1991.

THE CONCLUSIONS CONTAINED HEREIN REPRESENT THE OPINION OF THE CONTRACTOR AND DO NOT NECESSARILY CONSTITUTE ENDORSEMENT BY THE COMMERCIAL DIVISION, CANADIAN EMBASSY IN CHILE.

CONTENTS

CONTENTS

ENVIRONMENTAL ISSUES IN CHILE

I.- GENERAL ASPECTS OF ENVIRONMENTAL ISSUES IN CHILE

I.1.- INTRODUCTION

For the last decade, Chile has been engaged in an industrialization process that has permited diversification of its economy from a mainly copper exporting nation to a country that exports a variety of resources and products. This submersion into a vigorous developmental growth has proven economically attractive to national as well as international businessworld. Nevertheless, the environmental dimension has not being included as a prerequisite for the acceptance of new projects or ongoing ones, consequently, environmental problems are emerging. Few of them are impossible to ignore, such as the atmospheric pollution of Santiago, the Chañaral coasts contamination with copper mine tailings, or the steel, petrochemical and fish industry wastes that pollute Talcahuano's water, but other are yet not perceived by the general public as an environmental hazard.

After the 1987 Brundtland Report, many developed nations have adopted the principle of a **sustainable development** that promotes the use of natural resources in such a way that not only present needs are fulfilled but also future generations will be able to benefit theirs. This concept is now being incorporated into many speeches of government authorities, as well as, of the productive sector. Although that environmental issues have not been a priority in government policies, several Chilean organizations have been interested and

ENVIRONMENTAL ISSUES IN CHILE

I.- GENERAL ASPECTS OF ENVIRONMENTAL ISSUES IN CHILE

I.1.- INTRODUCTION

involved in environmental problems, ie. CODEFF (National Committee for the Defense of Flora and Fauna) founded 20 years ago, ACHIDAM (Chilean association for the right to the environment), Comité de Ciencias Ambientales de CONICYT, and especially CIPMA (center of research and planning of the environment) created in 1980.

Environmental issues are becoming more and more important not only in the academia sector, but also in the government, the businessworld and the general public.

People are becoming aware of the potential damage both to their health and to their working sources if productive sectors do not incorporate the environmental dimension. The public awareness of the environmental issues can be perceived not only because of the increase of conservationist groups but also, because this was a topic included in all of the 1989 presidential candidate's political proposals. Also, in the main Chilean newspapers and TV channels environmental related articles and programs are common nowadays. "El Mercurio", a Santiago newspaper, has created a permanent once-a-week environmental column. A recent Gallup study (September, 1990) carried out in Santiago, showed that 27% of people interviewed considered pollution as important as Human Rights Affairs, or as important as the Persian Gulf situation. Neighborhood and other social organizations are interested in environmental problems and they are involved in the elaboration of proposal of solutions to their community problems. One of the proposal that had caught public attention is the installment of an environmental seal to products that are "evironmentally friendly". Two environmental legislative projects have been already presented to the Congress in 1990 by two groups of politicians.

The **private productive sector** is perceiving that Chilean exports in the near future will be tied to environmental constraints imposed by the international community. The recent restriction by the European

Community on imports of indigineous tropical wood is seen as a clear signal that the international community will take measures to preserve biological diversity on a worldwide basis. The productive sector is actively participating in seminars and workshops to discuss with other sectors of the economy (academia and government) environmental policies. They are also, providing financial assistance to several environmental projects and supporting environmental organizations such as CIPMA.

The **academia**, because of its professional formation, will always be interested and involved in environmental projects. About 180 projects in diverse areas related to environment were submitted for 1991 financial assistance to MIDEPLAN(Ministry of Planning). At least 10 conferences or seminars have been held in Santiago in several universities and private organizations having invited well-known environmental expert speakers. CIPMA, a private academic corporation, has been concerned for over 10 years about coordinating, organizing, and carrying out events and publications that put together all sectors of the economy around the environmental issue in Chile. This organization is certainly the leading voice in Chilean environmental issues. Universities are conscious that there is no solid formation on environmental issues in the different professionals formed in their institution. Nevertheless, two Chilean Universities (U. de Santiago de Chile, and U. de Concepción) have started postgraduate studies in environmnetal studies. At the same time, universities realize that in Chile there are no programs of considerable scope directed to the creation and development of new technologies linking the basic sciences of the university and the requirements of the productive sectors.

The **government** must attend the increasing public concerns of the environment and also has to comply with the Chilean Constitution. The 19th Article, Nº 8, of the 1980 Chilean Constitution establishes that **every citizen has the right to live in an environment free**

of contaminants, and that the State should look after this prerogative as well as it should preserve nature. The present political authorities have included in their government program a commitment to the environment. They have created a national commission of the environment (CONAMA) dependent of the Ministry of National Goods, that is preparing an environmental legislation project to be presented to the Congress during early 1991. The main objectives of this state organization are: to stipulate a coherent national environmental policy, to propose an institutional scheme, and to implement training and educative programs for government employees that will be in charge of control and regulation. They have also created a commision that is dedicated to the solution of the atmospheric contamination of Santiago (Comisión de Descontaminación de la Región Metropolitana).

In summary:
The productive sector as well as the general public in Chile perceives that environmental legislation will be the topic where most of the changes will be done in the near future.

The following report does not pretend to be an exhaustive analysis of all environmental problems in Chile, but it is an abbreviated account of how Chile is responding to environmental issues, describing the main problems regarding the environment, how they are being perceived, what is being done today, and what are the proposed policies by different sectors to be implemented in the future. This study is based on the available Chilean literature published about environment as well as on seminar documents, personal communication with experts of this topic and on the informative media.

I.2.- LEGAL AND INSTITUTIONAL ASPECTS OF ENVIRONMENTAL POLICIES

One of the main problems when evaluating the Chilean environmental impact of all productive activity is the **lack** of **national policies** that could be integrated into one unique set of laws with the responsible authorities clearly established. Laws, norms and control are dispersed in several public institutions. Many government organizations such as SNS (National Health Service), Ministry of Public Works (MOP), General Directorate of Waters (DGA), Ministry of Mines, Ministry of National Goods, Agricultural Service (SAG), National Forest Corporation (CONAF) and regional courts have some role in managing the environment (monitoring, evaluation, control, authorization, decision making, norms dictation, sanctions), but there is no coordination in these actions.

The **Instituto Nacional de Normalización (INN-CHILE)** is a public organization dependent of the Ministry of Public Works (MOP) in charge of the elaboration of all Chilean guidelines, ie. water and air quality, sanitation of edible products, drinking water, plant treatment. The INN is member of the International Organization for Standarization (ISO) and of the Comisión Panamericana de Normas Técnicas (COPANT). The control of these norms is responsibility of many public institution, ie: water quality control is carried out by MOP (Ministry of Public Affairs), through DGA (General Directorate of Waters), while air control is carried out by Ministry of Health and Ministry of Transportation. If contaminants flow to the sea or other water masses under the Navy jurisdiction, the control and regulation is responsibility of the Dirección General de Territorio Marítimo y Marina Mercante (General Directorate of Marine Lands and Merchant Marine) dependent of the Chilean Navy. So, none of the institutions mentioned above will take full responsibility of the environment, but also, the institutions are unable to detect environmental problems. As mentioned before, problems caused by the mine tailings in Chañaral

1.2.- LEGAL AND INSTITUTIONAL ASPECTS OF ENVIRONMENTAL POLICIES

coasts and the polluted atmosphere in Chuquicamata, have been brought to the attention of authorities by the public, because these problems were impossible to ignore.

I.3.- ACTUAL LEGISLATION

Actually, there are about 2,000 legal norms and regulations related to diverse environmental issues, but they do not make a coherent legal body. These environmental norms and regulations were elaborated with different objectives, of which many are contradictory and anachronous. At present, CIPMA is gathering all legal norms and regulations concerning the environment. This document will be available this year. Some of the general laws regarding environment are:

-The 1980 Chilean Constitution establishes in the 19th Art., Nº 8, that every citizen has the right to live in an environment free of contaminants, and that the State should look after this prerogative as well as it should preserve nature and in doing so the State has the right to impose specific restrictions to some liberties.

- Continental waters are legislated by the Código Sanitario (1944) that "forbids the discharge of industrial or mining wastes into waters that serve as drinking water source, recreational or irrigation, without previous depuration according the established norms". The President has the faculty of ordering standstill to any activity that contaminates water.

-Ministry of Public Health: Art.Nº2 Decreto Supremo Nº 144(1961): "Every activity that uses solid or liquid fuels should have the authorization of this Ministry".

-Law of Protection of the Agriculture(1981): "The President has the faculty of stopping any activity that emits smoke, dust or gases into the atmosphere if it is proved that is a health hazard for nearby inhabitants, or it alters conditions of soil causing agricultural damage or there is danger for the flora and fauna".

- Flora and fauna is protected by the Hunting Law (1929) and its modifications (1972). There are international agreements signed by Chile regarding protection and trading of some species.

- Regarding pollution of the marine sector, there are many legal disposition from the DGTMM (Directorate of Marine Territory and Merchandise) that forbid all kinds of contamination from the productive sector. There are also several agreements regarding marine proctection, signed by Chile.

There is unanimous consensus among environmental experts from different sectors (academia, government and private) that the actual legislation regarding environment protection has large gaps. Among them there are:

- No requirement to follow the environmental situation through time.
- Mechanisms of action and control are not clearly defined. Therefore, although some regulations and norms are strict, there is no control made by government institutions.
-Regarding the faculty of the President to paralyze activities that are polluting the environment, there are no legal mechanisms by which citizens can compel him to apply it.

I.4.-ACADEMIA PERCEPTION OF THE PROBLEM

Propositions have been discussed in specialized meetings and seminars, concluding that a program should be implemented to have a national environmental profile, that would set the basis for the principal ecosystems defining the fundamental aspects of the functioning of each one. This would be the basic criteria to compare with in the future and should be considered as a model in the decision making level concerning environmental legislation and quality standards. There is a general feeling (academia, business, government and public) that actual guidelines should be reviewed considering Chilean reality on a national, regional and local basis because many of the actual norms are based on EPA standards and might not be the adequate ones for each local situation.

I.5.-GOVERNMENT BASIS FOR FUTURE ENVIRONMENTAL POLICIES

The government believes that **without a program for the protection of the environment, sustainable development of Chile is not possible.** The government is aware of the contamination problems derived from productive activities. Although some large companies have taken action to reduce damage, many small and medium size enterprises are contaminating the environment with little control from authorities. Some of the actions taken towards protecting the environment by present government authorities are:

- Signed the Montreal Protocol agreement, this agreement requires that the government takes adequate measures to protect the human health and the environment from deleterious effects of the disruption of the ozone layer caused by human activity.
-Proclaimed the species *Araucaria araucana* (an endemic conifer) a national monument, so as to protect the species from overexplotation.
-Created a commission specially in charge of a decontamination program for the metropolitan area.

- Created a national committee of the environment that is responsible for the government actions in environmental issues (CONAMA).
- Obtained financing from the World Bank and from the Interamerican Bank for Development to sustain programs of the above mentioned commissions.
- Incorporated the different Ministries to an interministerial commission of the environment that will decide norms and policies on environmental issues during this government.
- Reactivated all the ministry's comissions on the environment that will coordinate environmental policies of the productive sector with private and public enterprises and CONAM.

The government wants to make resource exploitation and processing compatible with a reasonable protection of the environment so as to improve life quality of Chileans, and to optimize the use of natural resources that are becoming scarce and be able to confront the environmental requirements of the international community. The government concept of environmental protection is a dynamic one, interrelating the terms "to use" and "to protect" in an efficient way.

II.- MINING INDUSTRY

The mining industry produces about 50% of chilean exports and has been historically the main productive activity in Chile. It is also the activity that has caused the most contamination to the environment.

The enviromental impact of the mining industry both in extraction and in processing, is mainly due to the chemical pollution of soil, water (superficial and underground) and air by mining extraction procedures and posterior processing. The principal mining activity in Chile is copper but other mining activitites also form part of the contaminant mining industries such as coal, iron, gold, silver, iodine, oil, and saltpetre. **The lack of environmental studies** in the mining area, as well as in most of the other anthropogenic activities in Chile, makes it impossible to assess the magnitude of the problem, for now, it is only possible to point out those interactions that are detected by the public and therefore have being published in the press and TV, as well as problems pointed out in seminars organized by public or private institutions related to the mining industry.

II.1.-WATER POLLUTION

II.1.1.- Pollution of rivers and bays by mine tailings.

This problem came to public light and awareness after the city of Chañaral (III Region) demanded legal action against CODELCO (national copper mine corporation) because the mine tailings of El Salvador were thrown directly to Chañaral Bay via Salado River for almost 50 years, producing embankment of residues as well as causing death of flora and fauna of the area. It is estimated that the seashore of Chañaral received a volume of 32 to 35,000 tons per day with 34% of sandy content. Bioaccumulation of contaminants in seafood causes serious problem to the inhabitants of the region. The Supreme Court

dictated a sentence against CODELCO and, at present, tailing ponds are being built to minimize contamination.

II.1.2.-The principal pollutions of waterways and bays by mining activity can be summarized as follows:

I Región

In the city of Arica, waters are being polluted with antimony, arsenic and heavy metals product of floating process of silver In Pisagua, water is being polluted with clay, mercury and other reagents used in the process of floatation and amalgamation of gold.

II Región

The soil of the north of Chile is characterized by a high content of arsenic, generating extra problems in the drinking water as well as in the extraction and processing of minerals.In Tocopilla and in Antofagasta, water is being polluted with products of lixiviation and floatation of copper as well as amalgamation and floatation of gold. Part of the wastes of Chuqicamata is discarded into the Loa River, the longest and only river of Northern Chile that travels to the sea. No environmental impact study has been published either by authorities or by CODELCO. There is public concern about the environmental impact that 12 liters/second of concentrated waste of La Escondida copper mine will cause in Coloso Bay when this mine starts its production shortly, although this Company has spent US$3,150 millions in an enviromental program that includes enviromental impact studies, the construction of recycling ponds and discharge systems, and the installation of a monitoring network.

III Region

In Huasco the CMP iron pellets plant contaminates the Chapaco Bay with iron and quicklime. Although 40% of El Salvador solid wastes will be retained in ponds, the Salado River will still receive wastes with arsenic, cyanide, carbon disulfides, and other chemicals used in the process of copper mining due to small mining operations.

IV Region

Coquimbo and La Herradura Bays receive wastes of gold and silver mining, both by artisanal miners as wells as by large mining companies. There are over 200 small gold mining operations that use mercury amalgamation methods by the Elqui River. Iron is also being incorporated into these water systems by iron mines in this region.

V Región

The smelting industry at Ventana belonging to ENAMI (national mining enterprise), contaminates nearby water through the products of its electrolytic plant that has a processing capacity of 170,000 tons /year of Cu, 140,000 tons/year of Ag and 6,000 tons/year of Au. The discharged volume is 4,53 x 10^6 liters/day of water with sulfuric acid, caustic soda, elemental selenium, and iron oxide, and 4,33 x 10^6 liters/day of cooling water. In Saladillo the discharge of copper and molybdenum mine tailings into the Río Blanco river is 12,99 x 10^6 l/day. The Andina mines and the Chagres smelting industry pollute the rivers Rio Blanco and Aconcagua.

Metropolitan Region

The floatation process of La Disputada de Las Condes has a discharge volume of 26,28 x 10^6 liters / day, although the water is recycled by means of reservoirs, in 1987 due to excessive rain and snow part of the reservoir was released into a tributary of the Mapocho River, there is no study available on its impact. There is no data available of the environmental impact of Pudahuel and La Africana mines.

VI Región

El Teniente copper mine, which belongs to CODELCO, is located in the Andes. They invested US$ 130 millions to build a tailing dam that will settle mine tailings for an estimated period of 100 years. Decanted water is incorporated into the Caren River, which arrives to Rapel Lake.

VIII Región

Important coal mines are located in this region, at Lota, Coronel and Lebu that contaminate the bays of Arauco and Carnero with discharges of various acids, iron salts and other wastes as coal powder, clays, etc.

XI Región

No information is available regarding periodic zinc mining operations in Coyhaique.

II.2.-ATMOSPHERIC POLLUTION

The main source of atmospheric pollution by the mining industry is sulfur dioxide (SO_2) and arsenic produced by smelting and roasting operations. In 1989 the Chilean smelting industry produced 2.5 millions tons of SO2 of which only 22% was treated. By 1993, with the building of sulfuric acid plants it is estimated that 60% of SO_2 emitted will be treated. This estimate does not contemplate new mining expansions or a decrease of the ore grade. Emission of arsenic is evident in Chuqicamata, Ventanas, Refimet and El Indio.

II.2.1.-The principal problems of atmospheric pollution produced by the mining sector can be summarized as follows:

II Región

Chuquicamata: Located in the desert, it is an open pit copper mine.Total emission of sulfur estimated for 1992 is 364 tons/day, and 1.1 tons / day of arsenic. According to data from CODELCO, 22% of the emission is sent to the atmosphere (estimates from other sources are significantly higher), affecting the inhabitants of Chuquicamata. No medical studies have been published, and no evaluation of possibles effects of acid rain in nearby regions have been made. There is a

monitoring network in the plant, but it does not cover regions where presumably emissions would generate acid rains. **El Salvador:** Located in a similar geographic areas Chuquicamata, it shows comparable atmospheric pollution problems as Chuquicamata, except that its emissions are higer in S (451 tons /day) and lower in As (0.3 tons / day). There is no monitoring network and no study has been done regarding health problem of inhabitants of El Salvador.

III Region

Producers of olives and olive oil, have made public their concern about low productivity due to contaminants produced by the iron pellet plants. There is no published studied referent to this problem. But, emissions of S in this plant are estimated to be low. Atmospheric contamination in Copiapó by smelting industries is considered an important problem by local inhabitants.

IV Region

The manganese plant Atacama located near the city of Coquimbo emits dust with high content of manganese.

V Región

Paipote is a smelting industry that belongs to ENAMI. Most of the copper of the small and medium size mines is processed here. There is no monitoring network, no environmental impact study, and no epidemical study in the nearby population. Estimate emission of S is 166 tons/day and of As is 0.4 tons /day.

Chagres: belongs to La Disputada Mining Company (EXXON). They have their own regulating norms of emission, as well as a monitoring network. Its emission are low (22 tons /day of S, and no emission of As).

Ventanas: Smelting plant that belongs to ENAMI. Important problems have been generated by the emissions of this smelting industry, especially acid rain and arsenic dust damaged agricultural activities.

Inhabitants of the region have established legal action against ENAMI. Estimated emission of S was 396 tons/day (1988) and with the construction of an acid plant it should diminish to 122 t/d by 1992. Arsenic emission in 1988 was estimated in 0.7 t/d and should diminish to 0.3 by 1992.

VI Región

El Teniente: Located in the Andes in the central region of Chile. This region is essentially farming land. Atmospheric pollution of this mine has similar characteristics as others mentioned above. Acid plants are being built to reduce sulfur as well as arsenic emissions. In 1982, a 3 year enviromental impact study was carried out by a private company. Although results were not accesible, the company stated that atmospheric pollution was not significant. No monitoring network was used but there does exist a medical monitoring program of mine workers.

XII Región

Coal mining emissions are causing damage to cattle adjacent to the Cocar operations.

II.3.- USE OF WATER BY THE MINING INDUSTRY

Although it is not a contamination problem by ityself, the excessive consumption of the water resource by mining industries is perceived as an enviromental threat. Most of the mining industry is located in the North of Chile (I,II, III & IV Region) where water is the most important limiting resource. The mining activity will continue to expand and develop, therefore, the industry's water consumption is expected to increase. The water used in mining industry is obtained from superficial as well as from underground sources, consequently limiting water resources to the local inhabitants as well as to the

unique local flora and fauna. Present legislation of water of desertic region is similar to that of the rest of the country where water is not scarce. Experts suggest that legislation of desertic waters should be appropiate to each region. Also, large mining industries should recycle mine tailings to reincorporate water in the productive circuit, and should develop seawater desalination techniques.

II.4.- ENVIRONMENTAL INITIATIVE BY THE PRIVATE AND PUBLIC ENTERPRISES.

Minera Escondida Limitada

This mine will start its production in 1991. They have implemented an Environmental Program that will employ environmental techniques and engineering in agreement with national and international regulations. The study has been centralized in two areas: the Punta Negra salt-lake (salar) where the water will be pumped from underground sources, and the Coloso Port, where copper concentrate will be processed. The concentrated mineral will arrive at the Coloso Port from the Escondida Mine through a 170 km long pipeline. The concentrate will be separated and the water will be filtrated and purified before being dumped into the ocean. The company decision to send the mineral ore through a water pipeline was based in several considerations which included cost of the operations and environmental impact in the mining area, towns and roads near Antofagasta as well as in the Coloso Port area. The environmental program of La Escondida, contemplates a baseline study of both regions, an impact evaluation of the mining operation and monitoring of atmospheric and water quality. The total cost of the environmental program was estimated at US$ 3,150,000.

Disputada de las Condes

This company was bought by EXXON in 1978, since then they have implemented several environmental program that includes training courses for worker, recuperation of mine tailing ponds, agriculture

developments in nearby areas, and impact studies to evaluate future constructions of mine tailing ponds.

This company has 3 main projects related to environmental issues in their operations:

-Los Bronces: The expansion of this mine is under construction and it is programmed to initiate operations by 1992. A detailed environmental impact study which identified the potential environmental risks was carried out. The decanted water of the new mining tail pond will be bio- evaporated by forestry (760 hectares) irrigated with pond water.

-San Antonio Port: New facilities for shipping mineral are being built, this will improve dust contamination generated by winds.

-Chagres smelter: In order to improve SO_2 emissions, there is an ongoing study to evaluate the feasibilty of a significative expansion in production together with a reduction of gas emissions.

ENAMI (Empresa Nacional deMinería)

This is a state company, and has appointed a Committee on the Environment that has resolutive atributions. Some of the actions to be taken by the committee will include the control of gas emissions, instalation of noise reduction equipment and the improvement of gas and dust extraction systems.The overall cost to materialize this plan is estimated at US$ 4 million.

The impact on the communities that live near the plant operations will be the matter of action programs in the short term. ENAMI is also willing to carry out environmental impact evaluations as well as technical capacitation of the mining workers in environmental issues using the assistance of specialized consultant companies.

In the particular case of Ventanas the committee has decided to start the construction of a second acid plant that will permit the reduction of 60 to 70% of gas emissions reducing the effects of the SO_2 in the nearby areas and the installment of a permanent atmosphere monitoring network. Ventanas has recently incorporated Swedish technology to treat arsenic emissions.

CODELCO (Corporación del Cobre)

This company is a state corporation in charge of the major copper producing mines in Chile. Considerations of environmental issues are now forming part of all decision making at executive levels at CODELCO. Some of the actions taken in each of their mines are:

-Chuquicamata: studies are being made to establish proper techniques in order to recycle decanted water from Talabre pond. The emissions of sulfur and arsenic have been reduced to 50% and 80% respectively, with the improvement of old acid plants and construction of new ones.

-El Salvador: Emissions of sulfur and arsenic are being reduced in Potrerillos sites by implementing measures that reduce gas emission with significant improvement on air quality of the camp.

- El Teniente: An acid plant is being built to reduce sulfur emission that was affecting nearby areas inhabited by the same conpany's workers, as Sewell, Colón and Barahona. They have hired consultants to assess the influence of El Teniente's emissions in Santiago and Rancagua, concluding that in both cases there is no direct influence of Caletones smelters in the air quality of these cities. An environmental impact study is being carried out by a Chilean University to assess the influence of waterwaste in the Carén river basin. An experimental agricultural program is being realized near the Carén dam, using decanted water to grow crops, cattle and forestry.

SHELL-CHILE.METAL DIVISION

Shell-Chile have been involved in mining activities in Chile since 1982.The Choquelimpie Project located in the Lauca National Park correspond to silver and gold mines in the high Andes of northern Chile.To asses the possible environmental impact of the operations, the company carried out an ecological base-line study to determine the diferent habitats in the area and to characterize the flora and fauna together with a detailed analysis of the natural concentrations of the various elements.

The results of the ecological base-line study showed the frangibility of the natural system where the mining operations will be established and in some areas the study revealed high levels of natural heavy metals in soil and water. In accordance with the results of this baseline study, diverse measures have been taken to prevent the effects of the new mining activity in the region.

II.5.- ACTUAL LEGISLATION OF THE MINING SECTOR

-Non renewable resources are regulated by the Ley Orgánica Constitucional sobre Concesiones Mineras (1982) and by the Código de Minería (1983), there is no enviromental protection established in them.

One of the main problems when evaluating the Chilean environmental impact of mining activity is the lack of national policies and the lack of a valid speaker. As it was mentioned in the previous section there are guidelines and maximum permited standards for several air and water contaminants, but the control of these norms are scattered among many government organizations, making the survey process inefficient or non-existent. The information regarding number of reservoirs and volume of water processed is kept at the Dirección General del Servicio Nacional de Geología y Minería, (General Directorate of Geology and Mines National Service) and it is

filed as confidential, therefore there is limited access to this information by the general public.

II.6.- GOVERNMENT BASIS FOR FUTURE ENVIRONMENTAL POLICIES

The government is aware of the contamination problem derived from mining activity. Although some large companies have taken action to reduce damage, many small and medium size mining enterprises are contaminating the environment with little control from authorities. Some of the actions taken by this government towards protecting the environment influenced by the mining activity are:

- Incorporated the Ministry of Mining to an interministerial comission of the environment that will decide norms and policies on environmental issues during this government.
- Reactivated the Ministry of Mining Comission on the Environment that will coordinate environmental policies of the mining sector with private and public enterprises and CONAM. This Commission will be the valid speaker on environmental issues of the mining sector with the Government.
- Created a national committee of the environment that is responsible for the government actions in environmental issues (CONAM).
- Obtained financing from the World Bank and from the Interamerican Bank for Development to sustain programs of the above mentioned comissions.

The government wants to make mineral exploitation and processing compatible with a reasonable protection of the environment. The government believes that reduction of mining activity contaminants should be a gradual and continuous process, a very strict norm would be inefficient and unreal. As an enterpriser, the government has taken urgent measures to reduce problems created by the activity of ENAMI and CODELCO, by financing studies and projects to diminish emissions in smelting factories. As a regulator institution, the government must

be able to have a clear diagnosis of the problem and to be able to take adequate measures so as the mining enterprise incorporates the environmental dimension.

II.6.1.- The need of a diagnosis

It is urgent to start with a study that informs about the real emissions of the mining sector and its impact in the environment. This should be done with scientific and technical criteria. This is a necessary previous step in order to define the precise maximum acceptable concentration of contaminants and to protect the use of natural resources that are subjected to contamination risks. A detailed assessment of the mining sector enviromental dimension is a prerequisite for the industry and the government to take permanent measures of environmental protection oriented towards a sustainable development.

This diagnosis should have as references the legal norms that regulate the quality of the environment as well as the norms that regulate emission of contaminants in the mining sector enforced in developed countries. It should also contemplate the study of local characteristics to propose baselines that will permit to estimate the dilution factor of contaminants. This diagnosis should study the impact of emissions on other productive activities of the area, on the health of the population and on the stability of the ecosystem. It should also include a technical and economical evaluation of the available environmental control technologies so as to set time limits for quality guidelines fulfillment.

II.6.2.-Towards enviromental policies in the mining sector.

The mining sector actually faces legal uncertainty regarding environmental issues. On one hand, there is a lack of specific legislation and on the other hand there are several government institutions that have legal power to control emissions.

Legislation should differenciate between existing mining operations and mining projects. For the latter, authority will require an enviromental impact study with detailed description of the technology to be used in order to control contaminant emissions. Similar procedures will be required for the expansion of existing operations that involve increase in production by new processes.

Based on these studies the authority will authorize the acceptability of the project. This authorization will be given by only one competent government institution within a reasonable time. Existing mining operations will adopt adequate measures of control of contaminant emissions within a period of time to be discussed with the authority. All mining activities should have an environmental license to operate. To carry out the above mentioned policy it is necessary to count with adequate technical competence to define and evaluate the compliance of the environmental license on a permanent basis.

II.6.3.-Two definite goals will be met in the short term by the Government:

- reduction of atmospheric contaminants produced by emissions of smelting activities.
- elaboration of a precise environmental policy in conjunction with public and private enterprises that will enable the mining sector to approach environmental requisitions.

II.7.-ACADEMIA PERCEPTION OF THE PROBLEM

Pollution due to mining activity is worrysome and actions should be taken.

Future trends recommended by academia regarding the mining activity are:

- To understand the environmental state of the art in all mining industry operations so as to establish baselines.
- To evaluate the actual environment influenced by mining operations from a mulitdisciplinary point of view (basic, economical and social).
- To study the environmental impact of atmospheric, hydric and soil contamination. Expand or set up new monitoring systems in bordering regions as well as in distant zones.
- To implement a continuous monitoring program on health considerations in nearby populations.
- To formulate an environmental protection law, that includes the obligation of environmental impact studies for all new mining industries as well as for those already established.
- To create a unique authority in enviromental control. It should be a politically and economically independent entity.
- To enforce training programs in evaluation and management of environmental issues related to mining industry.
- To habilitate valleys, basins and coasts affected by mining activity pollution.
- To have access to all information (public or private) regarding national environment as well as to the information regarding quantity and quality of emissions.
- To create appropiate channels of participation so that people may express freely their worries and fears, and their opinions can be collected and analyzed.

II.7.-ACADEMIA PERCEPTION OF THE PROBLEM

II.8.- PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sesssions).

-It is necessary to legislate in accordance to the Art. Nº 19 of the Constitution that establishes that every citizen has the right to live in an environment free of contamination, as well as the right to develop any economic activity as long as it is compatible with morale, public order and national security. The frame law concerning minery should establish the basic principles of use and protection of the national environment. This law should have a conceptual meaning of:

-- objective of the law and basic terminology.
-- responsabilities of the enterprises, the regional and national government and the citizens.
-- mechanisms and development of environmental guidelines.
-- environmental institutions.
-- environmental impact studies.
-- control, taxation and sanction.
-- mechanisms of appeal and arbitration.
-- economic aspects.
-- timelimits in the different requests.

- the mining sector, as other productive sectors, needs realistic standards, with specific and unambiguous rules related to environment.
- Environmental legislation should define precisely all parameters necessary
to be considered in project analysis, in new mine operations and conditions to which existent operations should adapt to fulfill the legislation.
- It is urgent to have an institutional ordering regarding environment.
- The norms and rules that regulate this sector should be feasible, and the cost of satisfying them would not mean paralization of activities or significant losses in international competiveness of this sector.

II.8.- PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sessions).

-It is necessary to legislate in accordance to the Art. Nº 19 of the Constitution that establishes that every citizen has the right to live in an environment free of contamination, as well as the right to develop any economic activity as long as it is compatible with morals, public order and national security. The frame law concerning minery should establish the basic principles of use and protection of the national environment. This law should have a conceptual meaning of:

-- objective of the law and basic terminology.
-- responsabilities of the enterprises, the regional and national government and the citizens.
-- mechanisms and development of environmental guidelines.
-- environmental institutions.
-- environmental impact studies.
-- control, taxation and sanction.
-- mechanisms of appeal and arbitration.
-- economic aspects.
-- timelimits in the different requests.

- the mining sector, as other productive sectors, needs realistic standards, with specific and unambiguous rules related to environment.
- Environmental legislation should define precisely all parameters necessary to be considered in project analysis, in new mine operations and conditions to which existent operations should adapt to fulfill the legislation.
- It is urgent to have an institutional ordering regarding environment.
- The norms and rules that regulate this sector should be feasible, and the cost of satisfying them would not mean paralization of activities or significant losses in international competiveness of this sector.

- The Ministry of Minery should: participate in the elaboration of standards and regulations, disperse environmental information among enterprises and comunity, carry on research, be a valid intersectorial speaker, coordinate decontamination programs, and offer training programs for mining personnel.
- CONAMA should be a coordinator organism among the different productive sectors, and should aknowledge and emit proposals of environmental matters of the sector.

II.9.- POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

SERVICES

- Training programs in air and water pollution:control, treatment, purification, methodology and techniques.
- Training programs in hazardous wastes disposal.
- Training in environmental engineering.
- Environmental impact, risk, assessment studies.
- Environmental standards and management.
- Environmental audits.
- Geophysical surveys.
- Air, water and soil sampling and analysis service.
- Noise and vibration monitoring measuring services.
- Remote sensing and mapping service.

EQUIPMENT

-Computerized instrumentation for monitoring and detecting air & water quality.
-Air pollution control: analysis, purification,dust collection, odor, filtration equipment.
- Sulfur dioxide and arsenic treatment technology.
-Water pollution control: analysis, purification, treatment, sampling, recycling of metal values, technology.

III.-FORESTRY SECTOR

III.1.- GENERAL ASPECTS

Like other New World Countries in the last one & half Centuries, Chile has destroyed an important part of its forest heritage, because of irrational destructive practices, to gain agriculture lands, that triggered erosion over millions of hectares of soil, especially in the Central-South region of the country. The increase in population associated with an increase in consumption displaced the indigenous vegetation of the Central Valley from the V to the X Región in response to development. Many forest regions were destroyed by agricultural malpractices making the last decades of the XIX Century and the five first decades of the XX Century be known as "the erosion era". There are estimates (in 1958) that about 19 millions hectares were affected by intense erosion. But, unlike other countries of the continent, Chile was able to create an important amount of non indigenous forest that restored the productivity of eroded soils as well as provided the raw material for one of the most dynamic and expansive sector of the national economy. Chile has excellent weather and soil condition for forestry development, a radiate pine grows in 20 - 25 years here, while in Canada an oregon pine takes about 80 years to grow. By 1989 there were 1.4 millions hectares of industrial plantations, 87% of which were pines (*Pinus radiata)*, about 24,000 ha were exploited with an output of 12 millions m^3 of wood and a return of US$ 800 million. The exportable capacity of the country will be doubled by 1996, with an estimated inversion of US $2,500 million. At present, there are about 12 million ha of potential forest soil that puts Chile in an advantageous position to supply international demand. Contrasting with this vigorous productive development, the public opinion, particularly in the educated levels, perceive the growing activity of forestry as an environmental threat. This perception is specially directed towards the explotation of indigenous forests, and

III.-FORESTRY SECTOR

III.1.- GENERAL ASPECTS

also towards pine planting even though the latter was welcomed by nature conservationalists at its beginning. Unfortunately, the debate among conservationist and forestry experts has not generated solutions. On the contrary, it has turned into a hot dispute with no enlightening end in sight.

Experts in this specialty are committed to finding the way to conciliate the growing of this sector without having a detrimental effect on the environment and without generating confrontation that may, with or without reason, be an obstacle to a fluent development of this sector. Most of the technical expertise in the area have agreed that Chilean forestry expansion does not cause important environmental problems, and if in few cases it does, these are substantially smaller than those generated by other industrial sectors.

The mains problems perceived by the public regarding forestry activities from the VI to the X Región are:

-Irrational exploitation of indigenous forest for firewood,coal and chips.

-Extinction of indigenous species caused by overexploitation.

-Inadecuate reforesting, especially with the use of monocultures of pine.

III.2.-INDIGENOUS FOREST

The public awareness of environmental problems in the forestry area is specially centered around the recent and growing exports to Japan of short fiber chips obtained from indigenous forests. In 1989, 18 millions cubic meters of chipped wood were exported, and 85% of this went to Japan. This activity is perceived as a depredation of indigenous forest, and the public have hostile attitudes towards transforming indigenous forest in highly productive plantations. At present, public debate is centered on the go-ahead to exploite 23,000

ha of indigenous forest in the X Region (Project of Terranova S.A., subsidary of CAP SA de Inversiones).

At present, there are 13,6 millions hectares of indigenous forest under protection by the government (regional or national parks). These protected indigenous areas are located in different ecosystems, offering the opportunity of conserving flora and fauna of each region. Apart from the latter, Chile has 7,6 million hectares of indigenous forest susceptible to exploitation and presenting great productive potential for the future.

To have a sustainaible exploitation of indigenous forest, experts suggest that silvicultural research should be stimulated by government and private institutions. Establishment of rational management plans should be implemented, and a modern geographical information system should be developed so as to identify the capacity-of-use of soils, types of indigenous forests, actual utilization of forests. These measures would permit formulation of simple and realistic management plans that could be efficiently controlled by government authorities so that indigenous forests would be productive without being destroyed.

III.3.-INDUSTRIAL PLANTINGS

At present, there are 1,4 millions hectares of industrial plantations mainly made up of pines (87%) and in lesser amount of eucalyptus. They generate about 14 millions m^3 of wood. The principal environmental problems perceived by the public are:

-vulnerability to patogen agents due to monoculture of exotic species.
- acidification of soils
- alteration of soil caused by explotation trails.
-alteration of the flora and fauna.
-negative impact on soils.

-negative impact on the hydrology of basins.

According to expert analysis the Chilean pine forest have not shown a significant pest problems. Nevertheless, they recommend employing a higher number of species, indigenous or exotic, in future plantings, as well as , starting of genetic improvement projects of economical important species with the objective of selecting resistant varieties. With respect to the acidification of soils, several studies show no significant pH differences betweeen pine soil and indigenous forest soil. It is estimated that during a decade pH acidity from pine forests can increase by 0.3 units. This can readibly be corrected with artificial fertilizers. Regarding the impact on soil of the exploitation trails there is no technical information available to evaluate it. The impact of pine plantings on indigenous flora and fauna has not been estimated, and no studies have been carried out on this aspect so as to propose proper measures. Some specialists suggest the incorportation of indigenous forest patches in a mozaic design.

III.4.-FOREST INDUSTRY

Two main activites are involved in the forest industry: the mechanical transformation of wood, and the chemical production in cellulose and paper factories. The sawmill industry here is not recognized as a contaminant industry. Nevertheless, there are international demands on environmental problems that affect the productive schemes. These problems are: generation of subproducts such as sawdust and barks, the utilization of fungicides, especially sodium pentachlorophenates that are toxic to worker and can eventually contaminate surrounding waters, and the use of formaldehyde resins whose gas emissions are health hazards.

The cellulose and paper industry in Chile shows an important development in the last few decades, but there are no environmental

problems technically identified by authorities nor perceived as significant by the public. However, this industry will certainly grow in the next few years, and most of plants will be placed in the Bio-Bio river basin, transforming the region in a environmental hazardous region. As the Chilean public is becoming more sensible to environmental issues the cellulose and paper industry will probably be perceived as a major contaminant. Main problems in this activity are that mill runs are discarded in surrounding water contaminating it with suspended solids (fibers and others), tints, foams and some toxic wastes such as organic-chloride compounds, altering the biological oxygen demand and other modifications of the watersystem. Also, emissions into the atmosphere of malodorous gases, as mercaptanes and other sulfurous compounds, and solid particles derived from boiler combustion is another problem.

III.5.-PROPOSITIONS BY ACADEMIA

The following future actions have been suggested by several experts to decrease environmental impact of forestry industry:

- Eliminate or decrease the effects of sodium pentachlorofenates by substituting with innocuous products or using effective preventive equipment, using of good quality products, preventing of spills,and propper disposal of contaminated cans.
-Find substitutes for resins containing formaldehydes.
-Incorporate modern technology in new cellulose and paper mills in accordance with norms from developed countries. Old mills should start modernization programs to reduce emission levels in pre-established periods.
-Update the government organizations in charge of regulation and control of emissions, providing them with modern control equipment.
-Create one organization in charge of environmental issues: regulation and control.

-Create channels of cooperation to discuss environmental issues with both private and public sectors.
- Stimulate applied research in environmental issues.

III.6.-PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sesssions).

SOIL

- Government organizations related to forestry (CONAF, CIREN-CORFO) should compile and process all information available regarding capacity-of-use of soils, their actual utilization and state of deterioration. This will establish an integrated and reliable picture of the country.
- Wide diffusion of results obtained from above action, so as to reduce subjectivity that actually overrides the public debate.

INDIGENOUS FOREST

To focus the public debate in technical an economical realities so as to reach equilibrated positions, the following measures are recommended:

-To characterize the different types of indigenous forest, and relate them to the potential use of the soil, differentiating the forests that should be preserved and the forests that can be exploited.

-To make the country aware that desert soil as well as mistreated soils are potential forest areas that could bring about job opportunities.

-To make public understand that having a system of Indigenous Forest Protected Areas will protect the country from ecological disasters in this area.

-To keep in mind that the private sector cannot be asked to preserve or conserve indigenous forest, with a soil capacity of VII or VIII,

without pay, or pretend that they will cultivate them without minimal rentability considerations.

INDUSTRIAL PLANTATIONS

- To stimulate research in : acid variation of soil, less damaging exploitation and planting techniques, productivity maintenance of soil, water consumption by different species, effect of silviculture on water quality, biological control of pests, genetic improvement, and effect of artificial plantations on indigenous flora and fauna.
-To develop socio-economic studies that evaluate the effect of large plantations on local inhabitants.
-To stimulate programs of protection and breeding of indigenous fauna in danger of extinction.
- To develop a national integrated program of pests and diseases.

MANUFACTURING INDUSTRY

Although emissions of forestry manufacturing industry have not produced significant environmental problems or public awareness, it is necessary to take preventive measures to avoid unnecesary confrontations such as those that have occured in USA. For this, its essential to proceed with the following actions:
-To establish guidelines and control procedures that give a basic reference frame for environmental protection without blocking the vigorous development of the forest manufacturing industry.
- To create an independent and expeditious institution in charge of control with an executive board related to the regional government where public as well as private sector can participate.

III.7.-FOREST INDUSTRY RESPONSE TO ENVIRONMENTAL ISSUES

CMPC (Wood and paper conglomerate manufacturing company)

This company owns 280,000 ha of pine forest, and several paper and cellulose mills placed along the country. In the metropolitan region, at Puente Alto, scrubbers were installed in the boilers, reducing emitted particles to 90 mg/m^3, circuit were modified to recover fibres from mill runs and reduce water volume discharge in the Mapocho River. By 1991 a new treatment plant will permit its recycling in the industrial process and a paper recycling factory will start operating. In the manufacturing of pulp, recycling projects as well as water treatment will start to operate shortly. At Buin and Valdivia sites, CMPC is implementing water treatment plants. In Laja, where a cellulose and paper mill operates, with an annual capacity of 310,000 tons, an US$11 million 5 year program is being enforced to reduce suspended solids of liquid wastes and scrubbers are being installed in the boilers to reduce emissions. Also, in the chlorine and soda plants, the electrolytic mercury cells are being replaced by membrane cells decreasing the risk of mercury loss through wastes. The cost is US$ 8,5 million. The fact that the newsprint factory at Nacimiento, produces 120,000 tons/year of paper, and particulate matter in their gas emissions is important. Several measures are being taken to reduce gas and water contaminants, such as recycling systems, scrubbers, and monitoring system in the Vergara River where water waste is discharged. Also, this company is supporting several research programs to reduce lignosulphates from mill runs and to find alterindigenous uses of this subproduct. **Total amount invested by CMPC in environmental improvement is about US$23 million.** CMPC together with Simpson Paper-USA are building a new cellulose mill in Mininco, this factory will include modern technology to reduce gas and water contamination.

This company also contributes to the maintenance of the environment through paper recycling plants, having a 45% recovery of old paper and a processing of about 70,000 tons/year.

FORESTAL MININCO

A subsidary of CMPC, is preparing to plant 20,000 ha in Aysen in the far South, with Oregon and Ponderosa pine. This plantations will give impetus to the reforestation of a region devastated by fires, in the thirties and fourties, caused by local farmers to clear for grazing. This land is now eroded and usuitable for grazing, and many hillsides and valleys are littered with fallen trees.

FORESTAL VALDIVIA S.A.

A long fiber, kraft bleached cellulose plant, with a processing capacity of 500,000 ADT. Indigenous forest, representing about 30% of its patrimony, is being conserved and used for several coservation research programs supported by this company. Among them: indigenous forest research, and conservation of the indigenous deer *Pudu puda* .

TASMAN-CHILE S.A. (subsidiary of Fletcher Challenge,Canada)

This company has adopted Canadian environmental standards.

III.8.- ACTUAL LEGISLATION

Guidelines and controls are scattered in many government organizations such as Navy, Ministry of Public Works (MOP), Ministry of Health, National Service of Health, Ministry of Agriculture, Ministry of the Interior, Agricultural and Stockbreeder Service and regional governments. This makes both the control of emissions and also the detection of environmental problems inefficient.

Actual law (DL 701) regulates the intervention of indigenous forests, and to exploit them, an authorization from CONAF (National Corporation of Forestry) is needed. The authorization is subjected to the approval of a forest management plan, that should be controlled by CONAF. Nevertheless, this organization does not have the economic resources nor the modern technology to do an efficient supervision.

At the moment the government subsidises three-quarters of plantation costs as part of forestry legislation introduced in 1974 to give incentive to the forest industry. There are no environmental considerations in this legislation.

III.9.-GOVERNMENT PRIORITIES

The creation of a National Commission of the Environment is a clear indication of the importance that government gives to environment protection. To provide the basis for environmental policies in the forestry sector it is necessary to work out the origins of the problem. The main ones are:

-Environmental Education.

To reverse degradation processes of the environment it is necesary to integrate and involve the population. This is a difficult and long term task because it means a change of attitude. Education in rural population is inadequate regarding training in agricultural practices with negative consequences to the environment caused by misuse of soil, water and indigenous fauna resources.

- Research and Technology

To find financial assistance to improve the national information services so as to have the adequate knowledge to take measures of protection, and to incorporate recent technologies available in other countries. This could implement control systems in indigenous forest infringement, forest fires, erosion processes, dune management, water

resources. This is specifically referring to satellite technology and geographic information systems.

-Forestation

Chile consumes a volume of fire wood similar to that used in cellulose mills. This is one of the main factors of desert formation in extremely fragile ecosystems. Forestation programs of small units of energetic forests will give relief to natural areas.

-Indigenous forest management

Elaborate a law to stimulate the recovery of indigenous forest through allowances, enrichment and management plans. In this way, indigenous forest should become a productive area and economically feasible to maintain.

- Indigenous Forest Protected Areas

To have representation of all biodiversity through the System of Protected Areas.

III.10.- POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

SERVICES

-Training programs in all forest related activities.
-Geographic and other satellite services (remote sensing and mapping).
-Environmental impact, risk, assessment studies.
-Forest management.
- Monitoring services.
- Noise and vibration monitoring measuring services.
- Air, water and soil sampling and analysis service.
- Training programs in hazardous wastes disposal.
-Air & water pollution control, treatment and purification.

EQUIPMENT

- Software and satellite information equipment.
- Forest fires control equipment and technology.
-Air and water pollution control equipment in the forest manufacturing industry (scrubbers, recycling circuits, filters, odor control, etc.).
-Monitoring equipment.
-Transport and storage of liquid or solid hazardous wastes equipment.
- Pulp and paper mills chemical recovery technology.
- Environment-friendly chemical products for wood and paper industry.

III.10.- POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

SERVICES

-Training programs in all forest related activities.
-Geographic and other satellite services (remote sensing and mapping).
-Environmental impact, risk, assessment studies.
-Forest management.
- Monitoring services.
- Noise and vibration monitoring measuring services.
- Air, water and soil sampling and analysis service.
- Training programs in hazardous wastes disposal.
-Air & water pollution control, treatment and purification.

EQUIPMENT

- Software and satellite information equipment.
- Forest fires control equipment and technology.
-Air and water pollution control equipment in the forest manufacturing industry (scrubbers, recycling circuits, filters, odor control, etc.).
-Monitoring equipment.
-Transport and storage of liquid or solid hazardous wastes equipment.
- Pulp and paper mills chemical recovery technology.
- Environment-friendly chemical products for wood and paper industry.

IV.-AGRICULTURAL SECTOR

IV.1. GENERAL CONSIDERATIONS

Chilean agriculture has been modernized since the 60's, and during the last decade the exportation activity of agricultural products especially fruits has become very dynamic and productive. At present, an objective and reliable diagnosis can not be established because there exists little information regarding the environmental impact of modern technology in agricultural practices and there is no public perception of this activity as a contaminant enterprise. Nevertheless, experts recognize relevant problems that will become important in the near future. Also, it has been pointed out that not only economically profitable agricultural practices contribute to environmental problems but also the agricultural practices of a sector of small farmers ("agricultura campesina") is important in this process because of malpractice and misuse of soils especially in fragile ecosystems.
Main problems identified in the agricultural area are:

Erosion

According to CIREN-CORFO (Center for the Research on Natural Resources of the state development agency) data, 11,6 million ha are affected by severe erosion, and an estimated of 6.000 ha per year are converted to desert. This problem is perceived as the most important in the agricultural sector, and is mainly caused by inadequate use of the resource. In the Central-South region of Chile, inefficient irrigation systems are causing enbankments of watersystems.

Salinity Levels

Irrigated lands of northern Chile (North of the Aconcagua River) are becoming salinized in a worrysome way. This effect is due to the employment of sophisticated systems and techniques of irrigation that were inappropiately chosen and inadequately designed. This situation

IV.-AGRICULTURAL SECTOR

IV.1. GENERAL CONSIDERATIONS

Chilean agriculture has been modernized since the 60's, and during the last decade the exportation activity of agricultural products especially fruits has become very dynamic and productive. At present, an objective and reliable diagnosis can not be established because there exists little information regarding the environmental impact of modern technology in agricultural practices and there is no public perception of this activity as a contaminant enterprise. Nevertheless, experts recognize relevant problems that will become important in the near future. Also, it has been pointed out that not only economically profitable agricultural practices contribute to environmental problems but also the agricultural practices of a sector of small farmers ("agricultura campesina") is important in this process because of malpractice and misuse of soils especially in fragile ecosystems.
Main problems identified in the agricultural area are:

Erosion

According to CIREN-CORFO (Center for the Research on Natural Resources of the state development agency) data, 11,6 million ha are affected by severe erosion, and an estimated of 8.000 ha per year are converted to desert. This problem is perceived as the most important in the agricultural sector, and is mainly caused by inadequate use of the resource. In the Central-South region of Chile, inefficient irrigation systems are causing embankments of watersystems.

Salinity Levels

Irrigated lands of northern Chile (North of the Aconcagua River) are becoming salinized in a worrysome way. This effect is due to the employment of sophisticated systems and techniques of irrigation that were inappropiately chosen and inadequately designed. This situation

is going to be critical in the near future (especially in the Copiapó Valley) unless control systems along with monitoring and appropiate technologies are adopted in the short term.

Pollution

Contamination of water systems with pesticides and fertilizers residues, and residue content in agricultural products, ie. animal hormones. The use of agrochemicals in Chile is increasing and this increment has not been accompanied by an increase in sophisticated techniques and equipment for their application. In general, agrochemicals in Chile, are used and misused, especially when products are for internal markets. Fortunately, several studies conducted in universities and in the INIA (Institute of Agriculture Research, dependent of the Ministry of Agriculture) have shown that the amounts of agrochemicals in products consumed by the Chilean population are in the low and medium levels, with no or little effect to human health. It is possible then to act on time before the problem is critical.

Regarding control of residues of products that are exported, the Chilean foundation, Fundación Chile, has a Quality Control and Residue Detection Program that follows procedures according to FDA. the main pesticides detected in Chilean fruits are: Phosmet, Diazinon, Endosulfan, Vinoclozolin, Captan, Iprodione, Methomyl, Azocyclotin, Chlorfenvinphos, Chlorpyrifos, and Parathion.

Pest Outbreaks and Pest Resistance

The introduction of monoculture practices, and the disruption of natural trophic chains prevent natural regulation of populations. The resistance of pests and diseases to chemical agents impinges upon gain and competiveness of affected products. Recent pest otubreaks in Chile were the pine moth, the blue fly (in grapes) and the Hoof & Mouth Disease.

The INIA, (agriculture research institute, dependent from the Ministry of Agriculture) is presently involved in developing agriculture techniques of no-or- low- environmental impact that would replace traditional practices.

IV.2.- LEGISLATION

-Law of Protection of the Agriculture(1981): "The President has the faculty of stopping any activity that emits smoke, dust or gases into the atmosphere if it is proved that is a health hazard for nearby inhabitants, or it alters conditions of soil causing agricultural damage or there is danger for the flora and fauna".

- Continental waters are legislated by the Código Sanitario (1944) that "forbids the discharge of industrial or mining wastes into waters that serve as drinking water source, recreational or irrigation, without previous depuration according to the established norms". The President has the faculty of ordering standstill to any activity that contaminates water.

The state agriculture service SAG is the organization in charge of control and regulation of agricultural activities. Nevetheless, other government organizations such as Ministry of Public Works through the Water Directorate, and Ministry of Public Health, among others, have control and regulation authority.

IV.3.-PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sesssions).

-The government together with agricultural organizations should find the means to achieve a realistic diagnosis of the interaction agriculture- environment, and the publication of an Agricultural -

Environment Atlas where each problem for each region is identified, and the actions to be taken to solve the problem are listed according to priorities.

- It has been agreed that the education of an agroprofessional is inadequate, and sometimes negative, regarding environmental issues. It is necessary that Chile form a human resource base that will be able to design ways of using natural resources, taking into account economic development and environmental conservation.

- More financial assistance should be given to organizations such as INIA and to universities for scientific- technological research.

- The more urgent problems should be approached immediately by study groups made up of public, private and academia experts, so that several national commissions can start working on erosion, salinity, fertilizers and pesticides. They should offer specific and unanimous solutions to each problem.

- To stimulate the practice of a sustainable agriculture, the Ministry Of Agriculture should establish national and regional awards for organic farmers as well as for research and education efforts regarding this topic.

- The government should install subsidies for the use of environmentally compatible technology, ie., water conserving routine met through non-till practices, mulch farming, use of cover crops; regular supply of organic matter; nutrient recycling mechanisms; and pest regulation through enhanced activity of biological control agents.

-The government should establish guidelines to evaluate agriculture investment projects from an environmental point of view.

- The establishment of an efficient information network should be formed where farmers can have easy access to alterindigenous technologies that are environmentally favorable.

- The Ministry of Agriculture should have a technical group designated exclusively to environmental problems and this group should evaluate the political proposals of government authorities.

- The SAG (state agriculture service) and CONAF (state forestry service) should continue to control, to protect and to preserve the agricultural and forest resources respectively. The INIA should provide adequate scientific-technical information which is necessary to determine guidelines and is most important to consider at the decision-making level.

IV.4.-POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

SERVICES
- Training programs in agroecosystems, organic farming, alter indigenous cropping systems, biological control, integrated pest management, etc.
- Training in environmental engineering.
- Environmental standards and management.
- Water and soil sampling and analysis service.
- Desalinization services.
-Residue analysis service.

EQUIPMENT
- Monitoring and measuring soil and water equipment.
- Desalination equipment.
-Agricultural equipment with incorporated sophisticated technology that minimizes contamination of soil and water.
- Agrochemical products enviromentally accepted.

V.- URBAN SECTOR

V.1. GENERAL ASPECTS

As in all western nations, Chilean population has drifted to the towns as a consequence of industrialization, increasing the role of urban areas in the life of a technological society. Santiago is the city that concentrates about 40% of Chilean population, and its atmospheric pollution occasionally reaches or goes beyond the index 501 considered dangerous by regulations emmitted from the Ministry of Health (Res. Nº 369). As most cities of the industrialized era, Chilean urban areas present the typical pollution of air, water and soil. Air pollution is the result of fuel burning in industrial furnaces, domestic fires and central heating, transport and natural dust. Water pollution comes from sewage disposal, and industrial wastewaters, and soil pollution is mainly due to garbage and, industrial and trade wastes. City activity has an added factor: noise contamination. Public pressure to solve main problems, together with the extreme air contamination of Santiago which is threatening public health, have taken authorities and experts to take measures to solve them. These will be discussed separately. The principal urban environmental problems perceived by inhabitants are listed below for cities in each region.

V.2.- MAIN URBAN ENVIRONMENTAL PROBLEMS

I Región

Have emissions of malodorous gases as well as organic and inorganic particles of fishmill industries. In Arica, its fishmill industry's atmospheric emissions have increased respiratory disease and allergic reactions. Bays and beaches are contaminated with industrial waterwastes and untreated sewage disposal. Sewage disposal is particularly important due to bacteriological contamination that has a

direct effect on health. In Arica a new sewerage pipe was built which goes farther out from the coastline and deeper than the old one. Nevertheless, the marine currents in the area keep this problem at its maximum. Atmospheric contamination is produced by a sulfuric acid industry placed in Arica.

II Región

Pollution of fresh water(Loa river) and bays are due to untreated sewage disposal, especially important in San Jorge BAy and in Tocopilla. In, Taltal, Mejillones and Tocopilla, atmospheric as well as water pollution is produced by fishmill industries. An acid plant placed in the residential sector Antofagasta caused public concerned, so it will be moved to an industrial area.

III Región

Atmospheric and water pollution caused by fishmill industries is an important factor in Caldera and Calderilla. Untreated sewage disposal is polluting freshwater (Copiapó river) and bays near Copiapó, causing an increase in the mosquito population. Malodorous contamination in Copiapó iscoming from nearby stabilizer mine tailing and sewage dams.

IV Región

Water contamination caused by sewage disposal is evident in La Herradura and Coquimbo Bay. A new sewerage pipe was installed recently in La Serena, but no evaluation is available yet. There is sewage disposal in the rivers Elqui, Limarí and Choapa which is worrysome because this water is used for irrigation and for cattle. Odor contamination in Coquimbo and La Herradura is due to fismill industry.

V Región

Air pollution in Valparaíso, Viña del Mar, Con-Cón and other nearby cities, is mainly due to: industrial processes associated with the oil refinery, cement, the smelting industry; and nearby forest fires. Also,

atmospheric pollution due to transport is noteworthy in downtown Valparaíso. Rivers and estuaries (Aconcagua, Marga-Marga, Reñaca, among others) are contaminated with industrial residues and with sewage disposals. These waters are used for agricultural purposes. Seawater and beaches are contaminated with sewage; most beaches are considered unsuitable for recreational purposes. It is presumed that fish and seafood of this region's coast is being affected but there is no evaluation of it. There is also oil spill threatenings in Con-Cón Bay where an oil refinery is placed.

VI Región

The main urban environmental problem in this region is the contamination of waterways with sewage disposal.

VII Región

Contamination of rivers (Río Claro and estero Piduco) with sewage disposal. Atmospheric and water pollution in Constitución is due to papermill industry.

VIII Región

Concepción, Talcahuano and nearby cities are considered to be industrial cities. Atmospheric pollution has not been significant due to strong winds coming from the ocean. Water pollution, on the contrary, is one of the serious problems of this region. Industrial wastes are disposed in nearby estuaries and rivers. There are studies indicating the presence of mercury and cadmium in the bays. Oil derived industries, oil refineries, and the fishmill industry are blamed for lifelessness of the coast. San Vicente Bay is considered a dead sea, due to the disappearance of biological diversity caused by contamination of industrial residues. Seafood and fish coming from nearby Concepción Bay is not recommended for human consumption due to industrial residues as well as bacterial contamination. Odor contamination produced by several fishmills placed in Talcahuano is becoming a threat for public health. Lakes, close to Concepción, which

were used for recreational purposes are nowadays eutrophicated. Drinking water in Concepción is considered of bad quality; part of the filter system is not working properly at Mochita water treatment plant.

IX Región

Sewage disposal contaminates water systems, especially in the Cautín river that receives affluents from nearby urban communities. Sewage solid waste removal is inefficient in the Cautín river. Atmospheric pollution in Temuco is due to wood heating systems and from transportation, noticeable during autumm and winter months.

X Región

In general, environmental problems of cities of this region such as Puerto Montt, Valdivia, Osorno, Ancud, and nearby cities, present problems related to sewage and garbage disposal.

XI Región

Sewage and garbage disposal are the main urban contaminants in Puerto Aysén, Coihaique and Puerto Chacabuco.

XII Región

Sewage and garbage disposal cause water and odor contamination in Punta Arenas and Porvenir. There is concern about residues of an ammonium-urea industry wastes.

Juan Fernández Archipelago

Sewage and garbage disposal are the main environmental urban problems.

Chilean Antartic Region

Problems are related to garbage odor and to inefficient solid waste disposal.

V.3.- METROPOLITAN REGION

There is no integrated evaluation of this region's urban pollution. Attention has been drawn to atmospheric pollution because of the severe contamination. Smog is impossible to ignore, and it has produced serious health problems in Santiago's population. Hydric pollution is less evaluated, and nothing is known about toxic residues disposal.

Dispersion and dilution of atmospheric pollutants is difficult because of the geographic location of Santiago. Infrequent low speed winds, thermal inversion at high altitudes and its presence at surface levels during winter months, scarce rain, and mountains surrounding the city, cause that low gas and particle emissions which produce high levels of pollution.

High industrial and domestic wastes pollute the Mapocho river, with the main agricultural land being located downstream. Food contamination with bacteria is a serious problem in Santiago, especially during Summer months.

Regarding solid waste disposal, Santiago uses sanitary land-fill that has been evaluated as good quality by international experts. Nevertheless, the public is pressuring to remove these land-fills. The negative perception of land-fills was due to operational mistakes at the implementation state, but they have been now adequately corrected.

Noise contamination is mainly due to mobile sources such as transport vehicles, especially the public tranport system. Regarding fix noise sources there are norms and regulations for maximum limits in the manufacturing industries.

V.3.- METROPOLITAN REGION

There is no integrated evaluation of this region's urban pollution. Attention has been drawn to atmospheric pollution because of the severe contamination. Smog is impossible to ignore, and it has produced serious health problems in Santiago's population. Hydric pollution is less evaluated, and nothing is known about toxic residues disposal.

Dispersion and dilution of atmospheric pollutants is difficult because of the geographic location of Santiago. Infrequent low speed winds, thermal inversion at high altitudes and its presence at surface levels during winter months, scarce rain, and mountains surrounding the city, cause that low gas and particle emissions which produce high levels of pollution.

High industrial and domestic wastes pollute the Mapocho river, with the main agricultural land being located downstream. Food contamination with bacteria is a serious problem in Santiago, especially during Summer months.

Regarding solid waste disposal, Santiago uses sanitary land-fill that has been evaluated as good quality by international experts. Nevertheless, the public is pressuring to remove these land-fills. The negative perception of land-fills was due to operational mistakes at the implementation state, but they have been now adequately corrected.

Noise contamination is mainly due to mobile sources such as transport vehicles, especially the public transport system. Regarding fix noise sources there are norms and regulations for maximum limits in the manufacturing industries.

V.3.1.- Atmospheric pollution in Santiago

Breathable particles, less than 10 um diameter, reach maximum peaks during the months of May and July, with values of 100 to 700 ug/m^3. According to recent samplings, realized according to EPA procedures, 15% of breathable particles concentration is natural dust, 77% comes from transport (especially diesel engines), and 8% from industries and other sources. A modern monitoring network was installed one and half years ago, permitting daily assessments of air quality.

Regarding emission of volatile organic compounds, 29% belongs to industries, 48% to mobile sources, and 23% to other sources. 95% of annual nitrogen oxides are emitted from mobile sources as well as 81% of carbon monoxide emission.

V.3.2.- Government action towards decreasing atmospheric pollution in Santiago

- A special commission was created with resolutive attributions whose objects are to evaluate, assess, coordinate and provide solutions for decreasing Santiago's pollution, especially smog: "Comisión Especial de Descontaminación de la Región Metropolitana".
- Environmental Sections are being implemented at the municipal level.
-About 50% of old and deteriorated public transport will be removed by 1991.
-The use of wooden stoves and wood burning fireplaces are not allowed in the most critical months (Autum and Winter).
-The exhaust systems of the fuel burning public transport have been modified to improve emissions.
- Every day, 20 % of vehicles have circulation restrictions, this restraint is kept for app. 8 months, dependent on changes in natural conditions, ie. thermic inversion phenomenon.
- Quality of exhaust emission is regularly monitored by police.

-During extreme smog condition, several industries are asked to paralize activities.

V.4.-LEGISLATION

-Resolution Nº 1215 of the Ministry of Health establishes maximum permitted for breathable particles in air suspention. Resolution Nº 369 from the same Ministry establishes the guidelines for air classification regarding gas and particle content. The following table shows average maximum concentrations permitted in ug/m^3 per each period of time.

	1 hour	8 hours	24 hours	1 year
CO	40.000	10.000	-	-
SO_2	-	-	365	80
O_3	160	-	-	-
NO_2	-	-	-	100
Total particles	-	-	260	75
Breath.fraction	-	-	150	50

- Regulation and control of water pollution is scatttered among several ministries and government organizations, making control inefficient or almost non-existent. The same legal situation that has been discussed for other areas of the economy affects the urban sector.

V.5.-PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sesssions).

V.5.1.- Industrial activity affects the quality of urban environment because of:

-- large amount of diverse industries, which affects the characterization and identification of cause-effect processes on the environment.

-- generation by industrial demand of other environmental important activities, ie. transport.

-- large number of people involved.

V.5.2.- The following actions are recommended to reduce environmental impact of industries in urban area:

-- reduction of emissions/source, either by changing the process itself or by using end of pipe technology.

--implement stable and realistic norms regarding industrial areas and environmental conservation, urban norms, and clear rules for new industrial activities.

--massive training programs on environmental evaluation, assessments, and other aspects related to the integration of processes.

-- to define the costs for the "use of the environment".

-- industry should have as a long term objective the zero emission.

Considering the above actions, there would be no need to decentralise industries in Santiago. If existing industries reduce their emissions,

there would be enough "environmental space" for increasing productive activity.

All actions of improving the environment should be in the context of adequate incentives/restrictions and should include all areas of the country. Nevertheless, emissions in other areas may be related to natural conditions of the area. Also, the punctual impact that individual emissions may cause in its surroundings should be regulated.

V.5.3. General Aspects.

-The responsibility either private, personal or corporate , belongs to the enterprises. These responsibilities should be analyzed and understood so as to be the conceptual frame of statal norms and regulations.

-The State should develop the mechanisms by which the industry responsibilities are related to environmental impact are clearly delimited and established. This action will probably be reflected by the increase of insurance companies and environmental related consulting firms.

- The ethical and moral responsibility of the entrepreneur to include the whole environmental impact derived from his activities, from production of raw materials to final elaboration of the product.

- Industrial managers have to understand that environmental protection does not limit growth but is a prerequisite for it.

V.6.- URBAN INDUSTRY RESPONSE TO ENVIRONMENTAL ISSUES

Cape Horn Methanol

This industry produces methanol (98,85% purity) form natural gas, it is located in Cabo Negro, Magallanes. Developers have considered U.S.A. environmental criteria for the building and operation of the plant. Waste water is disposed by pipe system 7 m deep in nearby bay, it is previously treated (99.99% water) and a diffusion system is located at the end of the pipe so as to minimize temperature shock. Sulfur is extracted from raw material by using a zinc reaction which then will be disposed of according to U.S.A. procedures. Impurities are recycled and used as combustibles. The company have installed computerized monitoring systems.

Lever Chile

A subsidiary of Uni-Lever, placed in Santiago, produces detergent and food stuff. They have a monitoring system for air quality, use filters and humid cyclon system. Wastewaters are treated and solids are extracted, and recycled wastewater is also used.

Renca Thermoelectric Plant (Chilgener)

This plant is located 4.5 km North of Santiago, it has two 50 MW units, and coal is used as a combustible. Vapor flow at the exit of the heaters is 238.350 kg/h at a pressure of 63 atm and a temperature of 488ºC. Thermic efficiency is 26% and consumption is 0.550 k of coal/ KWh. After an 1989 assessment study determined that gas emissions were over permitted limits, CHILGENER hired a consulting firm (LAHMEYER INTL.) to do an evaluation study for reducing gas and particle emissions. One of the sources of sulfur and particles emissions was due to the characteristic contents of Chilean coal. The company is now importing coal from USA which has low sulfur and ash content. Cost estimations for emission reduction (made by the consulting firm) are app. US$ 2,5 mn for particles, US$24-28mn for SO_x and US$ 22-25 mn for NO_x. CHILGENER is now waiting for norms and regulation that Chile will adopt befor deciding future actions.

V.7.-POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

The major problem detected in urban sector along Chile is the lack of treatment of sewage wastes. It is urgent that a national program be implemented to install treatment plants. For this, international assistance will be required.

SERVICES

-Training programs in air and water pollution: control, treatment, purification, methodology and techniques.
- Training programs in hazardous wastes disposal.
- Training in environmental engineering: ie. treatment plants.
- Environmental impact, risk, assessment studies.
- Environmental standards and management.
- Environmental audits.
- Air, and water sampling and analysis service.
- Noise and vibration monitoring measuring services.
- Solid waste management.
- Design, construction, supervision and operational guidance of treatment plants projects.

EQUIPMENT

-Computerized instrumentation for monitoring and detecting air & water quality.
-Air pollution control equipment: analysis, purification,dust collection, odor, filtration.
-Water pollution control: analysis, purification, treatment, sampling, recycling of wastewater technology.
- Solid waste technology.
-Toxic waste disposal technology.

V.7-POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

The major problem detected in urban sector along Chile is the lack of treatment of sewage wastes. It is urgent that a national program be implemented to install treatment plants. For this, international assistance will be required.

SERVICES

-Training programs in air and water pollution: control, treatment, purification, methodology and techniques.
- Training programs in hazardous wastes disposal.
- Training in environmental engineering: ie. treatment plants.
- Environmental impact, risk, assessment studies.
- Environmental standards and management.
- Environmental audits.
- Air, and water sampling and analysis service.
- Noise and vibration monitoring measuring services.
- Solid waste management.
- Design, construction, supervision and operational guidance of treatment plants projects.

EQUIPMENT

-Computerized instrumentation for monitoring and detecting air & water quality.
-Air pollution control equipment: analysis, purification,dust collection, odor, filtration.
-Water pollution control: analysis, purification, treatment, sampling, recycling of wastewater technology.
- Solid waste technology.
-Toxic waste disposal technology.

VI.- MARINE SECTOR

VI.1.- GENERAL ASPECTS

Concern about marine pollution in the South East Pacific goes back to 1966, when the IX Ordinary Meeting of the permanent commission of the South Pacific CPPS (Comisión Permanente del Pacífico Sur) agreed to prepare a group of measures to prevent contamination by harmful elements in the marine environment, and to preserve marine organisms (Resolution XII). Since then, Chile has been actively involved in programs regarding the prevention of pollution of the Southeast Pacific, especially the "Programa de Mares Regionales" (regional seas program) of the United Nations Program for the Environment " PNUMA". Many Protocol and Agreements regarding regulation of marine environment have been signed by Chile. There is an " Action Plan for the Protection of the Marine Environment and Coastal waters of the Southeast Pacific" from the CPPS together with PNUMA and COI (intergovernmental oceanographic commission). Part of this action plan is to elaborate documents with a diagnosis of the pollution of the Southeast Pacific. These documents were published in 1989, and considered contamination by hydrocarbon, heavy metals, pesticides, eutrophication and terrestrial sources.

Pollutant sources of the Chilean marine environment are mainly wastewater effluents and oil spills. Wastewater disposal in the marine environment arises principally from the untreated sewage water, industrial wastes and mine tailings, thus contaminating sea water with organic material, microorganisms, heavy metal and pesticides. The main sources of hydrocarbon contamination come from oil shipping, oil exploration and exploitation, oil refineries and oil loading and unloading processes.

VI.2.- POLLUTION FROM CONTINENTAL SOURCE

VI.2.1.-Sewage Disposal

The coastal zone of Chile,which is more than 4.200 Km long, receives domestic sewage water throughout 24 hydrographic basins.The areas that are most affected are Coquimbo Bay, Valparaíso Bay, rio Mapocho basin, which receive Santiago's discharge, and Concepción Bay that receives the sewage wastes from various towns and cities near Concepción. The total nation estimated discharge is 709 millions m^3/year, with an estimate of 140.000 tons/year of organic matter. A BOD of 27,170 t/year is estimated for direct organic discharge and 113,052 t/year for indirect organic discharge. Diseases such as typhoid are sporadically epidemic in sea resorts during Summer. In 1987, a resolution from the Health Service Branch at Coquimbo, forbid the extraction and commercialization of some filter feeding molluscs from Coquimbo Bay during the Summer, due to an outbreak of typhoid and hepatitis. In popular sea resorts there is permanent monitoring for microbiological contaminants, with the consequent closing of beaches if contaminant levels are over the accepted standards. In a monitoring study of 120 samples of 150 km of central coastal waters from 1983 to 1986, fecal coliforms were above permissible limits, arriving to upper of 95,000/ MPN/100ml.

VI.2.2.-Industrial and Mine Effluents

In Chile, the major industrial source of contaminants that affects the marine environment are the copper mining activities, cellulose, paper mills, and fish mills. The more affected areas are Valparaíso and Concepción Bays with a total of industrial residues estimated at 244,4 millions m^3/year with 67.000 ton/year BOD_5.

The mining industry has affected mainly the I, II and III Regions. The Chañaral coast, mentioned in previous sections, is the most environmental dramatic case. Fishmills have polluted primarily the I, II, and VIII Regions. Pulp and papermills together with petrochemicals,

VI.2.- POLLUTION FROM CONTINENTAL SOURCE

iron& steel and the textile industry have caused the deterioration of Concepción Bay.

In Chile, there are few studies regarding pesticides and heavy metals in the marine environment. In the VIII Región, heavy metals have been analyzed for water,sediments and some fishing resources. In the area of Tomé and Andalién, water mercury concentrations fluctuated between 0.5 and1.65 ppb, this quantitiy is beyond permissible limits according to EPA. Lead concentration (0.03 ppb) is above natural concentration in the bays of San Vicente, Concecpción, Arauco and Lenga stream. Niquel concentrations are below permitted standards, and silver (0.1ppb) is higher than natural concentrations in San Vicente Bay. Iron showed above standard's concentration in all places sampled (3.00 ppb). Zinc was high (5.00 ppb) in San Vicente Bay, and manganese was above natural concentrations in Concepción and San Vicente Bays and in the Lenga stream. In the V Región, near Valparaíso, cadmium (0.8-0.24 ug/l), copper(7.99-20.58 ug/l), lead (3.44-5.72), and zinc(8.66-55.61) showed concentrations above those levels established by Skinner and Turekian (1973).

Regarding sediments, cadmium concentrations were above natural content in Tomé , Andalién and Rocuant. In the Concepción and San Vicente bays and in the Lenga Stream concentrations of iron, copper, zinc and manganese were lower that those reported by Johnston (1976), and lead, niquel and silver concentrations were higher. In the North (Iquique, Caldera and Coquimbo), mercury concentration were reported above permitted levels.

A few analyses have been done in fishing resources in several areas of the coast. In general, heavy metal concentrations were below permitted levels with the exception of: severe cadmium contamination in a mitilid (*Perumytilus purpuratus)* from Coliumo, Burca and Lirquén (VIII Región), and moderate contamination of copper in the mytilid *Aulacomya ater* in the III Región. Lead contamination was considered

severe in the bivalve (*Mesodesma donacium*) and in the fish *Merlucius gayi* and *Trachurus murphyi* in Valparaíso Bay.

Regarding pesticides in water, Aldrin, Lindane, and DDT was considered severe in Bío-Bío, Lenga and San Vicente. DDE was severe in Lenga stream. The presence of Aldrin was detected in all sediments sampled in the VIII Región, in concentrations of 0.004 to 0.174 ppb. DDT detection limits were 0.009 to 0.68 ppb, for Lindane they were 0.021 to 2.151 ppb and for DDE they were 0.004 to 1.254 ppb. There is no permissible limit of sediment pesticides to compare with.

VI.2.3.-Fishing Sector

The fishing sector presented a sustained development in the last few years arriving at 6,4 mn ton of capture during 1989. This ranks Chile in the fifth place after Japan, China, U.S.A. and Soviet Union. The exports of the fishing industry have increased on an average of 19,8%/year between 1986 and 1989. This increment is welcomed from an economical point of view, but there is concern about resource overexploitation. A good example of export stimulus was the overexploitation of the gastropod "loco" (similar to abalone) that is now scarce and authorities have had to establish closed seasons for its capture. A new fishing law is being analyzed in the Congress, and there is public debate about it, especially because of its strict conservation measures towards marine stocks.

VI.2.4.-Fish Mills

The main contaminant source from the fishing industry is with the fish mills. In 1988 there were 58 fish mills, placed in Arica, Iquique, Tocopilla, Caldera, Coquimbo, Coronel and Talcahuano. Most of fish mills are located in urban areas, where strong odours are particularly disturbing for the local inhabitants. Wastewaters are often disposed to the marine environment with little or no treatment. The water used for pumping fish from the boats, water with blood content

coming from the fish dry wells, liquids from the squeezing process, together with water used in deodorizer and condensators goes back to the sea. Some industries have incorporated modern technology to recover solids and proteins from wastewater, and have installed filters for gas emission, but these are few.

VI.2.5.-Canned Fish Industry

There are 146 fish canning and 214 frozen fish industries. in Chile. Wastewater and solid wastes of these industries, are usually disposed in nearby garbage sites or coastal water, creating pollution problems.

VI.3.- OIL POLLUTION

The most sensitive areas with respect to hydrocarbon pollution are the Magallanes Strait because of ocean platforms and ship traffic and, Valparaíso and Concepción Bays, because they are oil refinery centers. As a result of oil and other marine transport, together with the long Chilean coast and adverse local geographic and weather conditions, there is always the risk of oil spill accidents. For example, in the Magallanes Strait tide differences are up to 10 meters, the coasts are sandy and sinuous, with some estuarine zones. Currents fluctuate according to tides and winds, some measured values are up to 3 m/sec. Winds speed is 20m/sec with gusts of 50 m/sec and sudden changes of direction.

Marine traffic in 1987, was estimated at7,800 ships distributed in 40 ports with a total load movement of 36 mn tons. Fishing activities that also have to be included in the marine traffic, added up to a total disembark of 5.374.722 tons of fish during 1988. Oil production comes from 23 platforms in Magallanes representing approx. 30% of national consumption. There are 37 oil terminals, and 3 oil refineries. From 1973 to 1986, 100,000 tons of oil was spilled, including major

accidents such as the "Metula" in the Magallanes Strait in 1974 (52,000 tons); the "Napier" near Chiloé in 1973 (30,000 tons) and the "Cabo Tamar" in Concepción in 1978 (12,000 tons). During 1987, the total oil spills detected was at 5,800 tons, mostly in the Magallanes Strait (5,500 t).

Regarding hydrocarbon concentration in seawater, maximun values reported was 66.0 ug/l in Valparaíso Bay. The higher average concentration in this same bay was 19.3 ug/l in 1985. From 1986 to 1988, average values were lower than 8.7 ug/l . Other coastal waters sampled along Chile (Iquique, Coquimbo and Concepción) showed average values of 2,5 ug/l (1985 to 1989). Hydrocarbon concentration in the sand were measured during 1986 and 1988 with average estimations of 0.08- 0.11 ug/l. A high value of 230 ug/l was found in the sand of Michilla (II Región) during 1986. The highest value found of hydrocarbon in benthonic sediment was in Concepción's samples, with an average of 2.5 ug/l with a dispersion of 0.14 to 5.06 ug/l. Other areas sampled showed average values of 0.14 to 0.64 ug/l. Hydrocarbon content in marine bivalves varies from 2.07 ug/l (Concepción, 1986) to 7.05 ug/l (Caldera-Coquimbo, 1989).

VI.4.-AQUACULTURE

Aquaculture in Chile has developed in the last 5-6 years with the installment of salmonculture in Southern Chile. Also, scallop as well as algae culturing is being developed in the Northern coasts.
The development of unknow diseases in seawater salmoncultures is worrying entrepreneurs. Recently, an "unknown agent" (AU) has caused serious economic damage to coho salmoncultures. Aquaculturists are supporting research towards solution of this disease. There are strict measures of control of imported eggs, and a control certification is required for importing them.

In general, no contamination has been perceived in this activity, except for public pressure to eliminate salmonculture activity carried out in several Southern lakes, because of contamination with organic matter. It is believed, however, that part of this public debate may be generated more by subjective perception (especially by the tourism industry) than by real studies. Recently, preliminary studies have been carried out to evaluate the impact of this activity in the lakes, and they showed that wastewater from nearby cottages and urban wastes, together with agricultural practices are far more contaminant activities than the salmon cages.

In 1989, fishing authorities made a significant advancement in incorporating the environmental dimension to regulations of aquaculture activity. Among these were:

-to present a project that contains the estimation of maximal annual production.

-to obey the 1,5 nautic miles of distance between cultures in lakes, seawater, or 3 km between river cultures.

-to consider technology for decreasing organic contamination in lakes and rivers.

VI.5. LEGISLATION

Legislation, guidelines, and norms regarding protection of the marine and most freshwater environments are the responsibility of the "Dirección General de Territorio Marítimo y Marina Mercante", DGTMM (general directorate of marine territory and merchand marine). Also the control and regulation is the responsibility of this organization.

VI.5.1. International Agreements signed by Chile.

- OILPOL/54. International agreement for the prevention of hydrocarbon contamination of seawater. 1954.
-LDC/72. Agreement for the prevention of pollution of the sea by wastes and other materials. 1972.
- CLC/75 International agreement on the civil responsability of damages caused by contamination of seawater by hydrocarbons. 1975.
- Agreement on the regional cooperation for the fight against contamination of the Southeast Pacific by hydrocarbons and other deleterious substances. 1981 (CPPS).
- Protocol for the protection of the Southeast Pacific against contaminants originated from terrestrial sources. 1986.
-Agreement for the protection of the marine environment and the coastal zone of the Pacific Southeast. 1986.

VI.5.2.- National Legislation

The main legislation regarding the marine environment are part of the Navigation Law D.L. Nº 2.222, 21 May, 1978. Articles Nº 142 to 163 of Title IX of the Navigation Law is dedicated to pollution. It contemplates:

-the prohibition of disposing in the sea garbage, ballasts, mine tailings, oil and derivatives, or any other harmful substance that will damage the waters under the Navy jurisdiction.
-to encourage the employment of appropriate technology to improve the marine environment and to comply with signed agreements.
- to penalize those responsibles for infractions.
- fines can be applied to Chilean ships caught in illegal oil unloading in waters that are not under the Navy jurisdiction.
-to acquire equipment, elements, or chemical products necessary for the control oil spills and to recover the damage areas.
-to adopt preventive measures to avoid the destruction of flora and fauna and coastal zone.

In August 1987, the DGTM y MM established a set of norms regarding all activities that dispose or will dispose wastewater to the sea or other water masses under its jurisdiction, known as "Programa Mínimo de Evaluación de Impacto Ambiental" (program of minimum evaluation of environmental impact) These norms establish that the above mentioned activities are required to carry out studies on characteristics of the effluents, a baseline study of flora and fauna together with oceanographic characterization of the environment that will receive the wastewater. Also, they should provide information regarding the design of the wastewater system with technical and dispersion characteristics. An environmental monitoring system is also required. New projects should summit this study before an authorization to operate is granted. Industries that are already operating have a time period until August 1992, to comply with this program.

VI.5.3.-Long term action by DGTM y MM

The DGTM y MM is developing activities of long term scope for protecting the marine environment. Among these are:

-the creation of the "Programa de Observación del Ambiente Litoral" POAL (program for the observation of the lithoral enviroment) which wll give baseline concentrations of contaminants both in a chronic and a permanent base.

-the elaboration of regulations for the control of marine and aquatic contamination. This document is awaiting approval from the Ministry of National Defense.

VI.6.-PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sesssions).

The proposals of actions of this sector were mainly oriented to the fishing activity and industry, with very general recommendations towards the environment. These were:

- to promote a preventive environmental policy.
- to conduct environmental impact evaluation before the authorization for introduction of exotic species.
-to establish a complete system of evaluation of the environmental impact.
-to require an environmental assessment as a prerequisite for authorizing new projects in the marine sector.
-to stimulate the participation of the fishing industry in the environment protection.
-it is necessary that government organizations reward those industries that employ "clean technology" and encourage environmental quality in their projects.

VI.7.-POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

SERVICES

-Training programs in water pollution:control, treatment, purification, methodology and techniques.
- Training programs in hazardous wastes disposal.
- Training in environmental engineering.
-Training in oil spill contingency plans.
-Oil spill fate and effects studies.
- Environmental impact, risk, assessment studies, fishery evaluation.
-Thermal discharge analisys.
-Marine water quality assessments.
- Environmental audits.
- Geophysical and oceanographic surveys.

VI.6.-PROPOSAL OF ACTIONS RECOMMENDED BY GROUP OF EXPERTS TO THE MINISTRY OF PLANNING AND COOPERATION (MIDEPLAN) in JANUARY 1991. (CIPMA- Plenary Sessions).

The proposals of actions of this sector were mainly oriented to the fishing activity and industry, with very general recommendations towards the environment. These were:

- to promote a preventive environmental policy.
- to conduct environmental impact evaluation before the authorization for introduction of exotic species.
-to establish a complete system of evaluation of the environmental impact.
-to require an environmental assessment as a prerequisite for authorizing new projects in the marine sector.
-to stimulate the participation of the fishing industry in the environment protection.
-it is necessary that government organizations reward those industries that employ "clean technology" and encourage environmental quality in their projects.

VI.7.-POSSIBLE AREAS OF INTEREST FOR CANADIAN PRODUCTS/ SERVICES.

SERVICES

-Training programs in water pollution:control, treatment, purification, methodology and techniques.
- Training programs in hazardous wastes disposal.
- Training in environmental engineering.
-Training in oil spill contingency plans.
-Oil spill fate and effects studies.
- Environmental impact, risk, assessment studies, fishery evaluation.
-Thermal discharge analisys.
-Marine water quality assessments.
- Environmental audits.
- Geophysical and oceanographic surveys.

-Undersea hazards studies.
-Coastal erosion, and shore protection studies.
-Ocean waste disposal and dumping.
-Coastal zone management and planning.

EQUIPMENT

-Computerized instrumentation for monitoring water quality.
-Water pollution control: analysis, purification, treatment, sampling, technology.
-Aquaculture implements.
-Oil spill containment equipment.
-Shoreline pollution cleanup, control equipment.
-Odor control systems.
-Solid and liquid waste handling equipment.

VII.- CONCLUSIONS

-Environmental awareness is increasing in all sectors of the Chilean economy, public, academia, private and government institutions.

- **Sustainable development** is the base concept around which all environmental proposals are being discussed.

- The public perceives environmental deterioration as threatening to health and environmental related problems, are being discussed at the community level.

- A new environmental legislation is being prepared by the government authorities which will be sent to the Congress for approval early in1991. The proposed environmental policies establish the mechanisms to produce standards and control, as well as, the definition of institutionality with clear nomination of a valid speaker. Legal regulations for each sector are being prepared including the requisition of environmental impact studies for all new projects in the productive sector as well as the environmental measures that actual industries and activities should take in the future.

- The state comission for the environment CONAMA, has available an international financial aid (US$ 20 million) to support its environmental program, included in it are: study and investment projects, equipment and substructures of the different ministeries, and institutional strengthening.

- Environmental issues: legislation, control and regulation will probably be a key priority this year, and by 1992 the environmental dimension will be enforced in the productive sector according to new legislation.

VII.- CONCLUSIONS

- Environmental awareness is increasing in all sectors of the Chilean economy, public, academia, private and government institutions.

- Sustainable development is the base concept around which all environmental proposals are being discussed.

- The public perceives environmental deterioration as threatening to health and environmental related problems, are being discussed at the community level.

- A new environmental legislation is being prepared by the government authorities which will be sent to the Congress for approval early in 1991. The proposed environmental policies establish the mechanisms to produce standards and control, as well as, the definition of institutionality with clear nomination of a valid speaker. Legal regulations for each sector are being prepared including the regulation of environmental impact studies for all new projects in the productive sector as well as the environmental measures that actual industries and activities should take in the future.

- The state comission for the environment CONAMA, has available an international financial aid (US$ 20 million) to support its environmental program, included in it are: study and investment projects, equipment and substructures of the different ministeries, and institutional strengthening.

- Environmental issues: legislation, control and regulation will probably be a key priority this year, and by 1992 the environmental dimension will be enforced in the productive sector according to new legislation.

- In the near future Chile will provide a good opportunity for the Canadian environmental products and consulting services especially in the fields of water and wastewater, solid and toxic waste management, pollution control instrumentation, environmental impact assesment, geophysic surveys, and urban utilities.

VIII.- ACKNOWLEDGMENTS

We would like to express appreciation to Domingo Lancellotti for his assistance in literature retrieval, and to Mrs. Laure Anne Edwards for critically reading this manuscript.

- In the near future Chile will provide a good opportunity for the Canadian environmental products and consulting services especially in the fields of water and wastewater, solid and toxic waste management, pollution control instrumentation, environmental impact assesment, geophysic surveys, and urban utilities.

VIII.- ACKNOWLEDGMENTS

We would like to express appreciation to Domingo Lancellotti for his assistance in literature retrieval, and to Mrs. Laure Anne Edwards for critically reading this manuscript.

IX.-BIBLIOGRAPHY

Armada de Chile,Dirección de Territorio Maritimo y Marina Mercante.1987. Aprueba Programa Mínimo de Evaluación de Impacto Ambiental en el Ecosistema Costero. Resolución Nº 12600/550.

Asenjo, R. 1990. Legislación ambiental y honestidad política. Amb. y Des. VI(1):77-81.

Ayala, E. 1990. Experiencia de CMPC en la conservación del medio ambiente. Ser. Doc. Seminario. Sector Forestal. CIPMA.

Berdegué, J. 1990. Agricultura y Medio Ambiente. Ser. Doc. Seminario. Sector Agrícola. CIPMA.

Boré, D., Pizarro,F., Cabrera,N. 1986. Diagnostico de la contaminación marina en Chile. IFOP-CORFO. Santiago.

Cabrera,N.1989. Contaminación Marina en el Pacífico Sudeste Proveniente de Fuentes Terrestres : Inventario de Fuentes de Contaminación a 1989. Doc.PNUMA/OCA/PSE-CPPS/COI IG.72/13 INFO 2. Bogotá, Colombia.

Cañete,P. 1988. Experiencias de Dow Chemical. Amb. y Des. IV (1,2): 111-113;

Cheeseman, C.T. 1990. Experiencias de Forestal e Industrial Santa Fe en la conservación del medio ambiente. CIPMA Ser. Doc. de Seminario.

Chuecas,L.1989. Contaminación por metales pesados en el litoral de la región del Bío-Bío, Concepción, Chile: el caso del mercurio y el cadmio. Amb. y Des. V (1):137-145.

CIPMA, 1990. Directorio de personas vinculadas al tema del medio ambiente en Chile. Ser. Directorio Nº 1.

Comisión Permanente del Pacífico Sur. 1986. Seminario taller sobre evaluaciones de impacto ambiental en el medio marino y áreas costeras del Pacífico Sud Este. Santiago, Chile. CPPS. Ser. de Seminarios y Estudios Nº 6. Bogotá, Colombia.

IX.-BIBLIOGRAPHY

Armada de Chile,Dirección de Territorio Marítimo y Marina Mercante.1987. Apruebe Programa Mínimo de Evaluación de Impacto Ambiental en el Ecosistema Costero. Resolución Nº 12600/550.

Asenjo, R. 1990. Legislación ambiental y honestidad política. Amb. y Des. VI(1):77-81.

Ayala, E. 1990. Experiencia de CMPC en la conservación del medio ambiente. Ser. Doc. Seminario. Sector Forestal. CIPMA.

Berdegué, J. 1990. Agricultura y Medio Ambiente. Ser. Doc. Seminario. Sector Agrícola. CIPMA.

Boré, D., Pizarro,F., Cabrera,N. 1986. Diagnostico de la contaminación marina en Chile. IFOP-CORFO. Santiago.

Cabrera,N.1989. Contaminación Marina en el Pacífico Sudeste Proveniente de Fuentes Terrestres : Inventario de Fuentes de Contaminación a 1989. Doc.PNUMA/OCA/PSE-CPPS/COI IG.72/13 INFO 2. Bogotá, Colombia.

Cañete,P. 1988. Experiencias de Dow Chemical. Amb. y Des. IV (1,2): 111-113.

Cheeseman, C.T. 1990. Experiencias de Forestal e Industrial Santa Fe en la conservación del medio ambiente. CIPMA Ser. Doc. de Seminario.

Chuecas,L.1989. Contaminación por metales pesados en el litoral de la región del Bío-Bío, Concepción, Chile: el caso del mercurio y el cadmio. Amb. y Des. V (1):137-145.

CIPMA, 1990. Directorio de personas vinculadas al tema del medio ambiente en Chile. Ser. Directorio Nº 1.

Comisión Permanente del Pacífico Sur. 1986. Seminario taller sobre evaluaciones de impacto ambiental en el medio marino y áreas costeras del Pacífico Sud Este. Santiago, Chile. CPPS. Ser. de Seminarios y Estudios Nº 6. Bogotá, Colombia.

Comisión Permanente del Pacífico Sur/ Programa de las Naciones Unidas para el Medio Ambiente.1986. Plan de contingencia para combatir la contaminación del petróleo en el Pacífico Sud Este (Colombia, Chile, Ecuador, Panamá y Perú). Doc. PNUMA-CPPS/IG. 45-7, Rev. 2.

Comisión Permanente del Pacífico Sur/Programa de las Naciones Unidas para el Medio Ambiente (Ed.).1986. Informes Resumidos sobre el Estado de Desarrollo de los Planes Nacionales de Contingencia para Combatir Derrames de Petroleo en: Colombia, Chile, Ecuador, Panamá y Perú. Compilación Plan de Acción del Pacífico Sudeste Documento Adicional , Bogotá ,Colombia

Consejo de Rectores.1989. Guia de Autoridades Superiores de Universidades Chilenas.

Cortés,H. 1990. Manejo del bosque nativo y exportación de astillas. Ser. Doc. Seminario. Sector Forestal. CIPMA.

Delmastro,R. 1990. Experiencia de Forestal Valdivia,S.A. en conservación ambiental. Ser. Doc. Seminario. Sector Forestal. CIPMA.

Durán,H. 1990. Impacto ambiental de la actividad minera en Chile:Balance preliminar. Amb. y Des. VI,(1) :65-76.

Gallardo,A.1984. Revisión Actualizada a 1983 de la Contaminación Marina Provenientes de Fuentes Terrestres en la Región del Pacífico Sudeste,(Colombia, Chile, Ecuador, Panamá, Perú).Rev.Com.Perm. Pacífico Sur,(14): 19-173.

Geisse, G. 1988. Desarrollo sostenible aquí y ahora. Amb. y Des. IV (1,2):11-14.

Gurovich, L. 1990. Mejoramiento de suelos afectados por salinización causada por el riego por goteo en el valle de Copiapó-Chile. CIPMA Ser.Doc. Seminario.

Gutierrez, F. 1989. Diagnóstico de la Contaminación Marina en el Pacífico Sudeste por Metales Pesados, Pesticidas y Eutroficación. Doc. CPPS/COI/PNUMA(OCA)-PSE Consul 2. Bogotá ,Colombia.

Hakek,E., P.Gross y G.A.Espinoza.1990. Problemas ambientales de Chile.Vol.I y II. Alfabeta Impresores Santiago,Chile.

Herrera,J. y Vignolo,C. 1981. El desarrollo de la industria del cobre y las empresas transnacionales: La experiencia del cobre. Doc. CEPAL.

Instituto de Fomento Pesquero (IFOP). 1990. Directorio Pesquero Chileno.

Jimenez, F. 1988. Experiencias de Lever Chile. Amb. y Des. IV (1,2):119-123.

Johnston, R. 1976. Marine Pollution, Academic Press. London, N. York, San Francisco. 729pp.

Katz,R. 1990. Acción ambiental e industria: el caso de la región metropolitana de Santiago. CIPMA. Ser. de Doc. : 19-34.

Krausse, R. 1988. Experiencias de Cape Horn Mehtanol. Amb. y Des. IV (1,2):115-117.

Lagos,G. 1990. Análisis ambiental de la minería chilena .Amb. y Des. VI(1):43-51.

León, R. 1987. Experiencias ambientales de Shell-Chile. División Metales. Amb. Y Des. Número Especial: 59-64.

MacNeill,J.1990. Desarollo sustentable,economía y el imperativo del crecimiento. Amb.y Des.VI(1):25-42.

Meyer, M. 1990. El programa de la Fundación Chile para la certificación de productos con residuos no detectables. CIPMA Ser. Doc. Seminario.

Morales, E. 1990. Manejo del bosque nativo y exportación de astillas. Ser. Doc. Seminario. Sector Forestal. CIPMA Ser. Doc. Seminario.

Muñoz, O. 1988. Crisis y reorganización industrial en Chile. Notas técnicas, CIEPLAN 123, Santiago.

Novoa, R. 1990. Productividad agrícola y protección ambiental. Investigación y transferencia tecnológica. CIPMA Ser. Doc. Seminarios.

O'Brien, J. 1990. Empresa Nacional de Minería (ENAMI): Nuevas autoridades designan encargado ambiental para el diseño de planes y políticas. Amb.y Des. VI(1):87-88.

Ojeda, J.M. 1990. Minera Escondida: Programa ambiental en zonas de explotación y descarga de afluentes. Amb.y Des. VI(1):83-85.

Parrot, R. 1990. Peligro y oportunidades para la industria forestal chilena resultantes de la actitud internacional frente al tema del medio ambiente. Ser. Doc. Seminario. Sector Forestal. CIPMA.

PNUMA/COI. 1989. CONPACSE Evaluación y Recomendaciones.

Ramorino,L.1989. Diagnóstico sobre la Contaminación por Hidrocarburos de Petroleo en el Pacífico Sudeste:Colombia,Chile,Ecuador,Pamamá y Perú. Doc.CPPS/COI/PNUMA(OCA)-PSE Consult.1.

Ribbeck, C. 1990. Emisión de contaminantes- Central Renca. CIPMA. Ser. de Doc. : 83 - 88

Serrano, P. 1985. Función de las tecnologías apropiadas en el medio ambiente chileno. Amb. y Des. I (2):61-80.

Schmidt,H.1990. Manejo del bosque nativo y exportación de astillas. Ser. Doc. Seminario. Sector Forestal. CIPMA.

Skinner, B.J. & Turekian,K.K. 1973. Man and the ocean. Prentice hall, Inc. Englewood Cliffs. N.J.

Susaeta, E. y Benedetti, S. 1990. El sector forestal y la conservación ambiental. Ser. Doc. Seminario. Sector Forestal. CIPMA.

Trucco, R. Inda,J. & Fernández,M.L. 1990. Heavy metal concentration in sediments from Tongoy and Herradura Bays, Coquimbo, Chile.

Undurraga, J. 1990. Corporación Nacional del Cobre (CODELCO): Nueva administración implementa polítca de mejoras ambientales. Amb.y Des. VI(1): 89-91.

Valenzuela, F. 1990. Disputada de las Condes. Política de Protección incluye capacitación ambiental de los trabajadores. Amb.y Des. VI(1): 86-87.

Bulletins and Journals.

-Aqua Noticias Internacional (Fundación Chile).
-Ambiente Ahora.
-Ambiente y Desarrollo.
-Anuario Estadístico de Pesca (SERNAP).
-Boletín Informativo "Mar Chileno" (CONA).
-Chile Pesquero.
-CIPMA Serie de Documentos de Seminario.
-Comisión Permanente del Pacífico Sur:Serie Seminarios y Estudios.
-Industria y Medio Ambiente.
-Investigación Pesquera (Chile).
-La Gaceta de los Investigadores del Ambiente.
-The South Pacific Mail.

1.-ACADEMIA DIRECTORY

Centro de Investigación y Planificación de Medio Ambiente (CIPMA)
Guillermo Geisse G.
Presidente
Juan Crisóstomo Jacques 2268, Providencia
Santiago F : (02) 2339896 FAX : (562) 2338925

María T. Lladser L.
Coordinadora de Información
Juan Crisóstomo Jacques 2268, Providencia
Santiago F : (02) 2339896 FAX : (562) 2338925

Pontificia U. Católica de Chile
Facultad de Agronomía
Eduardo Venezian L.
Decano
Av. Vicuña Mackena 4860
Santiago F : (02) 5522375

Facultad de Ciencias Biológicas
Renato Albertini B.
Decano
Av. Libertador B. O'Higgins 340
Santiago F : (02) 2225603

Facultad de Ingeniería
Eduardo Varas C.
Decano
Av. Vicuña Mackenna 4860
Santiago F : (02) 5525804

Instituto de Estudios Urbanos
Patricio Gross F.
Director
El Comendador 1916
Santiago F : (02) 2325057

1.-ACADEMIA DIRECTORY

Universidad Arturo Prat
Italo Lanino R.
Director de Investigación
Av.11 de Septiembre 2120
Iquique F : (081) 21845; 21699

Centro de Estudios del Desierto
José Delatorre H.
Director
Av.11 de Septiembre 2120
Iquique F : (081) 21309 ; 22438

Departamento de Ciencias Básicas
José Vergara P.
Director
Av.11 de Septiembre 2120
Iquique F : (081) 21309; 22492

Departamento de Ciencias del Mar
Augusto Gonzalez M.
Director
Av.11 de Septiembre 2120
Iquique F : (081) 21349

Departamento de Ingeniería
Waldo Alfaro A.
Director
Av.11 de Septiembre 2120
Iquique F : (081) 21309; 22438

Universidad de Atacama
Germán Caceres A.
Director de Investigación
Av. Copayapu 333
Copiapó F : (052) 212662

Facultad de Ingeniería
Mario Meza M.
Decano
Av. Copayapu 485
Copiapó F : (052) 212005

Universidad Austral de Chile
Juan Slebe T.
Director de Investigación
Campus Isla Tejas Casilla 567
Valdivia F : (063) 212681

Facultad de Ciencias
Justo Zamora B.
Decano
Campus Isla Tejas Casilla 567
Valdivia F : (063) 212681

Facultad de Ciencias Agrarias
Rafael Pessot Z
Decano
Campus Isla Tejas Casilla 567
Valdivia F : (063) 212681

Facultad de Ciencias de la Ingeniería
Fredy Rios M.
Decano
General Lagos 2086
Campus Miraflores
Valdivia F : (063) 215070

Facultad de Ciencias Forestales
Eduardo Morales V.
Decano
Campus Isla Tejas Casilla 567
Valdivia F : (063) 212681

Facultad de Ciencias Veterinarias
Edmundo Butendieck B.
Decano
Campus Isla Tejas Casilla 567
Valdivia F : (063) 212681

Universidad Católica de Valparaíso
Fernando Acevedo B.
Director General de Investigación
Av. Brasil 2950
Valparaíso F : (032) 251024

Facultad de Agronomía
Eduardo Salgado V.
Decano
Fundo La Palma
Quillota F : (033) 251024

Facultad de Ciencias Básicas y Matemáticas
Victoriano Campos P.
Decano
A. Brasil 2950
Valoaraíso F : (032) 251024

Facultad de Ingeniería
Dante Pesce S.
Decano
Av. Brasil 2127
Valparaíso F : (032) 251024

Facultad de Recursos Naturales
Esteban Morales G.
Decano
Av.Altamirano 1505
Valparaíso F : (032) 217672

Universidad Católica del Norte
Sergio Espinoza R.
Director de Investigación, Extensión y Asistencia Técnica
Av. Angamos Nº 0610
Antofagasta F : (083) 241148

Facultad de Ciencias
Hugo Alonso
Av. Angamos Nº 0610
Antofagasta F : (083) 241751

Facultad de Ciencias del Mar
Ramiro Trucco B.
Larrondo 1281
Coquimbo F :(051) 311984 FAX : (056) 311287

Universidad de Antofagasta
Rafael Ledezma S.
Director General de Investigaciones
Av. Angamos 601
Antofagasta F : (083) 226689

Facultad de Ciencias de la Salud
José Grenet O.
Decano
Campus Coloso s/nº
Antofagasta F : (083) 241660

Facultad de Ingeniería
Decano
Pedro Córdova M.
Angamos 601
Antofagasta F : (083) 222228

Universidad de Chile
Francisco Aguilera G.
Director General Académico y Estudiantil
Alameda 1058 OF. 106
Santiago F : (02) 724094

Facultad de Ciencias
Camilo Quezada B.
Decano
Las Palmeras 3425,Ñuñoa
Santiago F : (02) 2724881 ; 2712865

Facultad de Ciencias Agrarias y Forestales
Antonio Lizana M.
Decano
Santa Rosa 11315
Santiago F : (02) 5587635 ; 5587042

Facultad de Ciencias Físicas y Matemáticas
Atilano Lamana P.
Decano
Av. Beauchef 850
Santiago F : (02) 6967442

Instituto de Estudios Internacionales
María T.Infante C.
Directora
Condell 249,Providencia
Santiago F : (02) 274 0850

Instituto de Nutrición y Tecnología de los Alimentos
Fernando Monckeberg B.
Director
Av. José Pedro Alessandri 5440
Santiago F : (02) 2214030

Universidad de Concepción
Mario Silva O.
Director de Investigación
Casilla 119-C
Concepción F : (041) 234985

Facultad de Ciencias
Moises Silva T.
Decano
Barrio Universitario s/nº
Concepción F : (041) 234985

Facultad de Ciencias Agropecuarias y Forestales
Alejandro Valenzuela A.
Decano
Casilla 537
Chillan F : (042)222645

Facultad de Ciencias Biológicas y de Recursos Naturales
Victor Herrera L.
Decano
Barrio Universitario s/nº
Concepción F : (041) 234985

Facultad de Ingeniería
Sergio Villafañe R.
Decano
Barrio Universitario s/nº
Concepción F : (041) 234985

Universidad de La Frontera
Valerio Bifani C.
Director de Investigación y Desarrollo
Av. Francisco Salazar 01145
Temuco F : (045) 241418

Facultad de Ciencias Agropecuarias
Decano
Av.Francisco Salazar 01145
Temuco F : (045) 241418

Facultad de Ingeniería
Roberto Gesche R.
Decano
Arturo Prat 321
Temuco F : (045) 210516

Universidad de La Serena
Blago Razmilic B.
Director de Investigación
Av. Raul Bitran s/nº
La Serena F : (051) 211868

Facultad de Ciencias
María Berrios S.
Decano
Benavente 980
La Serena F : (051) 211302

Facultad de Ingeniería
Emile Leroy B.
Decano
Benavente 980
La Serena F : (051) 211775

Universidad de Magallanes
Perdro Jadrievic K
Director de Investigación
Zenteno y Angamos s/nº
Punta Arenas F : (061) 224523

Facultad de Ingeniería
Jorge Reyes M.
Decano
Zenteno y Angamos s/nº
Punta Arenas F : (061) 224523

Universidad de Playa Ancha
Marcelo Gonzales C.
Director de Investigación
Av. Playa Ancha 850
Valparaíso F : (032) 217728

Facultad de Ciencias Naturales y Exactas
Rodolfo López A.
Decano
Av. Gran Bretaña 40
Valparaíso F : (032) 251525

Universidad de Santiago de Chile
Pedro Navarrete A.
Vicerrector de Investigación
Av. Libertador B. O'Higgins 3363
Santiago F : (02) 6812243 ; 6811100

Facultad de Ciencias
Gerardo Galindo G.
Decano
Av. Libertador B. O'Higgins 3363
Santiago F : (02) 6811739 ; 6811100

Facultad de Ingeniería
Mario Letelier S.
Decano
Av. Libertador B. O'Higgins 3363
Santiago F : (02) 6812033 ; 6811100

Universidad de Talca
Jorge Retamales A.
Director de Investigación
Av. Lircay s/nº
Talca F : (071) 233617

Facultad de Recursos Naturales
José Olaeta C.
Decano
Av. Lircay s/nº
Talca F : (071) 233617

Universidad de Tarapacá
Luis Alwin V.
Director Investigación y Desarrollo Científico
18 de Septiembre 2222
Arica F : (080) 222600

Facultad de Ciencias
Claudio Díaz M.
Decano
General Velasquez 1775
Arica F : (080) 232067

Facultad de Ingeniería
Hugo Mendizabal J.
Decano
Barros Arana 2930
Arica F : (080) 231798

Instituto de Agronomía
Eugenio Doussoulin E.
Director
Valle de Azapa KM 12
Arica F : (080) 224157

Universidad de Valparaíso
Juan Kuznar H.
Director de Investigación Científica y Tecnológica
Hontaneda 2653
Valparaíso F : (032) 250073 ; 212012

Universidad del Bío Bío
Marcial Cortés T.
Director de Investigación,Promoción y Desarrollo
Av. Collao 1202
Concepción F : (041) 238984

Facultad de Ciencias
Justo Lisperguer M.
Decano
Av. Collao 1202
Concepción F : (041) 238984

Facultad de Ingeniería
Francisco Rams L.
Decano
Av. Collao 1202
Concepción F : (041) 238984

Facultad de Recursos Naturales
Nora Plaza C.
Decano
18 Septiembre 580
Concepción F : (041) 223195

Universidad Metropolitana de Ciencias de la Educación
Gabriel Aval C.
Director de Investigación
Av. José Pedro Alessandri 550
Santiago F : (02) 2257731

Facultad de Ciencias Básicas
Mafalda Schiappacasse C.
Decano
Av. José Pedro Alessandri 550
Santiago F : (02) 2257731

Universidad Técnica Federico Santa María
Giovani Pesce S.
Director General de Investigación y Postgrado
Av. España 1680
Valparaíso F : (032) 660176

Facultad de Ciencia
Miguel Blazquez J.
Decano
Av. España 1680
Valparaíso F : (032) 660176

Facultad de Ingeniería
Alejandro Livingston B.
Decano
Av. España 1680
Valparaíso F : (032) 660176

2.-AGRICULTURAL SECTOR DIRECTORY

C y D Internacional S.A.
Oficina General
Los Conquistadores 1700 Torre A, 25º piso
Santiago F : (02) 2310075 ; 2310069

Del Curto S.A.
Oficina General
Av. Kennedy 5682
Santiago F : (02) 2112701

E.M.B.Empresa Agricola
Marcos Montt S.
Consultor Proyectos Administración
Fundo El Membrillo,Correo Peñablanca
Valparaíso F : (032) 951660

Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO)
José Leyton V.
Santa María 6700,Las Condes
Santiago F : (02) 2288056 FAX : (562) 484312

Semillas Hibridas Jacques
Oficina General
Huérfanos 1022, OF. 909
Santiago F : (02) 6981002 ; 6994242

Semillas Pioner Chile Ltda
Oficina General
Coyancura 2241, 3º piso
Santiago F : (02) 2313468 ; 2316295

Semillas Tracy Ltda
Oficina General
Antonio Bellet 347
Santiago F : (02) 2257844 ; 2749110

Unifrutti Traders Ltda
Oficina General
Miraflores 178, 18º piso
Santiago F : (02) 38111

United Trading Company Desarrollo y Comercio S.A.
Oficina General
Av. Antonio Varas 541
Santiago F : (02) 2514680

3.-FORESTRY SECTOR DIRECTORY

Aserraderos Copihue S.A.
Guillermo Güell
Gerente General
Av. 11 de Septiembre 2155 Torre C 14º piso
Santiago F : (02) 2326681 FAX : (562) 2311903

Celulosa Arauco y Constitución S.A.
Oficina General
Agustinas 1070,6º piso
Santiago F : (02) 6981961 ; 727522

Cholguan S.A.
Oficina General
Estado 337,2º piso
Santiago F : (02) 395097

Compañía Manufacturera de Papeles y Cartones S.A. (CMPC)
Ernesto Ayala
Presidente
Agustinas 1343, 4º piso
Santiago F; (02) 727532 ; 727644

Forestal e Industrial Santa Fé S.A.
Ricardo Ventura -Juncá T.
Gerente Legal y Asuntos Públicos
Av. 11 de Septiembre 1850, Providencia
Santiago F : (02) 2316616

Forestal Mininco S.A.
Daniel Contesse
Sub-Gerente de Planificación
Agustinas 1343 3º piso
Santiago F : (02) 6981941

Jaime Salas A.
Superintendente Técnico
Casilla43-C
Concepción F : (041) 371526

Forestal Río Vergara S.A.
Arturo Urrutia R.
Jefe, Depto.Desarrollo y Estudios
Recinto Industrial INFORSA s/nº
Nacimiento

Instituto Forestal (INFOR/CORFO)
Luis Otero D.
Huérfanos 554
Santiago F : (02) 391363 FAX (562) 381286

Alfredo Unda P.
Huérfanos 554
Santiago F : (02) 395377 FAX (562) 381286

Maderas y Sintéticos S.A.
Ricardo Hohf T.
Subgerente de Ingeniería
Chumpullo s/nº
Valdivia F : (063) 214451 FAX : (063) 216945

Proyectos Forestales
Eduardo Urrutia R.
Asesor Forestal
José Victorino Lastarria 202,Depto 304
Santiago F : (02) 399602

Tasman-Chile S.A.
Richard Parrot
Gerente General
Ahumada 179, 7º piso
Santiago F : (02) 6990088

4.-GOVERMENT DIRECTORY

Armada de Chile
Juan C. Toledo
Director General Territorio Marítimo y MM.
Errázuriz 537, Playa Ancha
Valparaíso F : (032) 258091

Rodolfo Camacho O.
Director
Instituto Hidrográfico de la Armada de Chile
Comite Oceanográfico Nacional (CONA)
Errazuriz 232 ,Playa Ancha
Valparaíso F : (032)251056

Ministerio de Agricultura
Juan A. Figueroa Y.
Ministro
Teatinos 40, 9º piso
Santiago F : (02) 6964496

Genaro Rodríguez F.
Coordinador Medio Ambiente
División Estudios y Presupuesto
Teatinos 40, 8º piso
Santiago F:6963241. FAX: (562) 716500

Gonzalo Villarino H.
Teatinos 40, 8º piso.
Santiago F : (02) 6963241

Corporación Nacional Forestal (CONAF)
Juan Franco
Director Ejecutivo
Bulnes 285, 5º piso
Santiago F : (02) 722724

4. GOVERNMENT DIRECTORY

Armada de Chile
Juan C. Toledo
Director General Territorio Marítimo y MM.
Errázuriz 537, Playa Ancha
Valparaíso F : (032) 258091

Rodolfo Camacho O.
Director
Instituto Hidrográfico de la Armada de Chile
Comité Oceanográfico Nacional (CONA)
Errazuriz 232 ,Playa Ancha
Valparaíso F : (032)251056

Ministerio de Agricultura
Juan A. Figueroa Y.
Ministro
Teatinos 40, 9º piso
Santiago F : (02) 6864456

Genaro Rodríguez F.
Coordinador Medio Ambiente
División Estudios y Presupuesto
Teatinos 40, 8º piso
Santiago F:6963241 FAX: (562) 716500

Gonzalo Villarino H.
Teatinos 40, 8º piso.
Santiago F : (02) 6963241

Corporación Nacional Forestal (CONAF)
Juan Franco
Director Ejecutivo
Bulnes 285, 5º piso
Santiago F : (02) 722724

Pedro Araya R.
Jefe, Sección Parques Nacionales
Bulnes 285, 5º piso
Santiago F : (02) 722724

Iván Benoit C
Jefe, Sección Flora Silvestre
Bulnes 285, 5º piso
Santiago F : (02) 722724

Juan Moya
Jefe Oficina de Estudios
Bulnes 285, 5º piso
Santiago F : (02) 722724

Carlos Weber B.
Depto. Areas Silvestres Protegidas
Bulnes 285, 5º piso
Santiago F : (02) 722724 ; 6960783

Iván Nazif
Director, División Estudios y Presupuesto
Teatinos 40
Santiago F:6963241. FAX: (562) 716500

Ministerio de Bienes Nacionales
Luis Alvarado C.
Ministro
Ministerio de Bienes Nacionales
Av.Bernardo O'Higgins 280.
Santiago F.(02) 2225718. FAX:(562) 2222886

Rafael Asenjo
Secretario Ejecutivo
Comisión Nacional del Medio Ambiente(CONAMA)
Av.Bernardo O'Higgins 280, 2º piso
Santiago F.(02) 2222256; 2222903. FAX:(562) 222271

Omar Cerda I.
Sector Pesquero
Comisión Nacional del Medio Ambiente(CONAMA)
Av.Bernardo O'Higgins 280, 2º piso
Santiago F.(02) 2222256; 2222903. FAX:(562) 222271

Guillermo A.Espinoza
Coordinador Técnico
Comisión Nacional del Medio Ambiente(CONAMA)
Av.Bernardo O'Higgins 280, 2º piso
Santiago F.(02) 2222256; 2222903. FAX:(562) 222271

Ana Maria Ibacache B.
Area Contaminación
Comisión Nacional del Medio Ambiente(CONAMA)
Av.Bernardo O'Higgins 280, 2º piso
Santiago F.(02) 2222256; 2222903. FAX:(562) 222271

Patricio A. Rodrigo S.
Jefe, División Planificación y Presupuesto
Av.Bernardo O'Higgins 280. 5º piso.
Santiago F.(02) 2225718. FAX:(562) 2222886

Ministerio de Economía, Fomento y Reconstrucción
Carlos Ominami
Ministro
Teatinos 120
Santiago F : (02) 725522 ; 723509

Ricardo Méndez Z.
Subsecretaría de Pesca, Depto.Recursos
Bellavista 168, 17º piso
Valparaíso (032) 212187; 212811 ;211195

Darío Rivas A.
Subsecretaría de Pesca, Depto.Recursos
Bellavista 168, 17º piso
Valparaíso (032) 212187; 212811 ;211195

Servicio Nacional de Pesca (SERNAP)
Juan Rusque
Director
Yungay 1731, 4º piso
Valparaíso F : (032) 217390

Esteban Palma I.
Jefe, Estadística Pesquera
Yungay 1731, 4º piso
Valparaíso F:(032) 250009 FAX: (032) 259564

Ministerio de Educación
Ricardo Lagos
Ministro
Av. Bernardo O'Higgins 1371
Santiago F : (02) 6983351

Comisión Nacional de Investigación Científica y Tecnológica (CONICYT)
Oficina General
Canadá 308
Santiago F : (02) 2744537

Ministerio del Interior
Enrique Krauss R.
Ministro
Palacio de la Moneda
Santiago F : (02) 714103 ; 717054

José Abalos K.
Jefe, Depto. Regionalización
Amunátegui 178 4º piso
Santiago F : (02) 6990069 FAX : (562) 6994293

Eduardo Arriagada
Presidente
Comisión de Descontaminación del Area Metropolitana de Santiago
Moneda esq. Morandé
Santiago F : (02) 6982413; 6987076

Juan Escudero
Secretario Ejecutivo
Comisión de Descontaminación del Area Metropolitana de Santiago
Moneda esq. Morandé
Santiago F : (02) 6982413; 6987076

Sergio Galilea O.
Jefe, Desarrollo Regional
Amunátegui 178 4º piso
Santiago F : (02) 6990066

Alfredo Saleh
Jefe, Depto. Protección Civil
Beaucheff 1367
Santiago F : (02) 718333

Ministerio de Minería
Juan Hamilton
Ministro
Teatinos 120, 8º piso
Santiago F : (02) 6965872 ; 6988404

Iván Valenzuela
Subsecretario de Minería
Teatinos 120, 9º piso
Santiago F: 6988404 ; 6986593

Ministerio de Obras Públicas (MOP)
Carlos Hurtado R.
Ministro
Morandé 59-71
Santiago F : (02) 6995581 ; 724506

Dirección General de Aguas
Morandé 59, 8º piso
Santiago F : (02) 6985341

Enrique Bley L.
Director Regional
Dirección de Arquitectura
1 Oriente 1253
Talca F:(071) 231839.

Pedro Bravo C.
Director Regional
Dirección Regional de Aguas. VII Región.
6 Oriente 1220
Talca F: (071) 234231; 231762

M.Angelica Rovira T.
Secretaria Ejecutiva
Jefe Unidad Técnica Medio Ambiente
Morandé 59, 6º piso
Santiago F : 723765; FAX : (056) 726609

Sergio Zenteno B.
Director General
San Martín 1062, 3º piso
Concepción F:(041) 233213; 222573

Servicio Nacional de Geologia y Minería
Hernán Danus V.
Director Nacional
Av. Santa María 0104, Providencia
Santiago F : (02) 375050

Ministerio de Planificación y Cooperación (MIDEPLAN)
Sergio Molina
Ministro
Ahumada 48
Santiago F : (02) 722033

Federico Arenas
Depto. Apoyo Regional
Ahumada 48
Santiago F : (02) 722033

Rodrigo Arévalo C.
Depto.Inversiones
Ahumada 48, 6º piso
Santiago F : (02) 722033 FAX : (562) 721879

Enrique Fernández
Secretario Ejecutivo
Comisión de Transporte Urbano
Ahumada 48
Santiago F : (02) 722033

Fernando Ordoñez
Subdirector Regional
Ahumada 48
Santiago F : (02) 715159

Alejandro Vergara B.
Abogado
Ahumada 48, 5º piso
Santiago F : (02) 722033

Ministerio de Relaciones Exteriores
Enrique Silva Cimma
Ministro
Palacio de la Moneda
Santiago F : (02) 724298 ; 6982501

Marta Rodriguez
Dirección de Política Especial
Depto. Mar
Morandé 441, 2º piso
Santiago F : (02) 6982501

Ministerio de Salud
Jorge Jimenez
Ministro
Enrique Mac-Iver 541
Santiago F : (02) 396480 ; 394001

Daniel Juricic V.
Jefe, Programa Sobre el Medio Ambiente
Mac Iver 541 4º piso.
Santiago F : (02) 381843

Ministerio de Transportes y Telecomunicaciones
Germán Correa
Ministro
Amunátegui 139
Santiago F : (02) 726503 ; 724531

Ministerio de Vivienda y Urbanismo
Alberto Etchegaray A.
Ministro
Serrano 15, 6º piso
Satiago F : (02) 332012 ; 393770

Eugenio Salvi
Jefe,Depto. Desarrollo Urbano
Av. Bernardo O'Higgins 924
Santiago F : (02) 383366

Comisión Nacional de Energía (Ministerio de Mineria)
Ricardo Katz
Teatinos 120, 7º piso
Santiago F : 6981757. FAX : (562) 6981757

Instituto Nacional de Normalización (INN)
Leonor Ceruti M.
Jefe, División de Normas
Matías Cousiño 64, 6º piso
Santiago F : (02) 6968144; 6960247

5.-MARINE SECTOR DIRECTORY

Centro de Educación, Desarrollo e Investigaciones de la Pesca Artesanal de Chile (CEDIPAC)
Luis Morales Z.
Coordinador General
Orden de Malta 1467-A
Santiago F : (02) 2257921

Empresa Maritima S.A. (EMPREMAR)
Juan Gamper R.
Almirante Gomez Carreño 49
Valparaíso F : (032) 258061

Empresa Portuaria de Chile (EMPORCHI)
Nobuo Suzuki S.
Jefe Sub-Depto. Prevención de Riesgos
Blanco 839
Valparaíso F : (032) 257167

Eperva- Indo
Ricardo Bravo L.
Huérfanos 863,3º piso
Santiago F : (02) 331155

Fundación de Pescadores Artesanales (FUNCAP)
Jacob Marcos M.
Subdirector
Teatinos 120 OF.806
Santiago F : (02) 6980543

Instituto Antártico Chileno (Ministerio de Relaciones Exteriores)
Daniel Torres N.
Jefe, Sección Ciencias Biológicas
Luis Thayer Ojeda 814, Providencia
Santiago F : (02) 2322617

Instituto de Fomento Pesquero (CORFO)
Patricio Bernal P.
Director Ejecutivo
Av. José Domingo Cañas 2277, Ñuñoa
Santiago F : (02) 2239627 ; 2256325

Instituto de Investigación Pesquera Octava Región S.A.
Hugo Arancibia F.
Casilla 350
Talcahuano F : (041) 541540

Pesca Chile S.A.
Eduardo Arriagada M.
Estado 10, 8º piso
Santiago F : (02) 398139 FAX : (562) 394527

Pesquera Friosalmón S.A.
Manuel Achurra L.
Gerente
Santiago F : (02) 2741012 FAX : (562) 334525

Pesquera Indo S.A.
José Cañon C.
Jefe, Depto.Investigación
Huérfanos 863,3º piso
Santiago F : (02) 331155 FAX : (562) 393436

Pesquera San José de Coquimbo S.A.
Juan Willumsen V.
Gerente Técnico
Av. Américo Vepucio 80, 4º piso,Las Condes
Santiago F : (02) 2281262 FAX : (562) 2285975

PROCHILE (Sector Pesca)
María Salazar L.
Av. Bernardo O'Higgins 1315,2º piso
Santiago F : (02) 6960043 FAX : (562) 6960639

Servicio Nacional de Pesca (SERNAP)
Esteban Palma I.
Jefe,Sección Estadística Pesquera
Yungay 1731, 4º piso
Valparaíso F:(032) 250009 FAX: (032) 259564

Sociedad Pesquera Coloso S.A.
Luciano Déaz V.
Ingeniero de Desarrollo
Av. Providencia 2653,14º piso
Santiago F : (02) 2323435 FAX : (562) 2326726

Julio Vidal J.
Consultor, Programa Recursos Pesqueros
Av. Providencia 2653,14º piso
Santiago F : (02) 2323435 FAX : (562) 2326726

Sociedad Pesquera Coloso S.A. y Guanaye Ltda.
Mirta Sanhueza D.
Asesor Ambiental
Casilla 576,Correo 11,Ñuñoa
Santiago F : (02) 279073 ; 2238027

Sociedad Pesquera Guanaye Ltda. y Pesquera Indo
Mirta Sanhueza D.
Av. Pedro de Valdivia 1219, Providencia
Santiago F : (02) 2238027

6.-MINING SECTOR DIRECTORY

Carbonífera Schwager S.A.
Oficina General
Almirante Pastene 315
Santiago F : (02) 2517384

Cape Horn Methanol Ltd.
Rodolfo Krausse
Av.Apoquindo 3200,5º piso
Santiago F : (02) 2465900 FAX : (056) 2316638

Comision Chilena del Cobre (Ministerio de Minería)
Oficina General
Agustinas 1161, 4º piso
Santiago F : (02) 713529 ; 726219

Compañia de Carbones de Chile S.A.(COCAR)
Efraín Friedman
Presidente
Moneda 920, Of.404.
Santiago F : (02) 710318

Compañía Minera del Pacífico
Oficina General
Huérfonos 699, 3º piso
Santiago F : (02) 395666

Antonio Reghezza I.
Jefe de Proyectos.
Brasil 1050.
Vallenar F : (054) 612431 FAX : (054) 611284.

Alfonso Rojo L.
Presidente Comisión Protección del Medio Ambiente.
Pedro Pablo Muñoz 657
La Serena F : (051) 312210

Compañia Minera Doña Ines de Callahuasi S.A.
Walter Bernal T.
Jefe Administrativo
Isidora Goyenechea 3162, Las Condes
Santiago F : (02) 2321201

Compañía Minera El Indio
Demian Posel M.
Superintendente de Salud y Prevención de Riesgos.
Sitio 58 Alto Peñuelas
La Serena F : (051) 212425

Corporación Nacional del Cobre (CODELCO)
Jaime Undurraga M.
Director,Asuntos Públicos y Control Ambiental
Huérfanos 1270
Santiago F : (02) 6988801

Rubén Pedreros Q.
Jefe Proyectos, Depto. Ingeniería Conceptual
Chuquicamata F : (083) 322201; 325489

Bartolomé Aljaro
Jefe Proyecto Control Ambiental
División El Teniente
Rancagua F : (072) 292716 FAX : (056) 292074

Juan Gimenez
Jefe Depto. Control de Calidad
División El Teniente
Rancagua F : (072) 292716

Empresa Nacional del Carbón
Oficina General
Antonio Bellet 281
Santiago F : (02) 2517408 ; 2517410

Empresa Nacional de Minería (ENAMI)
Adolfo Cuadro E.
Ingeniero de Proyectos
Mac Iver 459
Santiago F :(02) 396061

Empresa Terranova S.A.
Leonor Zemelman S.
Area Ecología
Huérfanos 669, 8º piso.
Santiago F : (02) 6967979; 395666

Geotécnica Consultores
María E. Parot
Jefe Proyecto Area Ambiental
Darío Urzúa 1944, Providencia
Santiago F : (02) 2734055

Manganeso Atacama
Oficina General
Agustinas 1022, OF.920
Santiago F : (02) 6966069

Sergio Véliz B.
Gerente General
Vulcano s/nº
Coquimbo F : (051) 311461 ; 312485

Minera Disputada de Las Condes S.A.
Fernando Valenzuela
Jefe División Aspectos y Reglamentación Ambiental
Av.Pedro de Valdivia 291
Santiago F : (02) 2333037

Minera Escondida Ltda.
Andrés Camaño M.
División Ambiental
Angamos 721
Antofagasta F : (083) 247935 FAX : (083) 247547

José Ojeda F.
Gerente de Recursos y Medio Ambiente
Av. Angamos 721
Antofagasta F : (083) 247935

Shell-Chile
Ricardo León
Gerente de Metales
Av. El Bosque 90
Santiago F : (02) 23337035

Sociedad Química y Minera de Chile S.A. (Soquimich)
Oficina General
Moneda 970,15º piso
Santiago F : (02) 6991956 ; 711121

7.-NATIONAL AND INTERNATIONAL ORGANIZATIONS

Centro de Estudios de Tecnologías Apropiadas para América Latina (CETAL)
Pedro Serrano R.
Casilla 197-V
Valparaíso F : (032) 680713

Centro de Estudios del Desarrollo (CED)
Eduardo Dockendorf
Ricardo Lyon 0128, Providencia
Santiago F : (02) 2312723 ; 2311953

Centro de Estudios Sociales y Educación (SUR)
Gonzalo Arroyo C.
Coordinador
José Manuel Infante 85, Providencia
Santiago F : (02) 497908 FAX : (562) 2740515

Gonzalo Fallabella G.
Román Díaz 199, Providencia
Santiago F : (02) 497908 FAX : (562)2740514

Centro de Experimentación y Capacitación en Tecnología Apropiada (TEKHNE)
Waldo Bustamante G.
Director
Ureta Cox 1034 San Miguel
Santiago F : (02) 5516056

Centro de Investigación de la Realidad del Norte
Victor Guerrero C.
Vivar 984
Antofagasta F : (083) 21965

Centro de Investigación y Planificación de Medio Ambiente (CIPMA)
Guillermo Geisse G.
Presidente
Juan Crisóstomo Jacques 2268, Providencia
Santiago F : (02) 2339896 FAX : (562) 2338925

María T. Lladser L.
Coordinadora de Información
Juan Crisóstomo Jacques 2268, Providencia
Santiago F : (02) 2339896 FAX : (562) 2338925

Centro de Investigaciones en Recursos Naturales (CIREN/CORFO
Agustín Cristi A.
Manuel Montt 1164, Providencia
Santiago F : (02) 2236641 FAX : (562) 2233664

Centro para el Desarrollo Campesino y Alimentario (AGRARIA)
René Martorell
Providencia 1387,3º piso
Santiago F : (02) 493530

Centro de Estudios,Medición y Certificación de Calidad (Cesmec Ltda.)
Pedro Vergara
Gerente General
Av. Marathon 2595, Ñuñoa
Santiago F : (02) 2380556 FAX : (562) 2384135

Rodrigo Saavedra G.
Jefe, Depto. Ingeniería General
Av. Marathon 2595, Ñuñoa
Santiago F : (02) 2380556 FAX : (562) 2384135

Edwin Party
Jefe, División Servicios de Ingeniería
Av. Marathon 2595, Ñuñoa
Santiago F : (02) 2380556 FAX : (562) 2384135

Comisión Económica para América Latina y el Caribe (CEPAL)
Sergio Boissier
Coordinador (CEPAL/ ILPES)
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051

George Kerrigan
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 6981757 FAX : (562) 6981757

Ian Thomson
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051

CEPAL/ONU
Fernando Fajnzylber
Asesor Regional Desarrollo Industrial
Director de División Conjunta
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051 al 485061

CEPAL /PNUMA
Francisco Brzovic P.
Consultor
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051 al 485061

Nicolo Gligo
Coordinador Desarrollo y Medio Ambiente
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051 al 485061

Osvaldo Sunkel
Asesor Especial
Secretaría Ejecutiva
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051 al 485061

Comisión Permanente del Pacífico Sur (CPPS)
Oficina Regional
Teatinos 20, 9º piso OF. 93
Santiago F : (02) 726652 : 726654

Comité Nacional Pro Defensa de la Fauna y Flora (Chile)
Oficina General
Antonia López de Bello 024
Santiago F : (02) 377290

Corporación de Fomento de la Producción (CORFO)
Ernesto Tironi
Gerente General
Moneda 921
Santiago F : (02) 380521

Corporación de Investigaciones Económicas para Latinoamérica (CIEPLAN)
Dagmar Raczynski
Av. Cristóbal Colón 3494, Las Condes
Santiago F : (02) 238262

Dirección General de Relaciones Económicas Internacionales (Prochile)
Dirección General
Av. Pedro de Valdivia 0193,9º piso
Santiago F : (02) 2315538 ; 2317108

Fundación Claudio Gay
Adriana Hoffman
Las Palmeras 3425, Ñuñoa
Santiago F : (02) 2748281

Instituto Antártico Chileno (INACH)
Daniel Torres N.
Jefe, Sección Ciencias Biológicas
Luis Thayer Ojeda 814, Providencia
Santiago F : (02) 2322617

Instituto de Ecología de Chile
Raúl Gillet
Presidente
Agustinas 641 OF.11
Santiago F : (02) 330963

Instituto de Fomento Pesquero
Patricio Bernal P.
Director Ejecutivo
Av. José Domingo Cañas 2277, Ñuñoa
Santiago F : (02) 2239627 ; 2256325

Instituto de Investigaciónes Agropecuarias (INIA)
Rafael Novoa
Director, Estación Experimental La Platina
Santa Rosa 11610 Paradero 33
Santiago F : (02) 5586061

Instituto Latinoamericano y El Caribe de Planificación Económica y Social (ILPES) de Naciones Unidas
Sergio Boisier
Coordinador
Area de Planificación Regional
Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051 al 485061

Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO)
Kyran Thelen
Oficial Forestal Regional
Santa María 6700, Las Condes
Santiago F : (02) 2288056 FAX : (562) 484312 1

Organización Maritima Internacional (OMI)
Oficina Regional
Av. Dag Hammarskjold s/nº, Las Condes
Santiago F : (02) 485051 FAX : (562) 480256

Programa de las Naciones Unidas para el Desarrollo (PNUD)
Oficina Regional
Pedro de Valdivia 0193, 7º piso
Santiago F : (02) 2324183 FAX : (562) 2325804

8.-URBAN SECTOR DIRECTORY.

Cemento Bio-Bio S.A.
Oficina General
Barros Errázuriz 1968, 9º piso
Santiago F : (02) 2250534 FAX : (562) 2250370

Cemento Melón S.A.
Oficinas Generales
Miraflores 178, 4º piso
Santiago F : (02) 381005

Eduardo Cornejo G.
Superintendente Técnico
Pedro de Valdivia 98
La Calera F : (033) 221011

Cemento Polpaico
Oficinas Generales
Amunátegui 178, 5º piso
Santiago F : (02) 712019 ; 728078

Chilectra Metropolitana
Ramón Torres U.
Santo Domingo 789
Santiago F : (02) 382000

Chiletabacos S.A.
Francisco Rosso N.
Encargado Asuntos Medio Ambiente
A. Jaramillo 1053
Rancagua F : (074) 858331

Compañía de Carbones de Chile S.A.(COCAR)
Efraín Friedman
Presidente
Moneda 920, Of.404.
Santiago F : (02) 710318

Dames and Moore Chile Ltda.
Jaime Illanes P.
Av. 11 de Septiembre 1860, Of. 45
Santiago F : (02) 25177174;2517238 FAX:(562) 23189

Empresa Nacional de Electricidad S.A. (ENDESA)
Fernando Orellana
Sub-Gerente Ingeniería
Santa Rosa 76.
Santiago F : (02) 2229098

Empresa Nacional de Petroleo (ENAP)
Oficina General
Ahumada 341
Santiago F : (02) 381845

Vicenta Perez D.
Jefe de Protección Ambiental
J.Nogueira 1101
Punta Arenas F : (061) 221721

Lever Chile
Francisco Jiménez
Director Técnico
Av. Carrascal 3551
Santiago F : (02) 6812511

Petroquímica Dow S.A.
Haroldo Avaria C.
Depto.Seguridad, Previsión de Pérdidas, Higiene Industrial y Medio Ambiente.
Rocoto 3013.
Talcahuano F : (041) 542547

Patricio Cañete T.
Gerente Proyecto Medio Ambiente
Casilla 337
Talcahuano F : (041) 542888; 372971

Petrox S.A.
Mario Espinoza G.
Jefe, Servicio Prevención de Riesgos.
Casilla 29-C
Concepción F : (041) 585696

Refinería de Petroleo Concón S.A.
Luis Riveros M.
Jefe, Laboratorio Químico
Casilla 242
Concón, Valparaíso F : (032) 811095; 811096

Same Ingeniería Industrial
Sabdiel Mella A.
Gerente
Portugal 28, Torre 4, Depto. 124
Santiago F : (02) 2221608