Table of Contents

EXECUTIVE SUMMARY

1. National Situation

1.1 General

The prospective Climate Change would, according to the current scientific knowledge, modify natural resources, productive activities and national economies. Uruguay (Republic of Uruguay) would not be an exception. Some activities and resources of the country would, to a greater or lesser extent, be vulnerable to the Climate Change.

Uruguay is situated in the mild weather region in the SE of South America. Its territory is 176,000 km^2 and its population slightly above 3 million inhabitants. In the last decade the population annual growth rate was 0.6%. The mean live expectancy at birth for a native Uruguayan is 72.4 years. The UN Human Development Index of 1994 placed Uruguay 32nd in the ranking. Montevideo (capital city) -and most of Uruguay's population- is located on the coast of the River Plate.

Uruguay's political system is a democracy of the representative type. The official education is non-religious, free and obligatory. There is absolute religious freedom, with a predominance of the Catholic religion and 38% of the people are non-religious. The official language is Spanish.

The climate is mild, with a predominance of NE winds, well-defined winter and summer seasons, and intermediate seasons (Cfa type according to Köpen). Rainfalls are irregular and characterized by their interannual variability.

Natural risks are mainly linked to climate events. Recent studies have shown the existence of changes both in the coastal climate and environment, although no cause has been identified.

The enforcement of the UN Framework Convention on Climate Change (UNFCCC), coincided with a process of change within the country. This process included economic, social, educational and institutional transformations.

The Uruguayan economy depends, to a large extent, on the service sector. Cattle breeding, agriculture and fishing form a sector of great importance, which employs 15% of the labour force. The manufacturing industry generated around 90% of the income corresponding to the Uruguayan exports in 1996. The growing tourist industry and its associated services represent an important source of resources for the country.

Various changes are taking place in the energy structure of the country, mainly related to the development of regional interconnections (natural gas and electricity) with neighbouring countries.

Uruguay, together with Argentina, Brazil and Paraguay have created the Southern Common Market (Mercosur). In 1996, Uruguay's 48% exports and 44% imports were made within the Mercosur.

1.2 Characterization of Specific Sectors.

The Agriculture sector plays an important role within the national economy, and its activities occupy a large extent of the national territory. Wheat, rice and barley are the main crops. The most common practice is to alternate crops with pastures for bovine and ovine cattle. Meat and wool production are based on natural pastures.

The coastal area presents a succession of sandy beaches divided by rock outcrops. There are also slopes and cliffs. The storms affecting the coastal areas, when associated to SE winds, are characterized by increments in the height and frequency of the waves and by a rise in the sea level.

The variability of the Uruguayan coast determines the presence of a great diversity of species and sea resources. On the coast, there are several human settlings as well as economic developments (tourism, fishing, etc.). Most of the fishing is done in the River Plate and in the Atlantic Ocean.

2. National Inventory of Greenhouse Effect Gases: 1990 (INGEI 90)

The National Inventory of Greenhous Gases of 1990 (INGEI 90) was elaborated with the methodology of the Inter-government Panel on Climate Change (IPCC Guidelines annexed to Decision 10/CP.2). The corresponding report was published in July 1997 and its completion and publishing are expected for the first half of 1998.

For the development of these activities, the UCC has implemented and is at present using a management system that involves both private and public enterprises and activities. The UCC has not only counted on technical assistance but also acted within a broad interinstitutional cooperation framework.

The results of the Inventory (reference year 1990) show, as well as possible, the net emissions of Greenhouse Effect Gases in the country during the reference year.

Methodological limitations have partially affected the representation of some sectors of INGEI 90. Neverthelless, in spite of some difficulties in reference to emission factors and data uncertainties, etc, the results obtained are considered to reasonably reflect the reality.

Uruguay's net CO_2 emissions reached nearly 5 million ton in 1990. In decreasing order, the Transport, Residential and Industry subsectors were those with a larger participation in the emission of this gas. The Forestry subsector was an important fixer of this gas.

According to IPCC Guidelines, CO_2 emissions from traditional biomass burning are not included in the Energy Sector. Yet, considering their relative importance and for their discussion, they are analyzed together with energy-related emissions. Around a third of CO_2 emissions resulted from biomass fuel consumption, particularly firewood, and almost a third of the total emissions of that gas were compensated by its absorption in the Forestry sector (new forests and sprouting of the existing ones).

Transport and Small Scale Combustion were responsible for most CO_2 emissions, followed by the Industrial subsector. Within Transport, Road transport was the main source of CO_2 emissions.

CO_2 emissions from biomass burning in urban and rural households represented more than 90% of the Small Scale Combustion subsector.

Also, almost 208 kton of CO_2 emissions were generated by Portland cement production.

Most methane emissions arose in the Agriculture Sector. These emissions were mainly originated in cattle breeding, particularly bovine. Another sifnificant source of methane emission in this category was the Rice subsector. However, emissions from rice cultivation were considerably lower than those from enteric fermentation.

The Waste Sector also was an important source of CH_4 emissions, mainly through the decomposition of municipal solid waste (MSW). The Province of Montevideo generated 58% of MSW emissions. Methane from commercial and domestic wastewater and industrial wastewater was significantly less than that from other sources.

The main source of N_2O emissions from soils was animal excretion.

Most emissions of NO_x and CO were caused by the energy sector. The emissions of NO_x and CO from biomass burned on site are scarce.

In Uruguay, the cutting down and burning of forests to change the use of the land is not a common practice. The Forestry Law fostered the development of new forests. Since the enforcement of this law the number of sinks has increased.

In the long run, the partial contributions of Uruguay to global warmng through CH_4 and N_2O emissions (both significantly lower than the one of carbon dioxide) will turn to be more important than those from by CO_2 emissions.

3. Measures for the application of the UN Framework Convention on Climate Change

Uruguay had an active participation in the negotiation of the UNFCCC, which was enforced in the country on November 16, 1994. The Convention objectives and the commitments arising thereof are coincident with some national goals.

The existing regulatory and institutional framework was the basis for structuring the initial actions of application of the Climate Change Convention. In order to apply the Convention decisions, the Climate Change Unit (UCC) was created. The UCC implemented a project for the institutional strengthening of the Ministry of Housing, Territory Arrangement and Environment (MVOTMA). This project has the support of the Global Environment Fund and the United Nations Development Program. The results of the Project URU/95/G31 were brought along the lines of the main commitments of the country. The CCU is the operational and management agent and the focus for the UNFCCC.

With the support of the Country Studies Program (USA), the National Committee for Global Change carried out the first stage of the Country Study relative to the Climate Change Impact Assessment for the Agriculture and Coastal Resources Sectors in Uruguay. The second stage of the study is being developed with the assistance of the Country Study Program.

Although no goals have been set for developing countries, Uruguay is actively involved in contributing to the stabilization of the atmospheric concentrations of Greenhouse Gases. The specific sectorial measures and initial steps for adaptation are being identified within the framework of the projects with the assistance received.

The activities of the energy sector are being assessed by means of offer & demand simulation models and technological options.

Within the non-energy Sector, the Agriculture Sector presents mitigation options presently under study. The practice of direct sowing (zero tilling) appears as an interesting option to reduce CO_2 emissions and contribute to its fixation. The efficiency in the use of fertilizers will result in a substantial decrease of direct emissions of N_2O and also in an indirect mechanism for CO_2 fixation. For that purpose, also the increase of forest areas destined to long-life use wood production may result attractive.

Specific measures to mitigate methane and carbon dioxide emissions are currently at an advanced stage of implementation both in the Waste Sector and Portland cement and Lime production Sector.

The applicability of the general circulation model for the region was assessed during the first stage of the mentioned Country Study relative to the vulnerability and adaptation. Likewise, all data relevant for Climate Change studies existing in the country was surveyed and analyzed.

In the agriculture component, the Study evaluated the vulnerability of two winter crops (barney and wheat), two summer crops (rice and corn) and pastures for cattle breeding. The main national crops would be vulnerable to higher increases in temperature, with uncertain results respect to rainfalls variations. In the case of barney, the harvest yielding would decrease with temperature rise and greater rainfalls. In reference to rice, it has not been possible to establish conclusions. The yielding of dry farming corn crops would be affected by temperature rise and fewer rainfalls and with rainfall variability increase while being favored in scenarios with rainfall increase. Scenarios with temperature rise would imply an increase in fodder production, an effect which could be enhanced or not, depending on the rainfalls behavior.

The coastal resources component determined that the rates of rise of sea mean-level (SML) observed in Montevideo and Punta del Este ports, show values quite below those of the global average. The studies of simulation models showed a positive co-relation between wind intensity increase, with directions within the South quadrant, and the height of the waves. The dunes adjacent to the low lands and to the Atlantic coast are greatly sensitive to the changes in atmospheric circulation and eolic transportation.

Coastal wetland flooding, recession of the coastal line and erosion would affect differently the various coastal areas. The risk value for the different scenarios of sea mean level rise, increases rapidly above the growth factor of 0.5 m. The limited studies performed (section 3.12c.1) show that in economic terms, the

most vulnerable coastal areas would be those with the highest population density.

In spite of some uncertainty, some general initial measures of adaptation have been identified. Nevertheless, complementary studies are required in order to determine with greater precision the value of natural coastal resources and to deepen the knowledge on the different processes both of natural origin and induced by Man's action.

Training, generation of public awareness, the active participation of the private sectors involved and of the NGOs, and the optimization of the technical assistance available are crucial for action.

Efficient legal instruments are necessary in order to facilitate and ensure adequate transference of knowledge and technology to the developing countries. Mitigation activities carried out between countries are a valuable tool to be taken into account.

With the participation of various organizations and national and foreign institutions (section 3.13), a broad training program is being implemented to facilitate the execution of projects, improve the existing technical capacity and inform and motivate different population sectors.

An urban national study-survey showed that in 1995 (section 3.14), the population -though apparently informed about some global environment problems- was unaware of both the Greenhouse Effect and the Climate Change impact. Various publications were printed aiming to diffuse the problem and generate public awareness. Most of them were destined to highschool and primary school students. For the same purpose, campaigns, workshops, conferences, leaflets and press interviews are among the activities developed.

Uruguay also participates in the world programs of observation and watching of both climate and environment. Likewise, Uruguay takes part in the regional American research effort through the Inter-American Institute of Global Change Investigation.

Research and studies related or connected to the climate or Climate Change are commonly carried out in isolation and not within the framework of the application of the UNFCCC.

4. Information relative to paragraph 5, 16, 19 and 22 of the Annex to Decision 10/CP.2.

In Uruguay, both studies and research relative to the application of the UNFCCC have been or are being executed. These first steps for the formulation of general programs for mitigation and adaptation should be complemented by more detailed works and integrated into a general plan, for which technical and financing assistance are required.

Fluid and economical access to practices and processes for mitigation and adaptation is considered indispensable to implement these programs.

The already existing assistance mechanisms (financing and technical) are also required in order to improve data quality, determine the local factors of emission and include several minor activities (not considered until now) in the INGEI.

Although the existing infrastructure is adequate to perform the assessments and identify mitigation and adaptation measures, as well as to implement specific projects in some areas, it will be necessary to complement it with additional funding and adequate transference of technology. The presence of stimuli is vital to obtain the results desired through the application of policies and measures.

1.National Situation

1.1 General

1.1.1 Introduction

Societies and eco-systems have always evolved naturally adapting to the climate. However, fast and deep climate change such as the one forecasted for the next decades will probably have a radical impact on life conditions, and on those activities and economies based on the use of natural resources. In Uruguay, as well as in other countries, certain sectors such as farming and cattle breeding, water resources, use and development of coastal areas, forest systems, and human health are potentially vulnerable.

Geography and location factors determine the level of vulnerability. Part of Uruguayan territory extends along the down-stream coast of the River Plate - a system of great natural variability-, and receives therefore, the impact of the activities and works developed along the coast. Likewise, it is subject to the effects of the complex ocean-land-atmosphere interaction of the South-Western Atlantic Ocean, where the River Plate runs and the Malvinas and Brazil currents meet.

Uruguay, owing to its small size and low degree of industrialisation, is a minor contributor to the global warming process.

As a consequence of the globalisation process of the post-cold-war period, Uruguay has the imperious need to come to terms with a highly competitive scenario at large scale: the global economy.

The country, within the context of the Southern Common Market (Mercosur), faces the challenge to preserve the values and characteristics of its democratic society, based on an important middle class and a balanced system of social distribution, and, at the same time, trigger the transformation of its production sector, so as to be able to meet the new demands of development and of an ever-increasing market.

With this in mind, a process of change has been fostered, which is based on two basic main objectives: obtaining gradual control over the inflation and the complete integration of Uruguay within Mercosur.

The success of the reform of the social security system, the return to a sustained economic growth, the start of an educational reform, the slow reduction of the inflation rate down to historical levels, the reform of the constitution and the effective downsizing of the State, are the most visible symptoms of the above mentioned readaptation process.

Uruguay has reverted its recession, reactivate the exporting sector and increased the investment rate both in public and private spheres, while its fiscal situation evolves positively. Although Uruguayan industrial sector is relatively small, it has been reactivated and shows an increasing rate of investment, which is now in full expansion as a result of a lowered inflation rate, the disappearance of the delayed exchange rate and a higher regional demand.

1.1. 2 Territory and Population

The Republic of Uruguay (Uruguay), is situated between coordinates 30º-35º South and 53º-58º, East. It is surrounded by Argentina to the west, Brazil to the north and north-east, the River Plate to the south and the Atlantic Ocean to the east.

The Uruguayan coast covers 680 km, 452 of which correspond to the River Plate and 228 to the Atlantic Ocean. Along the coast are several important urban centres. Montevideo, Uruguay's capital city, is the most important one. Approximately 70% of the country population live in this coastal area.

Thanks to its geographical situation Uruguay has a strategic position in the South Cone of the continent. This substantially favours its regional integration policy. The country provides an outlet for the countries of the River Plate basin (over 3 million km2 covering part of the territory of Argentina, Bolivia, Brazil, Paraguay and Uruguay) and represents a bridge between the two greatest national economies of the region, its neighbouring countries, Argentina and Brazil.

Uruguay's territory comprises approximately 176.000 km^2, none of which is inhospitable and nearly 90% of which is usable. In addition there are almost 140.000 km^2 of territorial sea, islands and jurisdictional waters of border courses and lakes.

Uruguay is divided into 19 Provinces. Montevideo, its capital city, which rises over a harbour on the River Plate, has a very good natural port which provides services and facilities in accordance with the modernisation process of the city.

The population of the country, above 3 million, is primarily of European origin, mainly Italian and Spanish, with various contributions as a result of an open-doors immigration policy. The predominance of the white race is almost absolute with a very reduced presence of black of African origin who arrived in the country in colonial times. The indigenous population who originally inhabited the region disappeared more than a century ago. The average population density is 17.8 inh./km2.

Although most of the Uruguayan territory is devoted to agriculture, 89% of its population live in urban areas. Montevideo's metropolitan area concentrates practically 42% of Uruguay's population. For the period 1985-1996, the annual rate of population growth was 0.6%, among the lowest for developing countries.

1.1.3 Socio-cultural Characteristics

Uruguay is a democratic republic with a presidentialist government with a three-power division: executive, legislative and judicial. The President of the Republic is elected through direct, popular vote every 5 years (there is no mechanism for re-election). With the exception of two short interruptions in this century, the country has developed a democratic tradition since its independence in 1825.

The official education system in Uruguay is non-religious, free and obligatory. Such is the rule for Primary Education since 1887 and has progressively been extended to Secondary Education, while the public University is also free. The non-religious principle does not apply to private education institutes.
In 1995, the literacy rate was 96.2% for the population over 10 years of age, and the student-teacher ratio is 21.

The Constitution guarantees religious freedom. Thus, several religions coexist: Catholics represent 56.2% of the population, non-religious people 38.3%, Protestants 2%, Jews 1.7% and others 1.1%.

The official language is Spanish.

The average life expectancy at birth is 72.4 years, which is evidence of the acceptable levels reached in health and food development. In 1994 the households below poverty line amounted to 6%. Uruguay ranks 32^{nd} in the Human Quality Index of the United Nations among a total of 174 nations, third in Latin America following Argentina and Costa Rica (table 1.1). The country's Income distribution is similar to that of Denmark.

Poverty, measured in terms of unsatisfied basic needs (UBN), has evolved from 17.7% in 1984 to 7.6% in 1995. The report on Economic and Social Progress in Latin America (IDB, 1995) states that Uruguay's social expenditure is the highest of the region, and that it represents 21% of the GNP. The social security system covers 66% of the population economically active. The unemployment rate for the last biennial oscillated around 12%.

In general, Uruguay is a developing mean income country.

Figure 1.1

	Uruguay	Argentina	Brazil	Mexico	Venezuela	USA
GNP per capita US$ (1994)	7,710	8,720	5,400	7,040	7,770	25,880
Life expectancy at birth (years)	72,4	71,8	66,3	71,5	71,8	77.0
Literacy (%)	96,2	96,0	81,1	87,6	89,8	99.0(*)
Infant mortality (% born alive)	2,0	2,4	4,7	3,4	2,3	0.9
Homes below poverty line (%)						
UN Human Development Index	6	12	39	29	41	N/A
(global position 1994)	32	30	58	48	44	2

Sources: UNPD, Human Development Report, 1996; Economic Commission for Latin America and the Caribbean, Statistics 1996; World Bank Atlas 1995.
(*): datum of 1993

1.1. 4 Climate Characteristics

The climate is mild without abrupt extreme variations. Uruguay has an undulated topography without significant differences in height respect of mean sea level. This together with its small territorial size imply that the climate parameters, such as temperature, rainfall, etc. show very little spatial variations.

In general, there is a strong influence of the semipermanent anticyclone in the Atlantic which determines the entry of tropical air of high temperatures and humidity and a predominance of North-Eastern and Eastern winds.

The Pacific anticyclone introduces frequent polar air currents, predominantly from the Southeast which reach Uruguay along maritime or continental paths, which in turn determines lower or higher humidity.

In general, rainfalls and harsh weather are associated to the passage of cold and warm fronts, instability lines and frontal depressions.

Winter and summer periods are clearly defined and there are intermediate or transition seasons, autumn and spring. According to Köppen classification, Uruguay classifies as Cfa: warm weather, mild, humid environment, irregular rainfall, with mean temperature between -3 to 18 ºC in the coldest month and above 22 ºC in the warmest one.

Mean effective insolation per year ranges between 2500 and 2700 hours, the mean annual temperature is 17.5 ºC, ranging from 20 ºC in the Northeast and 16 ºC on the Atlantic coast. The highest mean temperatures occur in January and February and the lowest one in June and July.

Total mean rainfall varies from a minimum on the coast of the River Plate of almost 1,000 mm and a maximum on the Northeastern region of about 1,400 mm. The rainfalls are characterised by their irregularity and inter-annual variability. Long periods of drought and heavy rainfall have been recorded along the years.

There is a clear predominance of north-east winds. Mean wind speed is within a range of 15 km/h, although markedly higher values are registered in some coastal areas. During storms, maximum wind speed has reached 200 km/h.

Mean relative humidity fluctuates between 70% and 75%. July is the month with the highest mean relative humidity (80%) and January the one with the lowest (65%). In general, maximum humidity occurs at first hour in the morning and the minimum after midday.

Natural risks in Uruguay are mainly linked to climate events: sporadic droughts, floodings, frosts, heat waves and other meteorological phenomena at the micro or medium scale (hailstorms, tornados, squalls, etc.).

Today, it seems that both Uruguayan climate and the coastal environment are in a process of change

although causes have not been identified. These changes include: a) an increase of 200 mm in rainfalls in Montevideo since 1883, which became more evident in the period 1961-1990 (Bidegain and Deshayes, 1992), b) an increase of 0.5 ^{o}C in air temperature and a decrease of 0.5 mm Hg in atmospheric pressure (Nagy et al., 1996), c) for the period 1961-1990, an increase in mean summer temperatures (Panario and Bidegain, 1996), d) in the last decades, an increase of 30% in the fluvial flow pouring in River Plate and a decrease in mean annual salinity in the Uruguayan coast (Nagy et al., 1996) and e) a greater occurrence of noxious algae build-up in the Eastern coast of the Uruguay river (Méndez, pers. com.). These changes alone -without considering the global change- justify the need to conduct in-depth research on the local environmental processes and their interaction with regional and global phenomena (such as ENSO).

1.1.5 Economy

The Uruguayan economy depends strongly on the service sector, which includes trade, tourism sector, financial and insurance services, real estate agencies, and services to companies. In 1996, the service sector accounted for over half of the Gross National Product (GNP), the Industrial and the Agriculture and Fishing sectors which play an important role in the economy, 17.8% and 10.0% respectively (Figure 1.2).

Figure 1.2

Gross National Product (GNP) per sector of activity (US$ million and GNP %)

Sector	1992		1994		1996(*)	
	US$	%	US$	%	US$	%
Agriculture and fishing	1,225	10.3	1,412	8.7	1,890	10.0
Mining	25	0.2	31	0.2	31	0.2
Manufacturing Industries	2,783	3.5	2,953	18.1	3,385	17.8
Electricity, Gas and Water	322	2.7	537	3.3	699	3.7
Construction	505	4.3	793	4.9	840	4.4
Trade, Restaurants, Hotels	1,512	12.7	2,423	14.9	2,351	12.4
Transport and communications	804	6.8	1,092	6.7	1,305	6.9
State Ag. and Servic. To Enterprises	1,655	14.0	2,662	16.4	3,319	17.5
Financial Serv. And Insurances	1,088	9.2	1,470	9.0	1,632	8.6
Government Services	1,084	9.1	1,525	9.4	1,846	9.7
Municipal, Social and Personal Serv.	1,236	10.4	1,892	11.6	2,264	11.9
Payment adjustments by financial instititutions and import tariffs	(381)	(3.2)	(521)	(3.2)	(585)	(3.1)
GNP (US$ million at common prices)	11,858	100%	16,269	100%	18,972	100%

Source: Uruguay Central Bank (*): Preliminary Data

The agriculture and fishing sector has had, with some exceptions, a sustained increase during the period 1992-1996. The sector as a whole has a greater economic significance than that of its participation in the GNP, since it produces raw material for the manufacturing industry, which is a major exports and employs approximately 15% of the labour force (1995). A detail of primary production can be seen in Figure 1.3.

Figure 3.1

Primary Products
(US$ million, except otherwise indicated)

Production	1992	1994	1996(1)	GNP % 1996
Crops:				
Cereals	272	253	520	2.7
Wheat	51	66	207	1.1
Rice	153	125	181	1.0
Oleaginous	14	33	35	0.2
Legumes	109	162	(2)	(2)
Fruit	78	127	(2)	(2)
Others	259	240	700	3.7
Bovine Cattle	436	491	564	3.0
Wool	168	217	228	1.2
Milk	167	218	267	1.4
Other type of cattle	144	161	161	0.9
Fishing	43	44	43	0.2
Total	1,689	1,945	2,518	13.3
Slaughtering (thousands)	1,334	1,612	1,840	
Milk (million litres)	1,078	1,190	1,313	
Wool (tons)	87,845	81,649	81,847	

Source: Uruguay Central Bank - (1): Preliminary Datum ; (2): included in “Others”

The agriculture sector, is in full development. It has reassumed its leading role in exports and is well ahead in the economic growth of the country with rates that exceed those of the economy as a whole. The bovine sector has grown both in stock and slaughter. The country is penetrating new markets since it was recognised as a foot-and-mouth-free country and the quality of the fodder level was substantially improved. Exports of wool tops, yarns, fabrics and garments, despite the low international prices, show a dynamic behaviour, of significance in the sector.

Milk production shows a sustained growth of 5% per year. This is due to the increased productivity in the primary stage of exploitation and the increased added value of agro-industrial by-products. The investment of international capitals in this area has also been relevant.

There are several crops with significant development. In 1996, rice production and exports, as well as the area dedicated to rice crops was above previous records. The same happened with barley and wheat. Farm production (poultry farming, potatoes, garlic and onion), vine-growing and fruit production (deciduous leaf and citrus) improved their participation in the exporting market.

The mining activity consists primarily in the exploitation of stone and sand quarries, and is mainly directed at the construction industry. It is the least active sector of the economy and its participation in the GNP has remained constant since 1992. Until now, no oilfields or gas fields have been discovered. There are, however, various ongoing projects for the exploitation of gold and semi-precious stone deposits.

The manufacturing industry is a key sector of the Uruguayan economy and generated around 90% of the country's exports in 1996. This sector has received an injection of new investments and technological upgrading which have made it more efficient and competitive both in regional (Mercosur) and global markets.

The electricity, gas and water sector has grown steadily together with the GNP, mainly due to the increase in electricity demand. Power consumption in Uruguay breaks down as follows: 58% oil derivatives, 0.5% gas, 19% electricity and approximately 23% biomass (mainly firewood).

The energy sector is undergoing changes, with the aim of meeting local demand by introducing reliable and more competitive products, and, simultaneously, developing a regional interconnection with the neighbouring countries. The construction of gas pipelines between Buenos Aires and Montevideo, and between Entre Rios and Paysandu, are samples of this trend. Both projects were scheduled for completion

by 1998. Negotiations are underway between Uruguay and Brazil for the construction, exploitation and commercial operation of the first interconnection between both countries' power systems, which should complement the existing interconnection with Argentina.

The energy policy of the country is based on the following key aspects: energy is an essential service which must be reliable and have a competitive price; an adequate relationship energy-environmental quality should be kept and the consequences on the country's economy and security assessed.

The contribution of the construction sector to 1996's GNP, despite some fluctuations, has remained relatively constant. This sector is very sensitive to mortgage policies set forth for home-building and also to the presence of Argentinean investments in that area.

Shops, restaurants and hotels, and the associated tourism income, have developed steadily if measured in American dollars -although they have not in their participation in the GNP-, and constitute one of the pillars of the economic growth. This sector is also sensitive to the circumstances of the economies of neighbouring countries.

The participation of the transport, storage and communications sectors in the GNP has remained steady in reference to that of 1992. However, its value in American Dollars has increased constantly. Particularly, the communications sector has developed remarkably at the technological level and in the number of telephone lines per inhabitant.

The expansion of tourism has also added to the growth of the transport sector.

Real estate and services rendered to companies have steadily grown with respect to the GNP of 1992. This has been the result of a growth in trade service, a trend to subcontract administration, maintenance and cleaning services on the part of manufacturing companies, while mortgages and rents were fostered by the increasing demand of the tourism sector. This sector is one of the most important sectors for the development of the economy.

The finance and insurance sector has reduced its participation in the GNP, although it has had a stable performance if compared in American dollars. During the 1992-1996 period, banking deposits went well.

Uruguay integrates together with Argentina, Brazil and Paraguay the Southern Common Market (Mercosur). The decision to create Mercosur emerged from the need to develop a regional economic environment to enhance the opportunities of the national economies of its country members in global competition. It has contributed to strengthening the position of the country members in their relationships with other countries and economic blocks.

As of January 1, 1995, with the implementation of the Customs Union, Mercosur started new stage of consolidation. Today, negotiations are in course to extend the scope of the Treaty in reference to free trade, economic complementation and the potential incorporation of new members. This process involves negotiations with Bolivia, Chile, Colombia, Ecuador, Peru, Venezuela and the European Union.

Within this framework, intra-regional trade grew by 300% between 1990 and 1995. In 1996, 48% of Uruguayan exports were within Mercosur while 44% of imports came from this regional market.

Sub-regional integration exceeds the commercial and financial aspects. Integration efforts also cover other issues, such as education, justice, energy, environment, labour, social security, migration, health, etc.

1.2 Sector Characteristics

1.2.1 Farming

Crops cover approximately 4% of the national territory (600.000 ha). Wheat accounts for 20 to 30% of the sown area, rice 25 to 29%, barley 14 to 18%, corn and sunflower 8 to 10% each, and sorghum 4%. Wheat, corn, sunflower and sorghum are aimed at the local market while most of the rice and barley production is for export.

The most common sowing practice is that of rotation of crops (2 or 3 years) with sown pastures (3 to 5 years) used in meat or wool production. This practice enables soil recuperation and provides a better protection against water erosion.

The high variability of the region's climate, particularly in reference to rainfalls, determines the existence of significant fluctuations in several aspects, such as, annual harvests, surface devoted to sowing, labour practices used and moment chosen for sowing and harvesting. Market conditions further contribute to the fluctuation in the surface devoted to sowing and the economic profit of the various crops.

1.2.2 Cattle breeding

Meat and wool production obtained on natural pastures is one of the traditional bases of the Uruguayan economy. Depending on the characteristics of the country's various regions, the land is devoted to sheep breeding, feeding or production in different proportions. This is complemented with the production obtained on sown pastures. It is precisely on these latter that milk production has expanded in the last years.

Natural pastures include different species adapted to different types of soil and degrees of humidity. Permanent grasslands are mainly composed of annual and perennial grass, source of a variety of fodder which sometimes reach critical points in quality and intensity. In winter fodder is affected by low temperatures (and excessive humidity) and in summer by the water deficit of soils caused by the high rates of evapotranspiration.

1.2.3 Soils

The main types of soil are: soils with high content of organic matter with B textural horizon at 30-40 cm deep; soils with sandy surface horizon and clayey B textural horizon of variable depth (reaching 70-80 cm) with low organic content and good physical properties; and superficial soils (30 cm) on basalt or granite rock. The first two are used for rotating crops and pastures and the latter for cattle breeding and forestation.

1.2.4 Coastal Resources

a. Environmental characteristics of Uruguayan coast

Sandy beaches separated by rock outcrops are the most characteristic formations of Uruguayan coast. There are also dunes and sand bars along the coast. There are also sectors with banks and cliffs on various geological formations along the coast, many of which leave wide beaches in front.

On the west coast (Colonia and San José) erosion cliffs are frequent. Jackson (1991, in Volonté and Nicholls, 1995) estimates erosion rates of 20 m for a 25-year period (0.8 m/year). The south eastern ocean coast is characterised by a succession of coastal lagoons and associated marshlands, which constitute habitats of particular interest because of their biological diversity, and also because they are suitable for the development of a wide range of aquatic organisms. Many of these lagoons periodically isolated, in varying degrees, from the maritime environment by sand strips.

Predominant winds on Uruguayan coasts come mainly from East and North East, with an annual mean speed of around 25 km/h (OAS-IDB, 1992). The exposure of Uruguayan coast to waves drastically increases from west to east. Tides amplitude vary from 0.4 and 0.6 m (Volonté and Nicholls, 1995). Storm occurrence on the coast is highly variable. In particular, storms associated to South East winds are characterised by the significant increase in wave formation and in sea level during the storm, the so called "storm high tide". The maximum increase in Montevideo is 4.3 m, in Colonia 4.87 m and in La Paloma 3.02m (Chao, pers. com.). Sometimes, these storms will cause serious flooding in the coastal area.

Five out of the six significant hydro basins existing in Uruguay cover some of the coastal area: the low basin of Uruguay river, the basin of the River Plate, the basin of Santa Lucía river, the basin of the Atlantic Ocean and the basin of lake Merin. The water reserve of the Santa Lucía river is at present the only source of drinking water for Montevideo and fourteen other urban centers of the province of Canelones. It supplies water to 57% of the country population (OAS-IDB, 1992).

Among the maritime sediments of the River Plate and the Atlantic Ocean, are continuous coastal aquifers of an extension that varies from local to semi-regional, and some of which are free or semi-free, at a depth smaller than 35 m, and in general with high quality water. The most important one is at Chuy (OAS-IDB, 1992).

From a biological point of view, the environmental variability of the Uruguayan coast determines the presence of a wide diversity of aquatic species and resources, ranging from sub-tropical and sub-antartic marine species, to fluvial species and species adapted to the estuary conditions of the River Plate. Although tolerance to environmental variations is greater in the species characteristic of an estuary environment, in general, it is generally more critical during the key stages of the biological cycle, such as reproduction. It should be pointed out that the coast of the River Plate near the mouth of Santa Lucia river and along the coast of Montevideo province constitutes an important area of spawning and growth of several species of commercial interest.

b. Uses and Activities of the Uruguayan Coastal

Urban centres occupy 34% of the coastal line. Other uses linked to economic activities include: location of industries, mainly on the outskirts of Montevideo, San Jose and Canelones, ports related to urban centres along the coast, agriculture, forest exploitation and sand extraction.

The main economic activities which depend on the coast are: tourism (local and international), fishing (industrial and small-scale) and maritime traffic. Tourism is markedly the coastal activity which generates the largest income to the country. The presence of Uruguay as tourism destination in the main tourist source markets shows an image linked almost exclusively to coastal offer. Approximately 80% of international tourists choose the coast for their summer vacations.

The fishing activity in Uruguay experienced a significant increase in the 70's and the 80's. However, during the last years the total catch has stabilised in 120.000 ton annual approx. Most of the catch in Uruguay comes from the River Plate and the Atlantic Ocean. Inland fishing is of small significance in the country. Capture of the main species of Uruguayan fishing and exports have apparently reached a maximum.

In reference to small-scale fishing all fishing villages on the Uruguayan coast are characterised by their precarious dwellings and facilities located directly on the beach. The environmental conditions determine that practically all fishing resources of commercial interest are migratory, which affects the behaviour of small-scale fishermen who travel along the coast during the various seasons of the year in search of the target species. This has led to conflicts about the use of the coastal space as a consequence of the clash between fishermen and residential and tourism activities.

Maritime traffic has significantly increased in the last decade. The number of ships sailing along the coast rised from 3.764 in 1991 to 5.414 in 1995.

Agriculture on the coast is located mainly in the provinces of Colonia and San José. Coastal forest activity is developed mainly in San Jose, Montevideo and Canelones while sand extraction is exclusively done in Colonia, where approximately 25% of the coastal strip has been affected by this activity. Although sand extraction has practically been stopped, it has had a considerable impact on the coast of Colonia.

1.3 Information on Paragraphs 5, 6, 19 and 22 of the Annex to Decision 10/CP.2

In reference to the provisions of paragraphs 5, 16, 19 and 22 of the Annex (Guidelines for the preparation of the initial national communications of non-Annex I Parties to the Convention) to Decision 10/CP.2, this section includes the preliminary and general considerations in reference to the needs and concerns of Uruguay in the application of the UNFCCC.

The studies, evaluations and research already carried out or on course with the assistance of GEF, UNDP and the Country Studies Program (USA) - constitute a very useful effort to foster new undertakings in the sector. However, further effort is required to identify and assess, targets, measures and strategies - including the determination of their priorities, costs, viability and adverse effects (on economy, health and

environment) -and to develop awareness in areas not considered until now (water resources, fishing, human health, etc.). For this purpose, technical assistance would be necessary so as to develop and implement appropriate methodologies to elaborate a general program aiming at the achievement of the national objectives established for mitigation and adaptation, and to foster sustainable development.

Even though a general programme of measures has not been defined, the need is evident for a mechanism to collect data and to provide access to technologies, practices and processes which may control, reduce or prevent anthropogenic GHG emissions, so as to develop projects contributing to the final goal of the UNFCCC in the most economical and practical way possible in all sectors affected, including industry, transport, agriculture and wastes.

It is also evident the need to perform sectorial specific studies, preparatory for, or complementary to, the activities of overall planning, which, owing to their nature and complexity, deserve a special treatment and may take several months or years (as the case may be) and different inputs (technological, methodological, material, etc.) which, in many cases, are not available. Some examples are, the identification of mitigation measures for land transport (particularly urban), the promotion and transfer of technologies and processes and the elimination of barriers to mitigation (energy and industrial sectors), the preparation of integrated management plans for coastal areas, water resources, agriculture, etc. These studies and evaluations require technical assistance.

The capacity should be improved to foster and support scientific, technical, technological and socio-economic research of the causes, effects and chronological distribution of Climate Change, the economic and social consequences of response strategies and the reduction of uncertainties.

Assistance is required to: identify, reduce and progressively eliminate the barriers which prevent the penetration of renewable and cost-efficient sources of energy in order to improve the energy efficiency of the products consumed in the local market (residential, commercial and industrial), develop a market for efficient fuels of low-CO_2 emission or alternative fuels, and establish laws which may enable the improvement of the insulation systems in buildings to be built.

A great effort should be made to promote and improve energy efficiency and to minimise energy losses and GHG emissions in transport and distribution, mainly in the energy and industrial sectors. The country will need assistance to create a mechanism of promotion that will facilitate the implementation of the measures and the introduction of methodologies suitable to reach those goals and to develop a voluntary information program on GHG emissions applicable to all sectors.

The efforts to improve the existing legal and institutional framework should be reinforced to assure the full development of the activities emerging under paragraph 1 art.4 of the UNFCCC.

2. Inventory

2.1 Introduction

Uruguay's National Inventory of Greenhouse Gases (GHG) for the reference year 1990 (INGEI 90), which was completed by 1997, was elaborated in compliance with one of the main commitments undertaken by our country under the UNFCCC.

Both the spreadsheets and the outputs of INGEI 90, have followed the Guidelines indicated in paragraph 8 of the Annex of Decision 10/CP.2. These Guidelines had been elaborated by the Intergovernmental Panel on Climate Change (IPCC), with the cooperation of the Organisation for Economic Cooperation and Development (OECD) and the International Energy Agency (IEA).

They provide a simplified methodology appropriate to calculate and estimate emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and their precursors: Nitrogen oxides (NO_x), carbon oxide (CO) and Non-methane Volatile Organic Compounds (NMVOC).

Likewise, the application of these guidelines enables the comparison of the relative contributions of the Parties to the intensification of the greenhouse effect, and what is more important, a specific evaluation of the problem in the country, which will in turn permit the analysis of the feasibility of mitigation measures and policies, both at the national and international levels.

INGEI 90 reflects, in the best possible way, greenhouse gas anthropogenic emissions and removals in Uruguay, which arose as a consequence of human activities (fuel burning, etc.) or natural processes affected by human activities (Land-Use Change, etc.). The analysis of the results shows that Uruguay - according to the characteristics and circumstances described in Chapter 1- has a very low relative participation in the global increase of greenhouse gases in the atmosphere.

At present, we are elaborating the National Inventory of net GHG emissions for the reference year 1994. The completion of the study has been foreseen for the next year together with a comparative analysis of 1990-1994 GHG emissions in Uruguay. For these studies the IPCC revised methodology will be used.

2.2 Institutional Arrangements for the Elaboration of the National Inventory of GHG (INGEI)

Among the various options for organising and performing the task, Uruguay chose to centralise all the activities in the Climate Change Unit (UCC). This unit was created by the Ministry of Housing, Land Management and Environment (MVOTMA), in December, 1994.

The UCC has implemented and operated a Management System for the INGEI, which covers all data and information used in institutions, organisations and public and private companies related to the sectors and activities resulting in emissions and removals of GHG. It also includes the identification, information and management of the supporting services required (studies, counselling, punctual and specific consultancies, etc.).

The UCC counted with the technical assistance of ICF Incorporated (USA) who backed up the activities involved in the process of elaboration of data, verification of results and elaboration of the Report INGEI 90.

ICF's experts participated in, and provided technical assistance for, the organisation of a Workshop on the INGEI in Montevideo (Uruguay) in May 1996, aimed at bringing awareness and involvement among representatives of the public and private entities involved, respect to the task undertaken and the data and information they should provide.

For the preparation and presentation of the Inventory, the modules recommended by IPCC methodology were used, regardless of the relative importance of each sector.

The sectors included in the Guidelines and therefore in this Inventory are: Energy, Industrial Processes, Agriculture, Land-Use Change and Forestry and Waste.

The task was performed within a framework of cooperation and inter-institutional coordination which facilitated its performance and contributed to strengthen the relationships of the UCC with the rest of the INGEI Management System.

The data used, have mainly been obtained in national publications and sources. Whenever this was not possible, we used data obtained by default in Volume 3 of the Guidelines. In all other cases, the tables bear the sources of all data used.

Sources and sinks were grouped by sector and within them by subsequent subdivisions by activities, subactivities, categories, subcategories, so as to permit a more precise quantification of the emissions and removals of the greenhouse gases identified (for example: sector: energy; activity: fuel burning; sub-activity: transport; category, liquid fuel; sub-category: gasoline.).

2.3 Difficulties and Limitations Encountered in the Elaboration of INGEI 90

During the process of elaboration of the INGEI, difficulties of various degrees arouse which, in general, were successfully overcome. However, some outputs for some sectors or subsectors were conditioned by some of these difficulties, although not to an extent implying a degree of uncertainty that could significantly affect the overall calculation.

The methodology in force at the time had some limitations, in particular for Industrial Processes. For this sector only CO_2 emissions from Portland cement production were calculated. Calculations for other sectors also were affected by limitations, Land-Use Change and Forestry (for gases other than CO_2) and Wastes (for gases other than methane), and to a much lesser extent Agriculture.

In most cases, "default" emission factors were used. This was mainly caused by the absence of proper factors. Estimations are that this has primarily affected the quality of the outputs of the sectors, Agricultural, Land-Use Change and Forestry, and Waste.

The data available at the national level was not as detailed as required, which is particularly true to the technologies considered in most of the activities in Energy, Industrial Processes and Waste. Furthermore, data were scattered and in many cases not available in a direct usable form.

However, whereas all these limitations imply (depending on the case) different degrees of uncertainty or inaccuracy in some partial results, they do not significantly alter figures of national totals due to their scarce influence on the whole set of activities affected, as stated above.

With the reserves and limitations established by the methodology and the absence or scarcity of data for some areas, INGEI 90 constitutes until today, the best estimation made for a reference year on net emissions of greenhouse gases in Uruguay.

Although its outputs do not establish behaviour patterns for the past or future emissions of these gases in our country, they represent a sound basis of knowledge for any subsequent development or updating of these values, and provides a useful tool for the evaluation and definition of policies and measures for emission mitigation both at the national and international levels.

Until today, no plan economically viable has been made to enhance basic data or data collection systems or emission factors through the identification of local factors. Neither are there research activities in course which may enable in a near future the consideration of those minor activities not taken into account in this inventory.

To solve these problems and improve the quality of subsequent national communications, technical and financial assistance is required to elaborate, manage and implement a program to enhance the quality, collection and elaboration of general data and to identify and use local factors, mainly in non-energy sectors of the Inventory.

2.4 INGEI Outputs

2.4.1 General Comment

In general terms INGEI outputs met previous expectations. This is particularly true for CO_2 emissions. However, in sectorial terms the quantity of carbon dioxide captured in the Forestry Subsection (new forest plantation and sprouting of the existing ones) resulted quite above its previous expectations.

Figure 2.1

Emissions (kton CO_2)		Removals (kton CO_2)	
Fossil fuels combustion:	3,625.44	New forest plantation and	
Biomass combustion:	2,156.32	sprouting of the existing ones:	-1,961.90
Portland cement production:	207.97		
Industrial use of wood:	1,054.70		
Total:	**7,044.43**	**Total:**	**-1,961.90**
Net CO_2 emissions: 5.082,53 kton			

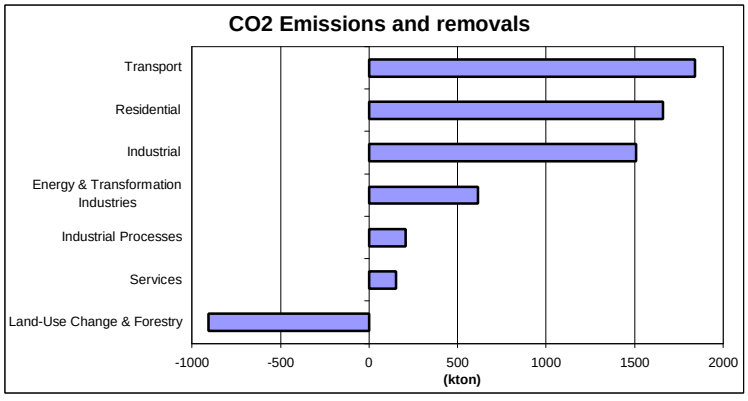
Total net carbon dioxide emissions are around a value scarcely higher than 5 million tons for 1990. This is the result of around 7 million tons release of CO_2 mainly from energy production (fossil fuel and biomass burning) and in the industrial use of wood (poles, columns, pulp, etc.) and Portland cement production, and of the absorption of almost 2 million by new forests and the renewal of the existing ones (figure 2.1).

Figure 2.2 shows the behaviour of net GHG emissions per sector.

On analysing the results by sector and subsector of sources and sinks, it seems that most of national emissions of CO_2 from fuel burning -fossil or biomass- in the Transport (mainly road transport, including tractors and other agricultural machines) Residential (rural and urban homes) and Industrial Sectors.

In comparatively lesser proportions, there follow in decreasing order: Energy and Transformation Industries, Industrial Processes (mainly Portland cement production) and Services.

Figure 2.2



Biomass fuel -particularly firewood- generated 37% of CO_2 emissions in Uruguay in 1990.

In reference to methane emissions, Agriculture originated almost 95% of the total in 1990. Over a national total of around 693.000 ton of CH_4, the main source was Cattle breeding, in particular bovine.

Practically all 33.800 ton of nitrous oxide emissions are generated in the Agriculture sector. Note should be taken that it was not possible to estimate the emissions of this gas for some subsectors.

In reference to nitrogen emissions, most of them (around 94%) resulted from fuel burning in the Energy Sector, mainly in the road transport subsector. Agricultural activities generated only the remaining 6% of the total NO_x emissions in Uruguay.

The emissions of carbon oxide were of around 407.000 ton, mainly from biomass burning in households and from fossil fuel burning by road transport. In this case also, biomass burning, particularly firewood in rural and urban homes played a preponderant role.

In reference to volatile organic compounds other than methane, emissions were estimated in around 19.000 ton. Road transport through fossil fuel burning, and residential fuel consumption (mainly biomass) were the main sources of emission of these gases.

Finally, as not all greenhouse gases have the same radiative forcing, i.e. the same degree of influence on the energy balance Earth-Atmosphere, the impact of the different gases was estimated following their Global Warming Potential (GWP) as determined by the IPCC (CH_4 and N_2O, in addition to CO_2 , which is used as reference) for various time horizons (20 and 100 years), using the emission values resulting from this Inventory for 1990 (figure 2.3).

Figure 2.3

Gas	Net Emission (kton)	Factor		GWP	
		20 years	100 years	20 years	100 years
CO2	5083	1	1	5083	5083
CH4	694	56	21	38864	14574
N2O	34	280	310	9520	10540

This table shows that at a first stage, CO_2 emissions prevail. However, it is also visible that in the medium and long term, lesser emissions of CH_4 and N_2O produce greater contributions to global warming. Thus, methane, whose emissions are significantly lower than those of CO_2, has an impact 7.4 times greater than carbon oxide when compared after 20 years of emitted and almost 3 times greater after 100 years.

Also nitrous oxide effects are of great significance when compared to CO_2. Despite the scarce amount of its emission in relation to carbon dioxide (less than 7/1000), its GWP is higher after 20 and 100 years of emitted.

The above considerations show the need to evaluate and weigh with greater accuracy the emissions of the various gases despite their small amount at the moment of identifying and planning mitigation measures.

2.4.2 Energy

a. Introduction

Following IPCC methodology, the Energy sector was divided into four Subsectors: Transport, Small Scale Combustion, Industry and Energy and Transformation Industries.

In Transport, consumption was evaluated and emissions calculated for the different transport categories (road, railways, navigation and aviation), but totals did not include the emissions from international navigation and aviation (international bunkers).

As established in IPCC methodology, the traditional biomass category includes all bio-fuels and coal consumption for traditional small-scale processes.

In INGEI 90, CO_2 emissions emerging from traditional biomass burning are presented separately and its

values do not compose the national total of the Energy Sector (tables A3 and BIO1 of INGEI 90). Without prejudice of the above, and due to the relative importance of the emissions from biofuel consumption they are analysed together.

Figure 2.4 shows the distribution of CO_2 emissions by subsectors following IPCC methodology. It includes both emissions from fossil fuel burning and those arising from biomass fuel consumption.

Figure 2.4

CO2 Emissions - Energy Sector		
Subsector	**kton**	**%**
Transport	1842.85	31.87
Small Scale Combustion	1813.70	31.37
Industry	1508.06	26.08
Energy and Transformation Industries	617.15	10.67

For the reference year, the greatest contribution to GHG increase was made by Transport and Small Scale Combustion practically in the same proportion, Industry came second not far behind. These results show the influence of concurrent factors: a relatively scarce industrial development and a significant consumption of biomass at the residential level.

b. Emissions from Fossil Fuel Consumption

The distribution of CO_2 emissions produced in the various Subsectors is shown in figure 2.2. It includes emissions from fossil fuels and biomass burning. Oil derivatives originated 63% of the emissions of the Energy sector and 51% of the total emission of this gas for 1990. The emissions from biofuel consumption amounted to 37% of the Sector.

For the reference year, the greatest contribution to the increase in GHG concentration was made by Transport and Small Scale Combustion practically in the same proportion, Industry came second. Two factors influenced on these results: a relatively scarce industrial development and a significant biomass consumption in the residential sector.

Notice should be taken that approximately 28% of CO_2 national emissions in 1990 - mainly from power generation, wood industrial use and the industrial processes of Portland cement production- were compensated by the absorption of that gas by Forestry, through an increase in the forested area and forest regeneration (figure 2.1).

Furthermore, the increasing demand mentioned in 2.1 above, also reflects in an increase of oil derivatives and biomass burning and consequently in CO_2 emissions.

Out of 2156 kton of CO_2 arising from biomass fuel consumption, most of it was in the Residential subsector (56%). Firewood accounts for 88% of these emissions.

b.1 Transport

The consumption of this subsector was evaluated and emissions calculated for the various transport categories: road, railway, navigation and aviation.

National totals for the subsector did not include the emissions from international navigation and aviation. Following IPCC methodology, although this fuel supply took place in Uruguayan territory, it is considered under "international bunkers"; therefore, these emissions were estimated separately and are not included in the national total.

Road transport (including the use of tractors and agricultural machines) accounted for 93% of the total CO_2 emissions of the Transport Subsector, while the rest, following an increasing order correspond to:

navigation, aviation and railways (figure 2.5).

Figure 2.5

Transport	CO2 Emissions (kton CO2)	%
Road	1709	93
Marine	93	5
Aviation	33	2
Railway	8	0
Total	1843	100

The contributions to greenhouse concentration arising from the use of fossil fuels for transport, if compared with other sources and national subsectors, occupy the first place.

Likewise, road transport emissions considered in isolation, represent almost 30% of CO_2 total emissions from fossil fuel burning and exceed those from Energy and Transformation Industries (electricity and heat production and Oil refinery), Industry and Small Scale Combustion (Services and Residential).

b.2 Small Scale Combustion

This Subsector includes all activities of consumption and emission of the Service and Residential sectors.

As defined in the National Energy Balance (annual publication of the National Energy Directorate), schools, hospitals, shops, hotels, restaurants, public lighting, public administration, etc. are included under Service, while Reisdential covers rural and urban homes energy demand (excluding personal transport).

CO_2 emissions of this Subsector are mostly due to home consumption, 1658 kton (91%), and only 154 kton (9%) to the service sector consumption.

It is to be noted that biomass burning, particularly firewood, is the most important source of CO_2 emissions in the sector. Figure 2.6 shows that emissions from firewood burning in rural and urban homes (1205 kton) accounts for 73% of the Residential sector (1660 kton) and 66% of the Small Scale Combustion Subsector (1814 kton). They also exceeded those originated by the same concept in the other sectors including those produced by energy industrial use (890 kton).

Figure 2.6

Residential		
Fuel	**CO2 Emissions (kton CO2)**	**%**
Firewood in Households	1205	73
Others	455	27
Total	1660	100

Small Scale Combustion		
Fuel	**CO2 Emissions (kton CO2)**	**%**
Firewood in Households	1205	66
Others	609	34
Total	1814	100

When considered within the total range of sectorial emissions, those of biofuels are second behind those of fossil fuel burning in road transport (1709 kton). This evidences the importance of biomass use and its relative impact.

b.3 Industry

Industry comes third as a source of CO_2 emission (1508 kton.) with a participation of 25% in the total emission of this gas and 26% of all fuel burning of the Energy Sector.

Biomass burning also plays a significant role in this subsector, being the source of 59% of CO_2 emissions (890 kton), mainly through firewood fuel consumption, which accounts for 44% (664 kton) of the total of the Subsector.

Biomass residues burning represented 13% of the total CO_2 emissions in the Subsector.

b.4 Energy and Transformation Industries

This Subsector includes CO_2 emissions produced by fuel burning (oil derivatives and biomass) to generate electricity and heat in thermal plants of public services and self-service electricity generation and in oil refinery.

The participation of this Subsector in CO_2 emissions amounts to almost 11%. Electricity and heat production account for 55 % of the total 617,15 kton CO_2 emissions of the Subsector while 45% originates in oil refinery.

c. Emissions of Other Gases due to Energy Consumption.

The following gases were considered: methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_X), carbon oxide (CO) and volatile organic compounds other than methane (NMVOC).

Figure 2.7 shows the emissions by sector, arising from biomass and fossil fuel burning.

Figure 2.7

SUB-SECTOR	GHG Emissions (kton)				
	CH4	N2O	NOx	CO	NMVOC
Energy and Transformation Industries	**0.0091**	**NE**	**1.4061**	**0.8513**	**NE**
Fossil fuels	0.0045	NE	1.3587	0.1108	NE
Biomass	0.0046	NE	0.0474	0.7405	NE
Industry	**0.1264**	**0.0093**	**2.2518**	**14.7765**	**NE**
Fossil fuels	0.0218	0.0093	1.2230	0.1235	0
Biomass	0.1046	NE	1.0288	14.6530	NE
Transport	**0.3483**	**0.0534**	**23.7801**	**127.1213**	**19.0783**
Fossil fuels	0.3483	0.0534	23.7801	127.1213	19.0783
Small Combustion	**0.9529**	**0.1363**	**3.1915**	**236.3966**	**NE**
Fossil fuels	0.0086	0.1363	0.6295	0.1165	NE
Biomass	0.9443	NE	2.5620	236.2801	NE
a Services	**0.0112**	**0.0412**	**0.1849**	**2.4314**	**NE**
Fossil fuels	0.0016	0.0412	0.1589	0.0303	NE
Biomass	0.0096	NE	0.0260	2.4011	NE
b Residential	**0.9417**	**0.0951**	**3.0066**	**233.9652**	**NE**
Fossil fuels	0.0070	0.0951	0.4706	0.0862	NE
Biomass	0.9347	NE	2.5360	233.8790	NE

Fossil fuel burning was the main source of N_2O and NO_X emissions while biomass burning produced the highest releases of CH_4 and CO.

Most methane emissions were originated in the Small Scale Combustion Subsector (66% of the total of the Energy Sector) and particularly in the Residential sector, responsible for 65% of the emissions of the Sector, through a great consumption of biomass. The Transport subsector (almost exclusively road transport), was the second source of CH4 emissions, accounting for 24% of the total, as a result of the use

of fossil fuel.

The Small Scale Combustion Subsector was the main N_2O emitter, with 68% of the total. For this gas, the Residential sector contributed with 48% of the national total. This is mainly due to fossil fuel burning. Transport contributed with 27% to N_2O emissions, mostly originated in road transportation.

A great part of CO emissions arose from biomass fuel and fuel oil burning, 64 and 34% (252 and 127 kton) respectively (figure 2.8). Most of it was produced in the Small Scale Combustion Subsector - 236 kton, which accounts for 62% of the Energy Sector - through Residential consumption of biomass. Practically all of it (247 ktep) from firewood (96%). Road transport emissions from fossil fuel burning amounted to 127 kton.

Figure 2.8

Carbon Monoxide - Energy Sector		
Sub-sector	**kton**	**%**
Small Combustion	236.40	62.0
Transport	127.12	34.0
Industry	14.78	3.9
Energy and Transformation Industries	0.85	0.1

In the case of NMVOC emissions, they were only determined for the Transport Subsector. Most of these emissions arose from fuel burning of road vehicles (over 99% of the total).

d. Emissions due to Biomass Consumption

Biomass consumption (firewood, residues, coal, etc.) produces emissions of the following GHG gases: CO_2, CH_4, NO_X, N_2O and NMVOC.

Consistent with IPCC methodology, CO_2 emissions arising from biomass fuel burning are presented separately and its total has not been aggregated to the national total of the energy Sector (tables A3 and BIO1 of INGEI 90).

Emissions of other gases different from CO_2 produced by biomass consumption represent net values and therefore they are accounted as emissions of the Energy Sector.

Out of a total of 2156 kton CO_2 emissions from biomass fuel burning, most of it took place in the Residential sector (56%), followed by Industry (41%).

The distribution of CO_2 emission by type of fuel used shows that firewood burning has been the source of 88% of these emissions, while biomass residues account for their 10% and the rest is divided between black liquor and coal (Figure 2.9).

Figure 2.9

CO2 Emissions by fuel		
Fuel	**kton**	**%**
Firewood	1906.05	88
Biomass waste	210.85	10
Black Liquor	30.53	1.5
Charcoal	8.89	0.5

In reference to carbon oxide, from a total of 252 kton emitted, a great majority, 93%, has its source in the

Residential sector (234 kton). Practically all emissions of CO (98%) were originated in firewood consumption.

Methane emissions were significantly lower, while those of NO_X were of around 3 kton. As in the previous cases, firewood consumption in the Residential sector was the source of most emissions of this gas, being the Industry sector the second contributor for this gas.

It was not possible to estimate the emissions of N_2O and NMVOC originated in biofuel burning.

2.4.3 Industrial Processes

Industrial activities require the existence of many processes which involve physical and chemical transformations of matter and release greenhouse gases (CO_2, CH_4, N_2O, PFC, etc.) and precursors of ozone and sprays. The emissions arising from these processes, despite their being in most cases related with energy consumption, have been analysed and estimated separately, following IPCC methodology.

IPCC methodology in force at the moment of making the Inventory only provided information for the calculation of CO_2 emissions, in particular those originated in cement Portland production. INGEI 90 does not include other emissions of this sector, owing to the lack of information about other processes, the corresponding factors of emission, or both. In future inventories, the availability of new methodologies will enable the inclusion of estimations of other gases that were not taken into account in this one. To this respect, the IPCC Guidelines revision, which has been recently approved, will certainly imply an improvement for future calculations of emissions in this Sector.

In 1990, Uruguay emitted almost 208 kton of CO_2 through Portland cement production, i.e. almost half a ton of carbon dioxide per ton of cement produced. This figure represents almost 3.5 % of the total CO_2 released by the country in the reference year, including the emission caused by biomass fuel burning.

2.4.4 Agriculture

a. Introduction

The calculation corresponding to the Agricultural Sector covered the following sources: cattle breeding, rice sowing, nitrogen fertilisation and burning of pastures and crop residues. These activities were considered as sources of emissions of the following gases: methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_x) and carbon monoxide (CO).

Other activities inherent in the Sector such as soil labour, pasture rotation including legumes and pulse, and irrigation practices, may probably contribute to greenhouse gas emissions. However, there is still too much uncertainty respect to their effects and therefore they were not included in this Inventory.

b. Methane Emissions (cattle breeding and rice crops)

In Uruguay, as in most parts of the world, enteric fermentation of bovine cattle is the main source of methane of this Sector.

Methane emissions associated to manure are generally less important and limited to the feedlot production systems or to the systems handling liquid manure. These situations are practically inexistent in Uruguay. However, it is quite peculiar of the country that the proportion is significantly high between the number of bovine and sheep and human population: approximately 3:1 for bovines and 7:1 for ovens.

In order to calculate methane emissions from enteric fermentation, the number and type of animals was considered (per age and type of production). In the case of dairy farming, conversion values obtained in systems where feeding is based on improved pastures and corn silos were used. For the rest of the species, natural field feeding was taken as basis.

Rice crops grown by flooding is another significant source of CH_4 emission in the sector. This sector emissions arise mainly from anaerobic decomposition (in absence of oxygen) of organic matter, which is carried out by microorganisms of the soil. In this biologic process, two other factors may affect methane

production: temperature and availability of substrate and nutrients in the soil.

As a result of the calculations made, it seems that the Agricultural Sector constitutes the main source of methane in Uruguay, accounting for more than 95% of the national total of emissions, being the remaining contributors Energy and Wastes (which do not reach 5% of the total).

Within the Agricultural sector, enteric fermentation is the source of almost 90% of methane emission (figure 2.10). Rice fields accounted for 10% and all the other sources together do not exceed 0.2% of the total for 1990.

Figure 2.10

Methane Emissions - Agriculture Sector		
Sub-sector	**kton**	**%**
Enteric Fermentation	589.55	89.33
Rice Cultivation	69.20	10.49
Others	1.20	0.18

The results also show that most of the emission of methane emission (70%) from enteric fermentation has its source in bovine cattle.

c. Emissions of Nitrous Oxide from Soils

Many of the practices of soil handling commonly used in agriculture contribute to greenhouse gas emissions.

Organic and synthetic fertilisers increase the amount of nitrogen absorbed by soils and therefore increase N_2O emissions.

Other agricultural practices such as sowing, irrigation, incorporation of pastures residues with legumes also affect the flow of gases from and towards the soil. However, in view of the existing uncertainties INGEI 90 only includes N_2O emissions arising from nitrogen applications to soils.

The most important source of N_2O comes from animal excretion while pasturing (Figure 2.11). Although there is a certain amount of N_2O which is directly lost by the animals (in the reduction of nitrates which occurs during digestion), such amount is generally negligible. Manure management in lagoons and other storage systems, is of scarce significance in Uruguay.

Figure 2.11

N_2O Emissions - Agriculture Sector		
Activity	**kton**	**%**
N from excretion	21.66	64.52
Leaching	8.44	25.14
NH_3 and NOx	2.21	6.58
N from soils	0.99	2.95
Others	0.27	0.81

There are indirect emissions of N_2O, i.e. , those arising from nitrogen loss in other forms which then returns to atmosphere as nitrous oxide. In the case of Uruguay, the main sources of indirect emission are atmospheric deposition of NH_3 and NO_x , arising from the denitrification and volatilisation of nitrates from leaching.

According to the studies performed, 99.8% of emissions of nitrous oxide in the country were in the Agriculture sector. Through animal excretion, cattle breeding, with an emission of practically 22 kton resulted the main contributor of N_2O of the Sector and also at the national level.

d. Emissions from Burning of Pastures and Crop Residues

The burning of dry pastures and crop residues releases different greenhouse gases: methane (CH_4), carbon oxide (CO), nitrous oxide (N_2O) and nitrogen oxides (NO_x). In Uruguay, two practices of handling result in major burning of biomass waste: the burning of morelands on the shores of watercourses and the burning of crop residues in the fields.

The basic objective of the first activity aims to clean coastal areas and promote plant growth of greater digestibility. Also, it aims to facilitate labour for crop sowing after harvesting.

For neither case are there official surveys about the areas affected by these practices. The information used for the calculations in this Inventory was obtained in interviews with technicians from the Ministry of Cattle Breeding, Agriculture and Fishing or with specialists or NGOs working on this area.

In spite of the lack of official information, it seems clear that greenhouse gas emissions from these sources are not significant, they amount to 6% and 7% of NO2 and CO national emissions respectively.

2.4.5 Land-Use Change and Forestry

a. Introduction

Cutting down and burning forests to change the use of land and grow pastures or crops is not a common practice in Uruguay. Neither is on-site burning of forests, nor the abandonment of managed lands as defined in IPCC methodology, common practice in the country.

In reference to forested areas, Uruguay has implemented a new forestation policy through the Forestry Law. Since the enforcement of the law, as a result of an incentive policy the forested area has significantly increased.

Between 1990 and 1993, 80.000 ha of new forests were developed, followed by sustained average annual growth of 40.000 ha.

At present, there are more than 200.000 ha of forests growing and above 3.5 million ha have already been designated as forestry priority. These forests in active growth, absorb part of the CO_2 in the atmosphere through photosynthesis, and constitute an extremely positive factor to counteract greenhouse effect.
It should be mentioned that this Forestry Law was prepared and approved without taking the environmental objectives into consideration. However, it has generated a significant subsidiary benefit by fostering the creation and development of an important mechanism of CO_2 capture (mitigation).

In this section of the Inventory, emissions estimates of other greenhouse gases or their precursors (CH_4, CO, N_2O) are not included, neither are those of carbon from forested soils, mainly due to the high degree of uncertainty existing respect to these flows, particularly, in reference to forest management effects.

b. Emissions of CO_2 in the sector

The Sector's net emissions were calculated for the reference year 1990, according to the guidelines established in IPCC methodology.

The first impacts of the application of the Forestry Law became visible in 1990. There were around 80.000 ha of growing forests woods (Annex A, Table D1 of INGEI 90). Most of them were of Eucalyptus, followed by Pinus and in a lesser extent by salicaceas (Populus and Salix).

Considering the rates of growth of these species in Uruguay, estimations were that the forested area produced an increase in carbon absorption of 535.000 tons per year (almost 2 million tons/year of CO_2).

Therefore, calculations were made for expected change in forest and other wood biomass and these conclusions were drawn:

a. The total net emissions of CO_2 of the Sector are of 1972 kton approx. This figure emerges from the difference between the emissions arising from the industrial use of wood and biomass burning (traditional and non-traditional) and the removals generated by the new forests and the sprouting of the old ones.

b. This is the only sector of the country that shows a significant value of CO_2 absorption: 1962 kton.

c. The total of CO_2 emissions from traditional and non-traditional firewood burning (1863 and 1017 kton, respectively) which belong to this Sector (following IPCC methodology), make it an important source of CO_2 emission (1972 kton approx), despite its absorption potential.

d. If firewood burning (traditional and non-traditional) were included in the Energy Sector (which would apparently be more adjusted to the reality), the Land-Use Change and Forestry Sector would be a net absorber of CO_2.

2.4.6 Waste

a. Introduction

This sector includes methane emissions from anaerobic decomposition of organic matter content of municipal solid wastes and domestic, commercial and industrial wastewater.

For the estimation of methane emissions, according to IPCC methodology, the following sub-sectors were studied: Municipal Solid Wastes, Domestic and Commercial Wastewater, and Industrial Wastewater. CH_4 emissions corresponding to this Sector were above 31 kton and accounted for 4.5 % of the total national emissions of such gas for 1990. This amount is small if compared with those from agriculture but greater than that estimated for fuel burning.

b. Municipal Solid Waste (MSW)

The transformation of organic matter in municipal solid waste is a natural process through which microorganisms obtain the energy required for their growth.

In Uruguay, solid wastes are disposed of in landfills which, due to their management system, can be assimilated to the so-called open dumps.

In order to determine the amount of MSW deposited in dumps, data were extracted from a previous study published under the title "Análisis Sectorial de Residuos Sólidos en Uruguay, Serie Análisis Sectoriales Nº 7". (Page. 121 of Annex "C" of INGEI 90).

Methane emissions from Municipal Solid Wastes decomposition was calculated at 28,5 kton, which represents 4.1% of the total national emissions of methane (692.8 kton). Likewise, it amounts to almost 91% of the total CH_4 emission of the Sector (Figure 2.12).

Figure 2.12

Methane Emissions - Waste Sector		
Sub-sector	**kton**	**%**
Municipal Solid Waste	28.53	90.7
Industrial Wastewater	1.82	5.8
Domestic and Commercial Wastewater	1.10	3.5

Furthermore, around 58% of such emissions originated in Montevideo Province, where the capital city is located. It is explained by the high concentration of population in this Province: practically 50% of the total

population of the country.

c. Domestic and Commercial Wastewater (DCWW)

Wastewater with a high content of organic matter can produce methane either through anaerobic treatment or through spontaneous decomposition or degradation in absence of oxygen.

The situation of the country in reference to DCWW treatment varies throughout the territory. In Montevideo wastewater is poured -without biological treatment- onto the River Plate, through a sub-aquatic sewage pipe or is otherwise channelled to watercourses. In the rest of the country, however, there are various systems of water treatment: Stabilisation lagoons, Inhoff tanks, and inactivated sludge (only one).

The estimation of methane emissions included DCWW treatment through Stabilisation lagoons (optional and anaerobic) and Imhoff Tanks. All other organic matter degradation systems have not been taken into account, since, owing to their aerobic nature, they do not represent a source of methane.

Methane emissions corresponding to the decomposition of Domestic and Commercial Wastewater resulted in scarcely 1.1 kton, which accounts for less than 0.2% of the total at the national level and 3.5% of the total of the Sector.

d. Industrial Wastewater (IWW)

The amount of methane released during IWW anaerobic decomposition depends greatly on the extent of their BDO values, i.e. of its biodegradation characteristics.

Thus, in order to estimate the emissions in this subsector, and according to IPCC methodology, calculations were broken down by type of industry.

The National Environment Directorate (DINAMA), through the Environmental Quality Division, controls waste dumps from industries pursuant to Decree No.253/79 which establishes the provisions to prevent environmental pollution through water contamination. As result of this activity, DINAMA has developed an important database on the facilities existing all over the country that provide physical, chemical and biological treatment of wastewater.

Methane released from Industrial Wastewater decomposition does not even reach 0.3% of the total national emissions. Likewise, methane emissions from the waste sector account for only 5.8% of the total.

Relative contributions made by the various types of industries to IWW total emissions are shown in figure 2.13.

Figure 2.13

Methane Emissions by Industry		
Industry	**kton**	**%**
Meat Processing Plants	0.8506	47
Wool Washers	0.5489	30
Milk	0.2579	14
Malt	0.0639	4
Tannery	0.0604	3
Fisheries	0.0174	1
Meal Elaboration	0.0169	1

3. Measures for FCCC application

3.1 Introduction

As Uruguay's economy depends highly on natural resources and climate, the country has attentively followed with great concern the information provided by scientists on the possibility of climate change which may derive from anthropogenic enhancement of the atmospheric concentration of greenhouse gases, mainly carbon dioxide.

The country has also participated actively in the process of preparation undertaken by the Intergovernmental Negotiating Committee of the Framework Convention on Climate Change and in the activities related to CC developed in various forums, such as the Intergovernmental Panel on Climate Change and the Second World Conference on Climate.

Uruguay signed the United Nations Framework Convention on Climate Change (UNFCCC) in the UN Conference on Environment and Development (Earth Summit) and then ratified it by Law 16.517 of July 22, 1994, which came into force on November 16 the same year.

3.2 Institutional Background

The Ministry of Housing, Land Management and Environment (MVOTMA) was created by Law 16.112 of June 8, 1990. It was responsible for: formulation, execution, supervision and evaluation of national environmental plans and policies; coordination with other national and provincial agencies; establishment of relationships with international organisations working on the issue; and monitoring compliance with environmental laws and regulations.

The National Environment Directorate was created by Law 16.623, of October 1, 1990. It is responsible for planning, programming, monitoring and implementing environmental policies; coordinating with other agencies (both at national and provincial level) and private institutions in pursuit of its tasks; and for normalisation and control of environment quality.

The Climate Change Unit (UCC) was created under the DINAMA by Ministerial Resolution No. 505/94 of 29 December 1994, for the organization and development of activities arising from the application of the FCCC.

3.3 Uruguay as Party to the UNFCCC

The Government of Uruguay adheres to the objective and principles of the UNFCCC, and has undertaken the fulfilment of its commitments under such Convention with due responsibility.

Furthermore, many principles characterising the Convention are in line with national objectives which aim at an improvement of the country's life quality within the framework of sustainable development, and therefore environmental considerations are to be considered for making decisions or defining policies or measures.

To comply with its commitments under the UNFCCC, among the courses of action taken, the Government has generated specific and adequate institutional capacity in the sector to develop the activities required by a new demand and to collect and produce the information required by the national community and the country, in pursuit of the accomplishment of the global objective established.

3.4 Government Strategy

Given the small degree of institutional development on the issue, and in order to face the national

commitments arising from the Convention, it was deemed necessary and convenient to evaluate, identify and develop a set of measures leading to:

a. Generate the adequate institutional capacity to execute the activities inherent to the application of the UNFCCC, through the creation of an operational executing agency which will in turn be the main tool of government management in the sector.

b. Take advantage of development and cooperation efforts already in progress in reference to the activities concerning the application of the Convention, which are mainly carried out in the sphere of the National Commission on Global Change, and to coordinate and integrate its results at the national level.

c. Take steps to comply with one of the most important commitments arising from the Convention: the elaboration of the Inventory of GHG Net Emissions;

d. Inform and sensitise public opinion in reference to Climate Change and its impacts;

e. Train, encourage and assist some productive and service sectors in order that they contribute to both national and UNFCCC objectives

f. Promote and support the application and diffusion of new methodologies, practices, processes, studies and evaluations to monitor, reduce or prevent anthropogenic emissions of green house gases;

g. Foster active participation of the private sector and NGOs in the activities mentioned; and,

h. Take advantage of technical, technological and other sort of transfer possibilities(available or to be created) in the international sphere, which may foster those activities proposed to meet the national commitments concerning the UNFCCC or related to those country plans, programs, and goals which favour the accomplishment of the Convention's objective.

3.5 Institutional Conditions

The National Commission of Global Change (CNCG) was created in May 1992, in the sphere of the Ministry of Housing, Land Management and Environment (MVOTMA).

The activities of the CNCG are oriented to foster the coordination of actions at the national and regional level concerning research on global change, and to represent the country before international programs and agencies, such as the Inter American Institute for Global Change Research (IAI) and the International Research Institute for climate prediction (IRI). In this sphere, a Country Study on Climate Change (Vulnerability and Adaptation) was conducted in cooperation with several national institutes and the support of the United States Country Studies Program (USCSP). Such Study was the first integrated effort in the area of vulnerability and adaptation to climate change made in Uruguay.

At the same time, among the actions taken to implement those activities resulting form commitments arising upon enforcement of the UNFCCC, Project URU/95/G31 was formulated considering the capacity and potentiality of the UCC, and is now being executed. The objective of this project is the institutional strengthening of the MVOTMA in areas concerning the application of the UNFCCC.

Such project has the technical and financial assistance of the Global Environment Facility (GEF) and the United Nations Development Program (UNDP). The Climate Change Unit (UCC) is the executing agency of Project URU/95/G31.

Execution has just started of the second phase of the Country Study, with the assistance of USCSP. This will be carried out in coordination with the UCC and with the participation of a wide spectrum of governmental and non-governmental organizations.

3.6 Expected Evolution of the National Sector Involved

The national sector involved includes those public and private stakeholders who directly or indirectly produce GHG emissions or are vulnerable to the impacts of Climate Change, together with all those institutions and persons responsible for identifying, planning and adopting measures to respond to such problems.

In the short term, expectations are that some factors, including the following, will contribute to the planning and adoption of mitigation and adaptation policies and measures:

a. Knowledge, with a high degree of certainty, of the annual values of net GHG emissions in Uruguay for the reference years 1990 and 1994;

b. Definition of policies, measures and legal provisions for the progressive incorporation of the various sectors of the country to the effort of global stabilisation of GHG emissions.;

c. Greater and generalised understanding of the problem by society, the State and specific sectors of the national activity;

d. Identification of areas in which technologies, practices and processes could be applied, resulting in lesser GHG emissions (mitigation);

e. Preparation of sectorial mitigation projects and availability of GEF assistance for these projects, following the steps established by the Convention and GEF policies and strategies.

f. Design and evaluation of priority measures to address the Climate Change and of corresponding implementation strategies.

g. Formulation of a National Program of General Measures for mitigation of GHG emissions and adaptation to Climate Change.

h. Development of adequate institutional capacity to address the activities considering the fulfilment of the commitments undertaken by the country under the UNFCCC and the corresponding execution programs, in an efficient, economical and sustainable way.

i. Establishment and availability of the financial and technology transfer mechanisms stated in the UNFCCC, which will support or facilitate the execution of national mitigation and adaptation programs.

3.7 Some Instruments for Action

A wide and diversified training scheme supports the development of programmed actions. This includes sectorial, group and individual training of staff within the country and abroad, training in the work place, participation in and organisation of workshops, conferences and informative events, as well as visits of international consultants and experts, etc.

In reference to public awareness and diffusion, an important role is to be played by the non-governmental organisations. The activities planned include: informative events, distribution of leaflets, organization of sessions and meetings of non-formal education on Climate Change and its impacts.

The private sector will also play an important role. This is mainly apparent in the areas where data of emissions and removals of GHG are required and where potential mitigation and adaptation measures are analysed and identified. Its participation will be crucial for the definition of plans and programs, as well as for the identification and evaluation of specific measures.

The modality of multisectorial and interinstitutional activities (joint activities) is common practice and facilitates and optimise the development of tasks, analyses and studies and the use of outputs which in view of their nature and characteristics require coordinated and collective development.

Apart from GEF and UNDP technical and financial assistance, other available support mechanisms are used that are provided by various international and national agencies. Searching for and managing of project external resources aiming at accomplishing the objectives established, are permanent tasks.

Also, the mechanism provided by Decision 5/CP.1, for the activities performed jointly as pilot experiences, constitute an interesting tool to fulfil the mitigation goals of the country.

Likewise, based on the positive experience existing of the operation of networks in support of activities carried out within the framework of different international instruments (Montreal Protocol, etc), Uruguay promotes the creation of a mechanism or instrument which may act as link for the focal points of different countries and which will constitute a space appropriate for interchange of national experience and information and for fostering, planning, facilitating and coordinating regional activities intended to the implementation of the UNFCCC.

3.8 Climate Change Unit (UCC)

The Climate Change Unit (UCC) is an executing and management agency specially created to promote, execute and evaluate, in coordination with the corresponding persons and institutions, the activities related to the application of the UNFCCC. It is the focal point of the UNFCCC and centralises communications and exchange of data on the issue.

It also organises, keeps and updates a library and technical records on Climate Change, and it supports the activities of implementation of the UNFCCC.

To facilitate its own performance, the UCC has implemented national and international links in the sector. At national level, it keeps contacts with the various stakeholders involved in the issue: Ministries, National Directorates and Commissions, Municipalities, public and private enterprises, Non-Governmental Organisations, etc. At international level, it develops interchange and management activities, through contacts made with the UNFCCC Secretariat, the Inter-Governmental Panel on Climate Change, UNPD, UNEP, the World Bank and other public and private global and regional institutions and ONGs.

The UCC is the agency in charge of preparing and transmitting information relative to the application of the UNFCCC (National Communication), in accordance with the provisions of articles 4.1.j) and 12 therein.

3.9 Projects on Course

3.9.1 Project URU/95/G31

The main objective consists of providing the Government with the necessary capacity for the application of the UNFCCC and the fulfilment of the commitments arising from such Convention.

The following outcomes have been foreseen:

a. Climate Change Unit (UCC): trained and able to address and develop the activities arising from the application of the UNFCCC.

b. A National Inventory of Greenhouse Gases (INGEI) and corresponding updating: elaborated and published.

c. National technical staff: duly trained.

d. Priority areas and project profiles for mitigation: identified and formulated.

e. Program for diffusion and public awareness of Climate Change, its impacts and response measures: applied.

f. Communication to the Conference of Parties to the Convention reporting on the application of the

Convention as set forth in 4.1.j) and 12 of the UNFCCC: submitted.

3.9.2 Project URU/94/008 (phase 2)

The National Commission of Global Change, with the support of the Country Studies Program of the USA, started the execution of phase 2 of the Country Study on Climate Change under project "Formulation of Plans for Adaptation to Climate Change in Uruguay", in pursuit of the following objectives:

a. Design and evaluate priority measures for adaptation to climate change, as well as the corresponding implementation strategies for the sectors relevant to the country's social and economic development, in accordance with mitigation plans for climate change.

b. Obtain consensus and support for those adaptation measures considered a priority.

c. Formulate plans of adaptation to climate change which integrate mitigation and adaptation measures for the sectors selected.

d. Promote the incorporation of measures to respond to climate change in national plans and programs of research and development.

e. Contribute to the preparation of Uruguay's national communications on the application of the UNFCCC.

The outcomes of the Study will serve as a basis for the elaboration and updating of integrated programmes of adaptation and mitigation measures, within the framework of the application of the UNFCCC.

3.10 National Inventory of Greenhouse Gases 1990 (INGEI 90)

The National Inventory of GHG emissions for the reference year 1990 was completed in March 1997. The Spreadsheets and the expression of outputs were made following the IPCC/OECD/IEA Guidelines. The report of INGEI 90 was published in June that year.

The detailed report and a brief of INGEI 90 and its outcomes appear in the Technical Attachment and Section 2 of this Communication, respectively.

A National Inventory of GHG emissions for the reference year 1994 is now being elaborated. It is expected to be completed next year together with a comparative analysis 1990-1994 of Uruguay's net emissions.

3.11 Activities Related to Mitigation

a. Introduction

As in most developing countries and some developed countries, there are practically no programmes in Uruguay oriented to the mitigation of GHG emissions. Therefore, there have not been any efforts oriented to the application of mitigation measures of this sort either. Possibly, this is partly explained by the lack of integrated and standardised information about the current situation of GHG emissions.

In general, the priorities of developing countries concentrate on the areas and issues of relatively immediate or short-term impacts. With some exceptions, those activities oriented to obtain results which will be noticeable after several decades -as would be the case of GHG emissions- are normally considered a low priority.

The limitations arising from the national circumstances typical of developing countries (economic, social, cultural situations, etc.) result in the adoption of measures oriented towards solutions to the most urgent problems, relegating long-term objectives. Thus, developing countries implement plans and programmes that are generally oriented to an increase of income of productive sectors and an improvement of life quality of society as a whole but, in general terms, within a relatively short-time range.

In view of this, plans and programs formulated for the application of mitigation measures in the various sectors of the national activity require the implementation of some sort of incentives or benefit in the short term for those sectors which adopt and apply those measures. A recent work published by Watson (1996) concludes that the adoption of measures which may remedy the present situation of GHG emissions, is not likely world-wide unless such measures ensure an economic profit for those who adopt them.

Mitigation measures of GHG emissions may be derived either from decreasing the emissions of these gases or from increasing the absorptions (sinks) of the same gases. The case of the Forestry sector in Uruguay is a good example of high efficiency in the fulfilment of plans and programmes in which productive and environmental interests, as well as sectorial and general, and public and private interests meet.

The approval of the Forestry Law and the elements provided in it to increase the forested area in Uruguay, have transformed Forestry into a great sink of GHG. The success obtained by the Forestry Law is based on the coexistence of economic and financial incentives in the area, the technical support offered by public and private sectors, the development of industrialisation agents and the exportation of wood products.

One immediate consequence of this programme has been the increase of the sector and the simultaneous development of a significant mechanism for mitigation of CO_2 emissions as a result of the sustained annual increase of around 40,000 ha of newly planted forests.

The plans and programmes to be established for the mitigation of GHG emissions in Uruguay should take the experience of the forestry sector as reference. That is to say, promote activities and technologies that result in a reduction GHG emissions or an increase of GHG sinks, and also in an economic benefit for those applying them.

b. General Information

Among the main provisions in reference to mitigation established by Art. 4, No.1 of the Convention, some should be adopted by the countries for the fulfilment of the final objective of the Convention. These mainly refer to: formulation of programmes, technologies, practice and processes; conservation or reinforcement of GHG sinks and reservoirs; responses to the adverse effects of the projects or measures.

In reference to the programmes, the Convention foresees that national and (if corresponding) regional programmes containing mitigation measures for Climate Change should be formulated, applied, published and updated, taking into account GHG emissions and removals.

Uruguay does not belong to the group of countries which are main emitters of GHG of anthropogenic source, both using the criterion of ton of net emissions per year or that of per-capita and per-year. Neither is it included in Annexes I and II of the UNFCCC. However, although a reduction of net emissions of GHG has not been established for Uruguay, the Government is well aware of its necessity and of the country's duty before both national and international community to contribute to the abatement of GHG emissions, as agreed.

Steps have been taken in this direction. With the assistance of the GEF and UNDP, the Ministry of Environment and Land Management (MVOTMA) is executing project URU/95/G31, which includes the planning and development of mitigation measures. One of the expected outcomes of this project is the identification of priority areas and project profiles for mitigation, aiming to generate national plans and projects to address this subject. The executing agency of the Project is the Climate Change Unit (UCC), described in section 3.8.

The UCC performs these activities based on the results of the National Inventory of GHG, through studies and evaluations made with the assistance of national and international experts and consultants in a sectorial approach (agricultural, industrial processes, energy, wastes, etc.).

Before the completion of the mentioned Project, a set of initial mitigation measures is expected to have been identified. Although the structure and description of activities of the Project do not foresee the elaboration of an integral national programme for mitigation of GHG emissions, the studies consider anthropogenous emissions of GHG by sectors, sources and sinks, the technical, economic and social feasibility of the application of measures in the short and medium run, as well as the human and material

resources required to ensure the success of the implementation of such measures. The corresponding activities are carried out in coordination and cooperation with public and private institutions and with NGOs.

Technical and financial assistance will be applied for in order to implement the mitigation measures identified upon execution of the Project. Likewise, without prejudice of the above, it is expected to define in a short time an institutional mechanism which serves as a space of development and support of the activities related to the elaboration of an integrated national programme containing mitigation measures.

In reference to technologies, practice and processes, the Convention establishes that the Parties should promote and support with its cooperation, the development, application and dissemination, including transfer, of technologies, practice and processes which control, reduce or prevent anthropogenic emissions of GHG in the corresponding sectors.

The Project training activities represent a contribution to public awareness and dissemination of knowledge in reference to mitigation. This process was started and continues under execution by the UCC, with the assistance of national and international experts and consultants. It constitutes the start of a long-term process which will require sustained cooperation and assistance.

From a national point of view, the institutional and political conditions enable fostering and support of these activities. Awareness and concern respect of climate change, its impacts and the potential response measures have been induced among the sectors involved. This is gradually taking place in public and private sectors, through training, diffusion and awareness activities, which are being developed by the UCC within the framework of Project URU/95/G31.

The technology transfers mentioned demand the adoption of efficient legal instruments to facilitate the steps to be taken by those who provide resources (UNFCCC Annex II Parties) and also by those who receive them.

Uruguay belongs to the group of countries which require such knowledge and with a limited capacity due to different circumstances or barriers, to introduce technologies, practice and processes available and from which could improve the country's response capacity. To this respect, as a country which requires these essential elements for developing such capacity, Uruguay is committed to promote and support those legal instruments necessary to provide the incentives for transferring those technologies, practice and processes available to monitor, reduce or prevent anthropogenous GHG emissions of the corresponding sectors, as established by article 4 of the UNFCCC.

In reference to the reinforcement and conservation of sinks and reservoirs, the most relevant activity arises from the application of the Forestry Law. Such law, entered into force in 1987with the aim of fostering and developing an economic activity of national interest: forestation. As a consequence of the measures taken to encourage investments in this sector, the forested area grew constantly generating an important tool for the capture and storage of Carbon dioxide (see chapter 2). It represented an absorption of 28% of the total CO_2 emitted for all concepts (including biomass burning) in 1990. As a result of the constant growth of the sector, a gradual increase of such capacity (sink -reservoir) is expected for the following years.

Although there are no integrated plans at present to conserve or reinforce the existing sinks and reservoirs, concrete measures are to be defined for the mitigation component of the national programme previously mentioned. In reference to the identification, evaluation and neutralisation of the adverse effects of the projects and measures undertaken for mitigation, as well as the characterisation of the economic and social consequences of response strategies, Uruguay has not yet developed specific studies or research, which will only be elaborated in the final phase of the study for the establishment of a national programme of response measures.

In general, technical and financial assistance will be required for the implementation of the activities relative to the common commitments mentioned in this section. The above consideration is applicable to the formulation of an integrated national programme of response measures, including the conservation and reinforcement of sinks and reservoirs, specific studies for neutralising the adverse effects of the measures to be applied and for characterising the economic and social consequences of mitigation strategies, as well as for the implementation of the activities corresponding to the national programme to be defined.

c. Specific Activities

With the assistance of international institutions and consultants, several studies and evaluations are being conducted to identify mitigation measures in various sectors of the national activity.

In reference to the Energy Sector a preliminary mission has been undertaken by a Consultant of the Centre UNEP-RISO (Denmark), for the transfer of a model for evaluation of mitigation in this sector and for the training of UCC and DINAMA technicians in its operation. An interinstitutional and multidisciplinary working group (WG) was recently created, with an aim of developing assessment activities of GHG mitigation options in the energy sector, through the use of module IMPACTS of ENPEP. Such WG will be trained and technically assisted by Argonne National Laboratory (USA) and supported by the national institutions involved. The outputs of this study -obtained through the evaluation of various scenarios- will serve as basis to identify and plan mitigation measures in the Energy Sector.

In the Agricultural sector, a mission of the international consultant from the University of Edinburgh (Scotland) collaborated in the preparation of activities for identification and assessment of mitigation measures in the sector, which will be performed by the UCC with external technical assistance and in co-operation and coordination with the public and private institutions involved. Technicians of the UCC are currently organising the activities of identification and evaluation of mitigation measures, with external assistance.

INGEI outputs clearly show that within the Agricultural sector, mitigation efforts should concentrate in cattle breeding and, particularly, on meat production (accounting for over 60% of the total methane emissions in the country).

Methane is normally produced during animal digestion. The amount of methane produced and excreted depends mainly on two factors: the type of animal and the type of diet of the animal.

Modern meat production is oriented towards increasing the extraction rates, that is to say, an increase of the amount of meat produced per unit of surface and time. To attain this objective, the animals should gain enough weight in short periods, which, in turn, requires young feeding on highly digestible food (improved pastures, and in some cases supplements as feed rations, silos, etc). At the same time, both a reduction of the average age of meet cattle and an increase of digestibility of its diet would also render an immediate reduction of methane emissions.

Watson (1996) estimated that a world-wide improvement of ruminant diet would lead to a reduction of methane emission of approximately 27 million ton/year. This is a case in which the implementation of programmes oriented to improving production efficiency would render immediate economic benefits for the productive sector as well as a reduction of GHG emissions. Tillage is another potential area for mitigation measures. In Uruguay, plantations coexist with cattle exploitation (meat, milk and wool). This is mainly due to the fact that most farmers have adopted a system of annual rotation of crops and pastures.

Whenever land is tilled as preparation for planting, wastes of previous annual crops are incorporated to the soil.

Normally, the "harvest index" is 40-50% (percentage of grain out of total dry matter produced), and therefore, the remaining 40-50% of residues after each harvest is incorporated to the soil by tilling. When the previous crop is pasture (natural or artificial grassland and legumes) in addition to the incorporation of a great amount of vegetable matter, the excretion of pasturing cattle is included. Soil microorganisms decompose these residues and the organic matter of the soil, and use the carbonated skeleton in the process of respiration, which produces CO_2. Thus, conventional tilling represents a great source of emission of carbon dioxide into the atmosphere.

Likewise, the degradation of soils by erosion causes a reduction of their productive potential, and therefore of the capability of crops to capture CO2 through photosynthesis.

In recent years, alternative tilling techniques have been developed. Among the most widely accepted ones is direct sowing or zero tilling. With zero tilling, the residues of previous crops or pastures remain intact on

the soil surface, sowing is directly performed on them. The absence of tilling prevents an explosive increase of the biological activity of the soil and a flow of CO_2 into the atmosphere due to respiration as in the case of conventional tilling.

Furthermore, in zero tilling, the permanent cover of the soil with vegetable residues reduces or eliminates the impact of rain drops on the soil particles, which results in a reduction or an elimination of erosion losses. Consequently, the productive potential of soils is maintained (or increased) and so is the capability of crops for carbon sequestration. There is evidence of increased content of organic matter in the soil when zero tilling is used, which, in turn, constitutes an increase of carbon sequestration capacity.

Thus, Martino (1994) estimated that, as a consequence of the increase of organic matter in the soil, if a certain farming surface changed from conventional to zero tilling, the soil would be able to remove 75% of CO_2 in the column of atmosphere existing on that surface.

For over 10 years, investigation results have shown the feasibility and, in many cases, the economic advantages for producers of implementing farming systems based on zero tilling. This is another example in which a programme oriented to foster the adoption of a technology with economic benefits for farmers also implies the establishment of a suitable mechanism for mitigation.

Another GHG emitted by the agricultural sector is nitrous oxide. One of the factors that have been cited in international literature as basic for reducing emissions of this gas is the development of techniques which may improve efficiency in the use of nitrogen-based fertilisers. An increase in efficiency of nitrogen utilisation from fertilisers would result in a greater proportion of this gas used by crops, and therefore in a lower remaining for leaching and volatilisation processes which directly or indirectly contribute to N_2O production.

At the same time, an increase of efficiency in the use of fertilisers also implies an increase in incomes for farmers; therefore this is also a case in which the environmental and economic objectives coexist. Briefly, a programme aimed at increasing the agricultural area based on zero tilling which includes fertilisation strategies which improve to use of nitrogen, would directly contribute to a reduction of the emissions of N_2O and to an increase of CO_2 removal.

Forestry is the only sector that is at present a sink of GHG. As previously mentioned, the implementation of the Forestry Law enabled a sustained increase in the forested area of 40,000 ha/year. However, it is possible to improve the current situation of the sector further, for instance, by increasing the participation of wood destined for long-life uses. At present, most of the wood produced in the country is used as firewood and for the paper industry. A new instrument for mitigation of CO_2 emissions would be created if a larger proportion of forests were destined to wood production for construction, poles and furniture, which allow a longer life for fixed carbon.

In summary, three clear potential actions have been identified for the Agriculture Sector for mitigation of greenhouse effect:

a) improving efficiency in meat production with diets of better digestibility and younger animal categories;
b) increasing the farming area based on zero tilling and with more efficient strategies of nitrogen fertilisation; and
c) increasing the participation of the use of wood for products of longer life.

All three options considered, represent a potential immediate economic benefit for producers, and therefore, imply a high probability of success for the technologies proposed. However, they also require the implementation of integrated programmes which should include legal mechanisms, financial incentives and technological support in order to ensure successful adoption.

Several circumstances should be highlighted that increase the possibility of success for the adoption of measures identified for the Agricultural sector. The existence of the Climate Change Unit and the National Commission on Global Change ensures an institutional framework adequate for the design and coordination of mitigation and adaptation programmes. There is also a certain degree of organisation of productive sectors through the Zero Tilling Association of Uruguay (AUSID), the Forest Producers Society,

the Rural Association of Uruguay and the Rural Federation of Uruguay.

Likewise, there is adequate infrastructure for the generation and diffusion of scientific and technological information (Ministry of Agriculture and Fishing, National Institute of Agricultural Research, University of the Republic), able to provide the necessary technical support for the activities of programmes established.

Technical and financial assistance will be required to implement these programmes. For the three options mentioned it has been foreseen that technical and financial assistance is required both for the development of impact studies and the definition of specific technologies for the various situations, as well as for the implementation of programmes. Likewise, the increase of the zero tilling area (for instance), may be effected through the creation of special credit lines for the procurement of machines and a training and diffusion programme of the technology to apply. Similar activities can be implemented to foster an increase in the use of wood for longer life products, and efficiency in meat production, through the improvement of natural grasslands.

With the help of international experts, who visited the country and through training activities and the provision of better qualified staff, the technical capacity of the UCC has been improved to undertake and promote the activities of identification of priority areas and project profiles for mitigation in the sectors Wastes and Industrial Processes.

During the visit of an international sectorial consultant of BC-Consult (Denmark), an evaluation was made of organisation, management and final disposal of refuse (mainly solid wastes). Based on this evaluation, a project was elaborated, whose main objective was to reduce methane emissions from non-controlled landfills through the production of electricity from methane and the consequent replacement of fossil fuels. At present, steps are being taken to apply for assistance of GEF through the World Bank to carry out this project.

Likewise, steps are also being taken towards implementation of a project of direct assistance to industry for the treatment of liquid effluents of high content of organic matter. The main objective is to reduce methane emissions from the decomposition of such organic matter. For this, the UCC is coordinating with the Industry Chamber of Uruguay (CIU) and managing a line for technical and financial bilateral assistance with the Government of Denmark. Early in August of this year, the Technical Coordinator of the Project URU/95/G31 and a representative of the CIU visited Denmark with the aim to establish contact with competent Danish Authorities and to see in situ the industries which have developed similar projects.

As a preparatory activity, a general survey was conducted in the Industrial Processes Sector, aiming at obtaining a database of the enterprises and activities which produce GHG emissions. This task was in the hands of the Center of Technological Management (CEGETEC) which works under the sphere of the CIU, after a public call for the provision of such technical study.

A detailed evaluation of cement and lime production activities was also made with the assistance of an international consultant in Industrial Processes (Santo Domingo) (May 11-18, 1997). At present, the international consultant is elaborating recommendations and profiles of projects relative to potential mitigation measures, particularly of carbon dioxide emissions in the productive processes mentioned. The assistance to projects derived form this activity will be eventually requested at the GEF through the World Bank.

3.12 Activities relative to Vulnerability and Adaptation

a. Introduction

The present studies and research are intended to estimate the impact which the climate change may produce in Uruguay, particularly in reference to the agricultural sector and coastal resources. They are also aimed at an evaluation of the adaptation measures which may serve as basis for decision makers to reduce the adverse effects and take advantage of possible benefits produced by the climate change.

In October 1994, the National Commission on Climate Change (NCCC) started the first phase of the

Country Study on Climate Change under the project of "Evaluation of Climate Change Impact in Uruguay". This two-year project was executed by the NCCC in cooperation with various national institutions and with the assistance of the United States Country Studies Program (USCSP). Its main objective was the evaluation of vulnerability of the country upon facing the climate change and the identification of adaptation options in areas of particular socio-economic importance (agricultural and coastal resources).

As a step previous to the evaluation of e vulnerability of the country to climate change, the possible scenarios were elaborated of climate change in the south east of South America (Uruguay, south of Brazil and east of Argentina), based on the utilisation of the General Circulation Models (GCMs). The outputs of the models were compared with the climatology of the region for the period 1951-1970.

The models were found to represent the temperature of the region accurately although they also tended to exaggerate the length of the cycle. However, none of the GCMs rendered a correct estimation of rainfalls, neither in volume nor in spatial distribution. This is mainly due to the fact that the temperature of the region is strongly linked to the global energy balance, while rainfalls are derived from the action of several factors of the local and regional scale which are not taken into consideration by the GCMs.

In conclusion, the projections were only considered in reference to temperature and for some specific analyses. Default scenarios were: for temperature, +2ºC and +4Cº and without change, and for rainfall, ±10% and ±20%.

Another activity performed within the framework of the Country Study was the inventory and an analysis of relevant information for climate change studies in the country. A database was created which contains references on localisation, means of storage, period and general features of the data of various fields such as meteorology, crops, soils, forestry sector, oceanography and hydrography, cartography, etc. References on social and economic indexes of interest for this sort of study were included (obtained from various sources, i.e. agencies, publications, research papers, etc.).

The creation of this database allowed the evaluation of baseline data in Uruguay. The conclusion was that considerable data has been collected by national institutions which serves as input for climate change studies. However, information drawbacks include, lack of digitalisation of some data, interruptions in long-term monitoring as a consequence of lack of funds, absence of standardised criteria for data collection and processing, etc.

The Study also aims at fostering the development of an inter-institutional and inter-disciplinary network suitable to address the implementation of new studies related to climate change.

Also a study was conducted in reference to the understanding of Uruguayan population on global environment phenomena, and more recently, on climate change and its potential effects. Details on this respect are presented in Section 3.14.

b. Agriculture Sector

The vulnerability to climate change in some relevant sub-sectors of the Agriculture Sector was evaluated and adaptation options were preliminarily identified. The sub-sectors involved included two winter crops (barley and wheat), two summer crops (rice and corn), and pastures for cattle breeding.

The results obtained within the framework of phase 1 of the above mentioned Country Study are analysed below.

b.1 Crops

For the analysis of crops vulnerability models CERES and DSSAT v 3.1 (Decision Support System for Agrotechnology Transfer) were used, which integrate simulations of crops growth with soil, climate and management practice data.

In general, the simulations models proved a good instrument for an integrated analysis of the behaviour of Uruguay's main crops, under short and long term variations and in various agro-ecological environments including different types of soil. They may also be used to evaluate management practices and economic

estimates, which would facilitate policy decision making anticipating or counteracting some extreme events (for instance severe water deficits). Without prejudice of the previous considerations, the models CERES for barley, wheat and corn require some adjustments in some of their routines in order to improve their application to local conditions according to the observations made, and therefore a greater effort was recommended in reference to calibrations and associated research.

Estimates are that Uruguayan main crops would be affected by the scenarios of higher temperature projected for mild regions (+4º to +5ºC), even though the volume and characteristics of precipitation variations are uncertain. Therefore, adaptation measures are required to face possible adverse effects -such as decrease in crop yields- or to develop genetic potentials so as to take advantage of the favourable elements of the scenarios projected.

Uruguay has the human and technical resources necessary to implement adaptation measures in an efficiently and relatively easy way (e.g.: genetic improvement).

Baethgen (1994) working specifically on wheat and barley, concludes that an increase of 4.1^0 C in temperature would cause a yield reduction for these crops of approximately 30%. Subsequent studies by Baethgen and Magrin (1995) estimate reductions of 10-20% in yield for wheat for the scenarios of a 2 and 4 ºC increase in temperature respectively.

In the case of barley, in addition to the simulation models, historical series were analysed. Both methods rendered a projection of yield decrease in function of the shortening of cycle for scenarios with temperature increase, and a decrease in yield for scenarios with rainfall increase associated to a deficiency of nitrogen in the soils due to flushing and denitrification. A decrease in rainfall, however, -since it induces a lower excess of water in the soil during winter and lower losses of N due to flushing - would favour barley production.

In a preliminary stage the following adaptation measures were identified: selection of cultivars sensitive to the photoperiod, application of nitrogen fertilisers in a rational way according to the changes in rainfalls, selection of cultivars with more resistant roots to anaerobiosis (due to water excess in soils) and research and monitoring of pests and diseases, aiming at improving these measures and identifying others.

Irrigation summer crops, rice for instance, show an increase in yield with temperature increase, although the models did not render well defined conclusions, which suggests that it would be necessary to continue working on them. An increase in rainfall would favour diseases and would change management practices, whereas a reduction would affect the availability of the volumes of water required for rice crop flooding, particularly taking into account that rice crops are in full expansion.

The following preliminary steps were identified for adaptation: improvement of the performance of simulation models, research and monitoring of diseases.

Secano showed to be considerably vulnerable to climate change. An increase in temperature would determine a shortening of the cycle and consequent lower yields. A decrease in rainfall or an increase of rainfall variability would worsen the present situation in reference to these factors. Corn yields show a favourable response under scenarios with an increase in rainfall, particularly in the case of soils with low capability of water storage. However, this situation can affect the efficiency of nitrogen use due to losses derived from flushing and denitrification.

For this crop, the following adaptation steps were identified: to improve the models so as to enable their accurate representation of water content of the soil, to increase knowledge in areas such as Nitrogen dynamics and root development, and the capability of crops of water extraction.

Other measures were also identified for the case of temperature increase, such as, anticipating the date of sowing, so as to reduce an acceleration of the period sowing-emergency and obtain a lesser decrease in the total cycle; developing cultivars with a greater sensitivity to photoperiod (to reduce thermal requirements) and cultivars with a longer cycle (to counteract a reduction of the cycle produced by temperature). Likewise, for rainfall increase, the application of nitrogen-based fertilisers is suggested so as to remedy any possible Nitrogen deficiency due to flushing and denitirification. For a scenario of rainfall reduction, irrigation should be increased and its efficiency improved.

b.2 Cattle breeding and Pastures

The analysis to evaluate the vulnerability of pastures to climate change was performed with model SPUR2 (Simulation of Production and Utilisation of Rangelands). The model allows the performance of general estimations but it proved in need for adjustments in order to be applied efficiently to our country's conditions, and thus be a good instrument to estimate the effects of the current climate variability. For scenarios with an increase in temperature and rainfall, a considerable fodder production increase was estimated. If rainfall decreases the positive effect of a temperature increase on fodder would be lesser and inter-annual variability would increase. A preliminary adaptation task was identified to continue working on the improvement of the simulation model.

c. Coastal Resources

Coastal resources vulnerability was assessed and preliminary adaptation options were identified. The impact of a possible increase in the sea level was studied in detail. The studies also identified and analysed other relevant effects of climate change in Uruguay.

Research previous to the Country Study only provided a study by Volonte and Nicholls (1994-1995) on the vulnerability of Uruguay to an increase in the sea level which was based on videos of air shooting of Uruguayan coast made in 1991, sampling of some coastal settlements and the analysis of historical data. The objectives of the study include an evaluation of coast vulnerability to sea level increase, an analysis of its potential impacts and the identification of mitigation measures

c.1 Uruguayan Coast Vulnerability to Climate Change

The increase of mean seal level (MSL) was only 0.069 mm/year in the Port of Punta del Este (for 1901-1992) and 0.69 mm/year in the Port of Montevideo (for 1902-1994). These values are lower than the global measure estimated by Douglas (1991) 1.8 mm/year and than the values of other sea stations in the South Western Atlantic Ocean which are close to 1.5 mm/year. The value obtained in the Port of Montevideo is not consistent with the estimations Volonté and Nicholls (1995) who indicated that the records for Montevideo showed a behaviour similar to that of Buenos Aires. Dennis et al. (1994, in Volonté and Nicholls, 1995) estimated an increase in sea level for the city of Buenos Aires (1.6 mm/year) considerably greater than that obtained for Montevideo.

The analysis of historical evaluation of storm high-tides for Montevideo and Punta del Este, based on the maximum annual records, showed an oscillating tendency in both cases. Curiously, the average of the maximum annual values for six coastal cities (Colonia, Juan Lacaze, Montevideo, Piriápolis, Punta del Este and La Paloma), using all records available until 1995, showed a value lower than the average calculated until 1974 for all of them. Likewise, the range of variation of maximum annual tide values seems to be lower when the second half of the century is compared with the first half.

The analysis of wave response to changes in wind patterns showed that, a 10% increase of SW wind intensity, would determine an increase of waves greater than 1.5 m from 7% baseline (based on wind actual data) to 34%. For S winds, the percentage of waves greater than 2.5 m increases from 12% baseline to 20% in the projected scenario of 10% increase in wind intensity, and for SE winds from 12% to 27% respectively. Refraction and diffraction deriving from an increase of 1 m in the sea level do not modify the angle of incidence of the waves on the coast.

The dynamics of the system of dunes adjacent to low lands and to the oceanic coast depends on the system of winds and eolic transportation; therefore dunes are very sensitive to global climate change. The region of Polonio Cape (Province of Rocha) is the last active relict of a coastal transgressive dunes of 35 km^2 of a sub-parallel development to the coast (Panario and Piñeiro, 1996). The application of empirical-mathematical models to Polonio Cape showed that an increase of 10% in frequency of the winds associated to the Anticyclone of the South Atlantic Ocean can determine a reduction by half of the transfer of sand to those beaches oriented to the East and North-East (Panario and Piñeiro, 1996).

Volonté and Nicholls (1995) compared the possible impacts on the Uruguayan coast of a sea level increase, and concluded that, erosion would have a greater impact than flooding. For a scenario with an

increase in the sea level of 1 m, approximately 94% km2 of land would be jeopardised by erosion and flooding. The endangered area would include the most expensive land on the coast and in the country. The coastal Province which has most land in danger is Rocha followed by Colonia and Canelones.

The analysis of vulnerability by coastal Province, made by Volonté y Nicholls (1995) under the same scenario, indicates that some significant impacts in Colonia would include the flooding of coastal wetlands and an important recession of around 50 to 150 m of sandy beaches. Coastal wetlands of San José would also be affected by flooding and the cliffs which are currently undergoing an erosion process would recede 60 m.

In Montevideo, the main impact would be the flooding of 12 km^2 of coastal wetlands near Santiago Vázquez. The beaches of Montevideo (from Pocitos to Punta Gorda) could experience a recession of the coastal line of even 125 m. The erosion would be greater on the beach of Carrasco (one of the most expensive residential neighbourhoods of the country). Most of the main coastal road of Montevideo (the Rambla) would be irreversibly damaged.

For Canelones, estimates were that the recession of the coastal line could reach 350 m, which would mean the complete destruction of some coastal cities. In reference to Maldonado, the current problems of coastal erosion of Piriapolis would worsen and the beach which surrounds the city could disappear; in Punta del Este the most vulnerable beaches are those of the west of the peninsula. Estimations of the recession of the beaches to the East of La Paloma in Rocha could be of 300 m.

Coastal lagoons in the East of Uruguay (Provinces of Rocha and Maldonado), and their biodiversity, constitute particularly vulnerable environments to an acceleration in the increase of sea level. These lagoons originated in bays and gulfs during the quaternary age, which became separate from the sea as a result of an intense exposure to sediments. Collazo (1996) estimated a recession of the coastal line of 0.9 m/year on the bar of Rocha lagoon. The potential effects of an increase of the average sea level would be a greater coastal erosion and an increase in floodable areas and modifications in the system of opening of sand bars which separate them from the sea (Collazo, 1996).

The value at risk for the various scenarios of sea level increase, both according to Volonté and Nicholls (1995), Nicholls and Leatherman (1995) and the CNCG (in prep.) dramatically increases above 0.5 m. In terms of population affected, for the scenario of 1 m increase, above 12.000 people would be affected (Volonté and Nicholls, 1995), not counting a great number of tourists who visit the Uruguayan coast in summer.

According to the estimations by CNCG of capital at risk, considering three scenarios of sea level increase 0.30 m, 0.5 m and 1 m, the areas with greater capital at risk per linear km of coast are in order, the provinces of Maldonado, Montevideo and part of Canelones and Rocha (see Table 3.1).

The Uruguayan coast appears not to be highly vulnerable (in terms of capital at risk) to the increase of the sea level of the most conservative scenarios (up to 0.5 m) due to the existence of large sectors which would buffer the impact whether because there are wide bands of beach or roads (coastal roads) which separate buildings from the sea.

However, it should be pointed out that the estimations of value at risk by Volonté and Nicholls (1995) only take into account the value for land and building costs. Therefore, the most vulnerable areas from an economic view point, are urban areas with a great density of buildings. But their estimations do not include the cost that the destruction of these coastal roads would imply for the country or the value of the beauty of this natural landscape for the population, including beaches, neither the loss of profit of tourism that would not come if the beaches of greater attraction would disappear.

To obtain more accurate estimates, new studies would be required to measure the value of natural coastal resources.

Zone	Section	SCENARIO 0.30 m				SCENARIO 0.50 m				SCENARIO 1.00 m			
		Bruun		Equilibrium		Bruun		Equilibrium		Bruun		Equilibrium	
		Surface Ha	Capital Thous. US$	Surface Ha	Capital Thous. US$	Surface Ha	Capital Thous. US$	Surface Ha	Capital Thous. US$	Surface Ha	Capital Thous. US$	Surface Ha	Capital Thous. US$
I	Colonia -Pta. Artilleros	96.70	8,368	155.45	36,113	161.17	37,443	259.08	72,589	322.34	90,314	518.16	146,802
II	Pta. Artilleros - A. Pereira	171.10	16,160	292.18	37,108	285.18	35,598	486.97	79,048	570.35	92,582	973.95	183,308
III	A. Pereira - Pya. Pascual	296.77	6,407	343.39	20,725	494.61	33,384	572.31	50,607	989.23	100,610	1,144.63	101,213
IV	Pya Pascual - Pta. Esprinillo	24.98	4,319	52.18	9,021	41.64	7,172	86.97	18,777	83.28	17,978	174.00	37,555
V	Pta. Espinillo - Pta Lobos	7.20	43	16.29	98	12.00	12	27.15	164	24.00	145	54.30	328
VI	Pta. Lobos - Atlántida	80.77	716,750	228.06	1,986,275	134.17	1,194,929	380.09	5,869,724	265.34	4,224,387	760.19	17,647,525
VII	Atlántida - Pta. Colorada	100.86	107,030	271.22	288,015	168.09	178,383	452.33	611,727	336.18	454,649	904.66	1,500,116
VIII	Pta. Colorada - Pta. Ballena	39.30	366,795	112.00	1,045,102	65.50	611,727	186.62	2,612,756	130.99	1,833,975	373.23	6,729,933
IX	Pta. Ballena - Pta. José Ignacio	82.32	2,214,300	242.28	6,516,124	137.18	3,690,500	403.80	16,290,309	274.39	11,071,500	807.59	48,870,926
X	Pta. José Ignacio - La Paloma	84.84	304,845	218.22	784,090	141.40	508,075	363.70	1,960,226	282.81	1,524,225	727.40	5,880,678
XI	La Paloma -Pta. Castillos Gde	82.65	15,899	246.00	47,091	137.75	26,498	409.75	117,191	275.50	78,795	819.50	349,498
XII	Pta Castillos G-Pta. del Diablo	66.08	410	207.48	1,286	110.13	683	345.79	2,144	220.26	1,366	691.59	4,288
XIII	Pta. del Diablo - Pta. Loberos	17.76	112	55.77	351	29.61	186	92.96	585	59.21	372	185.91	1,169
XIV	Pta. Loberos - Barra A. Chuy	38.67	2,076	121.43	6,518	64.46	3,460	202.38	10,864	128.91	6,920	404.77	21,728
	TOTALS	**1,190.00**	**3,763,514**	**2561..95**	**10,778,119**	**1982.90**	**6,327,646**	**4,269.91**	**27,696,710**	**3,962.80**	**19,497,819**	**8,539.82**	**81,475,067**

No specific studies have been conducted on the vulnerability of fishing to climate change. However, Nagy et al. (1996) highlighted the significance of fluvial flows and winds as regulators of the position and vertical structure of the saline intrusion, of the stratification and oxygenation of water in the northern coast of the River Plate, and therefore, of their influence on physical and biological processes. The combined effect of climatic changes would have a great impact on these processes and on some of the main fishing resources of the country.

In sum, a possible acceleration of the increase of the sea level or of the variability of climate, as well as the joint occurrence of both conditions, are motive of concern in relation to their potential impact on the coast and the economic activities which depend on coastal resources in Uruguay. But the adoption of adaptation measures to climate change, which represent a cost for the country, requires the development of substantially greater scientific knowledge of local, regional and global conditions and processes whether of natural or anthropogenous source.

c.2 Preliminary Evaluation of Adaptation Options

The costs of the following adaptation measures were analysed for the three scenarios of sea level increase (0.3 m, 0.5 m and 1.0 m) (CNCG, in prep.): not to take action or allow the destruction of the existing buildings in the jeopardised regions; and active protection (construction of breakwaters on the coast and artificial feeding of sand in the beaches). Tables 3.2 and 3.3 below show the corresponding data.

ZONE	SECTION	SCEN. 0.30 m Cost (thous. US$)	SCEN. 0.50 m Cost (thous. US$)	SCEN. 1.00 m Cost (thous. US$)
I	Colonia - Pta Artilleros	25,737	51,474	102,947
II	Pta Artilleros - A° Pereira	52,044	104,088	208,175
III	A° Pereira - Pya Pascual	55,137	110,274	220,549
IV	Pya Pascual – Pta Espinillo	9,353	18,706	37,412
V	Pta Espinillo – Pta Lobos	2,920	5,840	11,680
VI	Pta Lobos – Atlántida	36,636	73,273	146,546
VII	Atlántida - Pta. Colorada	47,408	94,817	189,634
VIII	Pta. Colorada – Pta Ballena	19,559	39,118	78,237
IX	Pta Ballena - Pta José Ignacio	40,971	81,942	163,883
X	Pta José Ignacio - La Paloma	46,450	92,901	185,801
XI	La Paloma - Pta Castillos Grande	50,278	100,556	201,113
XII	Pta Castillos Grande – Pta del Diablo	42,431	84,862	169,723
XIII	Pta del Diablo – Pta Loberos	11,406	22,812	45,624
XIV	Pta Loberos – Barra del A° Chuy	24,833	49,667	99,334
TOTALS		**465,164**	**930,329**	**1,860,658**

Table 3.2: Costs of the protection through waterbreaks

The costs of feeder beaches are quite above those of the construction of breakwaters (between two and

three times higher for the various scenarios of sea level increase). General application of any of these two measures, i.e. their application all along Uruguayan coast, would imply costs which Uruguay would possibly not undertake in its actual situation and in consideration of the degree of uncertainty of potential climate change. The most appropriate course of action would be to identify measures most convenient for each vulnerable sector of the coast after an in-depth study of each of them.

However, from the comparison between the amount of capital at risk and the cost of any of the measures of protection along the coast, conclusions are that, for all scenarios of sea level increase, the cost of not taking any measure is higher than the protection costs of the coastal strip between Punta Lobos (Province of Montevideo) and La Paloma (Province of Rocha), i.e. all the coast of the Provinces of Canelones and Maldonado.

ZONE	SECTION	SCEN. 0.30 m Cost (thous. US$)	SCEN. 0.50 m Cost (thous. US$)	SCEN. 1.00 m Cost (thous. US$)
I	Colonia - Pta Artilleros	73,146	121,909	243,819
II	Pta Artilleros - A° Pereira	138,668	231,113	462,226
III	A° Pereira - Pya Pascual	127,322	212,203	424,406
IV	Pya Pascual - Pta Espinillo	21,598	35,996	71,993
V	Pta Espinillo - Pta Lobos	7,780	12,967	25,934
VI	Pta Lobos - Atlántida	89,481	149,135	298,270
VII	Atlántida - Pta. Colorada	115,790	192,984	385,968
VIII	Pta. Colorada - Pta Ballena	47,771	79,619	159,238
IX	Pta Ballena - Pta José Ignacio	100,067	166,779	333,557
X	Pta José Ignacio - La Paloma	137,516	229,193	458,385
	La Paloma - Pta Castillos Grande	133,963	223,272	446,544
XI	Pta Castillos Grande - Pta del Diablo	113,054	188,424	376,847
XIII	Pta del Diablo - Pta Loberos	30,391	50,652	101,303
XIV	Pta Loberos - Barra del A° Chuy	66,167	110,279	220,557
TOTALS		**1,202,714**	**2,004,524**	**4,009,047**

Table 3.3: Cost of protection through beach sand filling

The construction or improvement of breakwaters and other rigid structures may constitute an appropriate measure for some areas where important infrastructure is to be preserved (such as harbours, coastal roads and buildings), or for places declared as national heritage because of their great national value, such as the historic neighbourhood of Colonia del Sacramento). The artificial filling of beaches would be therefore required for those beaches of greater recreational value and tourist attraction (in Montevideo and the main seaside resorts of the coast), in the case of actual occurrence of erosion.
In view of the great degree of uncertainty respect of the possible increase of the sea level, and taking into

consideration until today, it seems to be lower on the coast of Uruguay, than the global average, the most convenient actions to be taken would be: discourage the establishment of new buildings within the vulnerable areas of the coast, plan urban development in non-vulnerable areas, and establish conditions to withdraw or prevent the reconstruction of those properties damaged within critical areas.

Likewise, it was considered important to implement plans to develop an integrated management of the coastal area, as a measure to prevent or counteract any possible impact of climate change on the coast and to ensure the sustainable development of the coastal area.

The definition of adaptation measures for the Coastal Resources sector, requires the conduction of in-depth studies and research.

3.13 Training

To address this broad and complex subject matter, all opportunities were taken advantage of to apply for, obtain or offer training through the various means and modalities, both collective or individual, for professionals, technician and administrators of the various sectors (public, private, non-governmental, educational, productive, etc.) and the general public, in the countries and abroad, with technical and financial internal and external assistance.

The activities performed include:

a. A Workshop on Vulnerability and Adaptation to Climate Change in Latin America, organised by the Country Study (CNCG), in Montevideo from 22 to 24 April, 1996. 104 participants from 15 countries of the region, the United States of America and Holland attended this Workshop. The papers presented on the works performed and the instances for interchange allowed the evaluation of the progress made in reference to Climate Change research in Latin America. Likewise, the problems encountered were discussed as well as the advantages and disadvantages of the analytical tools available (MCGs, simulation models, etc.) and the perspectives for the development of future initiatives of joint research in the region. The Workshop memories will be published by Climate Research.

b. A course in the Application of Simulation Models for Crops and Pastures organised by the Country Study, was held in Colonia from 24 to 28 April, 1995. It provided training for those technicians who participated in that Study or were institutionally linked to it.

c. Training of UCC technicians, with the assistance of Lic. David Antonioli of ICF Incorporated (USA), for the elaboration of INGEI 90. This included data management and processing, calculations, outputs and elaboration of standardised spreadsheets for the elaboration of GHG Inventories.

d. The Workshop of pre-implementation of INGEI 90 (Montevideo, May 28, 1996) with the technical assistance of the international consultant mentioned. This Workshop was intended for a heterogeneous and multidisciplinary public belonging to the different sectors of the economy and national administration involved in the elaboration of INGEI 90. Its objective was to inform, identify and raise awareness about the methodologies applicable and the data required to elaborate the Inventory.

e. A National Workshop on GHG Mitigation in the Energy Sector (Montevideo, December 18, 1996) was held, with the technical assistance of Arturo Villavicencio, international consultant of UNEP-RISO Center (Denmark). This Workshop was addressed to technicians and managers who work on power generation, transmission and distribution and to large consumers. Its objective was to inform and raise awareness on the problem of GHG concentration in the atmosphere, its sources, the participation of the sector in the problem and mitigation measures.

f. A National Workshop on GHG Mitigation in the Agricultural Sector (Montevideo, November 27, 1996) was held with the technical assistance of the International Consultant Dr. Keith Smith of the University of Edinburgh (Scotland). Producers, technicians and managers linked to sectors which are net emitters of GHG were informed and trained respect to the mitigation measures which are currently being applied in other countries.
UCC members were trained and informed in reference to emissions and potential mitigation measures in

for Industrial Processes Sector and particularly, in the area of Portland Cement and Lime. Such activity was carried out with the technical assistance of the international consultant Mr. Eduardo S. Maal (Energy and Environment Consultant, Dominican Republic) from May 11 to 18, 1997.

Within the framework of the activities of phase 2 of the Country Study on Climate Change, new institutional and personal contacts were established with decision makers and specialised technicians, dissemination of the subject matter and widening of the range of institutions involved. With the aim of interchanging ideas about the scope of adaptation plans in Uruguay a Planning Meeting was held to establish an Inter-institutional Coordination, in Montevideo, on September 11, 1997.

A Workshop on the identification of national and global benefits and estimation of incremental costs in projects is scheduled within the framework of project URU/95/G31 for 1997. This workshop is intended for managers and plan-makers of the private and public sectors involved in projects related to mitigation and will have international technical assistance.

UCC technicians were trained in reference to emissions (particularly methane) and about measures for solid wastes mitigation. This was done with the assistance of international consultant Dr. Christian Mosgaard (BC- Consult, Denmark), in Montevideo, March 4 to 14, 1997.

Taking advantage of the available opportunities, members of the Project and Country Study mentioned, were trained through their participation in several Workshops on subject matters relative to the application of the UNFCCC: Vulnerability and Adaptation to Climate Change (Honolulu, Hawaii, 1995), GHG Mitigation (Berkeley, USA, 1995), Inventories of Greenhouse Gas Emissions and Mitigation Options (Margarita Islands, Venezuela, 1995); International Perspectives for Joint Implementation (Santiago, Chile, 1995), Vulnerability and Adaptation to Climate Change in Latin America (Montevideo, Uruguay, 1996), Support to the Elaboration of a Climate Change Action Plan (Arlington, USA, 1996), Integration Models of Evaluation (Tokyo, Japan, 1997), Cost Evaluation for Adaptation and Mitigation: Concepts, Methodologies and Appropriate Use (Roskilde, Denmark, 1997), Technologies for Activities Implemented Jointly (Vancouver, Canada, 1997).

3.14 Diffusion and Public Awareness Activities

Within the framework of the execution of phase 1 of the Country Study, a national urban survey (October 1995) was performed to get to know the viewpoint of the Uruguayan population on global environmental phenomena and, more precisely, on climate change and its potential effects.

In general terms, the population is informed of global environment phenomena such as ozone layer destruction, variations in climate such as droughts and flooding, extinction of species and deforestation. However, other phenomena, such as sea level increase, El Niño and global warming are relatively little known.

Other survey results show the efficacy of mass media as a source of information on climate change, and particularly to raise awareness among those sectors of the population with lower access to formal education. In addition, it showed the significance of other media, such as the press, for campaigns intended to develop a deeper concern and knowledge of environmental issues, as well as the increasingly important role of educational institutes in the dissemination of these issues. From there on, a great effort has been made to inform and raise awareness in the general public through the various means and modes, with a special emphasis placed on education.

A massive diffusion campaign was held (1996), through the distribution of information material (in primary, secondary and technical education centers), which included a Dissemination Workshop. An advertising agency was specially hired for the organisation and development of these tasks. For the distribution of the printed material, already existing official channels were used through the Ministry of Education and Culture, thus ensuring the most efficient and effective completion of the task and the widest scope.

Within the framework of this activity the following materials have been distributed: "Climate Change" (fifth and sixth grades of 38% primary schools), "To understand Climate Change: Basic Guidelines of the United Nations Framework Convention" (82% of High-schools and 51% of Technical Schools).

Finally, a Diffusion Workshop was held to train the press of Montevideo and authorities of primary, secondary and technical schools, in Hotel Belmont House (Montevideo, December 3, 1996). Climate Change and Ozone Layer issues were analysed, addressing their causes and impacts, and the measures that have been or are to be developed within the framework of the commitments undertaken by the country at the international level.

In order to support the dissemination and informative activities the following leaflets were elaborated and published aiming at different publics:

a. "National Inventory of GHG: 1990" (for the Parties of the UNFCCC and national institutions);

b. "Climate Change - Global Warming" (for teachers and students of high schools and technical schools).

c. "Climate Change" (for primary school teachers and students).

d. "To understand the Climate Change: Basic Guidelines of the UNFC" (for high schools and technical schools and teachers).

e. Didactic poster on "Climate Change and Uruguay", for the general public.

f. Stickers about the protection of the atmosphere (for the general public)

Through the UCC, lectures - with audio-visual aids - were given in several primary, secondary and higher education centers, as well as in clubs and service institutions and cultural events specially organized for these purposes.

Together with the Uruguayan Network of Environmental NGOs, the UCC has started a cycle of subregional Workshops in Uruguay. The objective of these Workshops is to inform -through lectures and distribution of informative material- on Climate Change and depletion of the Ozone Layer, their impacts and activities being developed at national level to address these global atmospheric problems. Such workshops are aimed for the various national NGOs and the general public.

In a complementary manner and frequently, interviews, press calls and declarations are made on the issue of Climate Change, its impacts, responses and national and international activities relative to mitigation and adaptation.

3.15 Observation, Research and Networks

Uruguay is a member of the World Meteorological Organisation (WMO), the Global Climate Observing System, the World Weather Programme, and the Atmospheric Research and Environment Programme.

The country has a National Network of Environment, Climate and Meteorological Observations that regularly makes systematic and standardised observations under the direction and control of the Meteorological National Directorate (DNM). This agency keeps, operates and updates a National Data Bank on climate and environment. Through the Climatological and Documentation Directorate, it collects and elaborates data and produces and updates climate and applied analyses, studies and investigations. Other national institutions operate complementary or specific networks in coordination and under the technical direction of the DNM.

Uruguay is member of the Inter-American Institute for Global Change Research (IAI). IAI coordinates a regional Network of research centers, which conduct basic research on global change processes of great significance for the region. IAI science agenda includes the following priority research areas: Tropical Ecosystems and Biogeochemical Cycles; Impacts of Climate Change on Biodiversity; el Niño Southern Oscillation and Interannual Climate Variability; Ocean-Atmosphere-Land interaction in the Intertropical Americas; Comparative Studies of Oceanic, Coastal and Estuarine Processes in Temperate Zones, Comparative Studies of Temperate Terrestrial Ecosystems and High Latitude Processes.

Diverse national governmental and university institutions, in cooperation or with the assistance of other institutions and countries, have conducted studies and research related to or connected with climate or Climate Change. However, until now, these efforts have been isolated and limited or aiming at goals which do not correspond to the application of the FCCC.

To this respect the following studies are to be mentioned: “Forestation and Environment”, about socio-economic effects and environmental impacts of forestation in Uruguay, by the Science Unit of Epigenisis of the Science School and the Inter-disciplinary Center of Studies on Development - Uruguay and the Project of Monitoring of the Impact of Hydrological Conditions in South-America: Tele-detection and Numerical Simulation". This is a regional project, financed by the Commission of European Communities. The component of national execution is in charge of the Water and Soils Directorate of the Ministry of Agriculture and Fishing, the Faculty of Agro-Meteorology of the School of Agricultural Sciences. The objective of the project is to create a network to monitor climate variability in the South of South America.

Within the framework of project URU/95/G31, the conduction of a study has been started with the following name “Study for the identification of mitigation measures of Greenhouse Gases in the Energy sector”. The UCC is the focal point of this study which is being elaborated by an inter-institutional Working Group, specially created for this purpose, with the technical assistance of Argonne Laboratory (USA).

During the development of project URU/94/008 (Phase I), several studies were conducted in support of the Country Study, which are included in table 3.4 below.

Titles	*Authors*
Análisis comparativo de valores diarios de temperatura reales y generados con simuladores de clima	Bidegain, M
Comportamiento de los Modelos Climáticos de Circulación General en la zona Sureste de Sudamérica	Hofstadter, R. and Bidegain, M.
Estudio País sobre Cambio Climático: Información de base para estudios de cambio climático en Uruguay. Versión 1.0	Ramos Mañé, C.
Las actitudes del público hacia fenómenos ambientales globales: un estudio de caso	González, L and Da Silveir, P
Primeros resultados de la aplicación del modelo SPUR 2 en Uruguay	
Vulnerabilidad y adaptación de la cebada cervecera al cambio climático en Uruguay	Chiara, J.P. and Cruz, G
Vulnerabilidad y adaptación del maíz de secano al cambio climático en Uruguay	Romero, R.
Vulnerabilidad y adaptación del cultivo de arroz al cambio climático en Uruguay	Sawchik, J.
Caracterización del escenario: características físicas de la planicie costera	Méndez, R and Roel, A.
Evolución granulométrica y morfológica de algunas playas del litoral costero uruguayo	López Laborde, J
Variaciones del nivel medio del mar en la zona costera uruguaya	López Laborde, J
Estudio de máximas crecientes	Forbes, E and Chao, R
Sensibilidad del oleaje de tormenta en Montevideo (Uruguay) frente a una hipótesis de cambio climático	Chao, R and Forbes, E
Modelo para la determinación de la modificación de la línea de costa frente a un incremento del nivel del mar	Teixeira, L and Lorenzo, E
Vulnerabilidad de la costa norte del Río de la Plata a la variabilidad a corto y largo plazo de los caudales fluviales	Teixeira, L and Lorenzo, E
	Nagy, G., et alt.

Table 3.4: List of specific studies performed within the framework of Phase 1 of Country Study on Climate Change (Assessment of Climate Change Impacts in Uruguay", National Commission on Global Change - US Country Studies Program)

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