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DEVELOPMENT AND CLIMATE CHANGE IN URUGUAY:
Focus on Coastal Zones, Agriculture and Forestry

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FOREWORD

This document is an output from the OECD Development and Climate Change project, an activity being jointly overseen by the Working Party on Global and Structural Policies (WPGSP) of the Environment Directorate, and the Network on Environment and Development Co-operation (Environet) of the Development Co-operation Directorate. The overall objective of the project is to provide guidance on how to mainstream responses to climate change within economic development planning and assistance policies, with natural resource management as an overarching theme. Insights from the work are therefore expected to have implications for the development assistance community in OECD countries, and national and regional planners in developing countries.

This document has been authored by Shardul Agrawala, Annett Moehner and Frédéric Gagnon-Labrun, drawing upon four primary consultant inputs that were commissioned for this country study: "Mainstreaming Climate Change Responses in Economic Development of Uruguay" by Walter E. Baethgen and Daniel L. Martino, (Carbosur Consulting, Montevideo, Uruguay); "Case study on Uruguay coastal zones" by Eugenio Lorenzo (IMFIA, Universidad de la Republica, Uruguay); "Analysis of GCM Scenarios and Ranking of Principal Climate Impacts and Vulnerabilities in Uruguay" by Stratus Consulting, Boulder, USA (Marca Hagenstad and Joel Smith); and "Review of Development Plans, Strategies, Assistance Portfolios, and Select Projects Potentially Relevant to Climate Change in Uruguay" by Maarten van Aalst of Utrecht University, The Netherlands.

In addition to delegates from WPGSP and Environet, comments from Tom Jones, Jan Corfee-Morlot, Georg Caspary, and Remy Paris of the OECD Secretariat are gratefully appreciated. The Secretariat and Maarten van Aalst would like to acknowledge several members of the OECD DAC who provided valuable materials on country strategies as well as specific projects. Stratus Consulting would like to acknowledge inputs from Tom Wigley at the National Center for Atmospheric Research (NCAR).

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EXECUTIVE SUMMARY

This report presents the integrated case study for Uruguay carried out under an OECD project on Development and Climate Change. The report is structured around a three-tiered framework. First, recent climate trends and climate change scenarios for Uruguay are assessed and key sectoral impacts are identified and ranked along multiple indicators to establish priorities for adaptation. Second, donor portfolios are analyzed to examine the proportion of development assistance activities affected by climate risks. A desk analysis of donor strategies and project documents as well as national plans is conducted to assess the degree of attention to climate change concerns in development planning and assistance. Third, an in-depth analysis is conducted for adaptation in coastal zones as well as for mainstreaming carbon-sequestration within the agriculture and forestry sectors.

Analyses of current climatic trends reveal a warming trend in recent decades with country averaged mean temperature increases of 1.1°C and 1.9°C projected by 2050 and 2100. Climate models also project increased precipitation both in summer and winter, although there is considerably less agreement across climate models on such projections. The most significant impacts of climate change are projected to be on Uruguay's coastal zones, both because of the higher certainty of sea level rise and the high exposure of critical economic and natural resources on the coastline. On the other hand, many other sectors dependent on natural resources – including forestry, agriculture and livestock – offer considerable potential for mitigating climate change through carbon sequestration. Natural resource management therefore is a critical link in Uruguay's efforts to both adapt to and help mitigate climate change.

Having a relatively low population and population density and a per capita income and social infrastructure that is closer to many industrialized countries, Uruguay receives only limited amounts of Official Development Assistance (ODA) – of the order of $20 million annually. In addition, the country receives a much larger amount of multilateral assistance in the form of loans, particularly from the Inter American Development Bank and World Bank. Analysis of donor portfolios for the country using the OECD-World Bank Creditor Reporting System (CRS) database reveals that roughly 19-28% (in terms of aid amount) or 17-19% (in terms of donor projects) of activities are in sectors potentially affected by climate change risks. These numbers are only indicative, and the reader is referred to the main report for a more nuanced interpretation. In general, donor strategy documents do not explicitly mention climate change concerns. However a few recognize weather and climate related risks and promote agricultural practices, which could enhance carbon-sequestration. Uruguay is a party to the UNFCCC and the Kyoto Protocol and it was among the first non-Annex 1 countries to submit their Initial National Communication in 1997. It has also started to institutionalize climate change concerns through the creation of a Climate Change Unit within the Ministry of Housing, Land Management and Environment in 1994. In addition, in 2000, the General Environmental Protection Act was passed which provides a formal framework for environmental protection and includes specific provisions for climate change.

With regard to coastal zones, an in-depth analysis identifies and evaluates several adaptation responses of which coastal monitoring, restoration of coastal areas, and coastal management are given priority. These measures have considerable synergies with existing regulations, for example with the Ecoplata program, which seeks to promote integrated coastal zone management of the Rio de la Plata. However there are significant barriers facing their implementation. Unlike in other developing countries,

key constraints are not necessarily the lack of adequate economic resources or domestic technical capacity but rather institutional factors, which inhibit co-ordination across multiple stakeholder groups. Thus there is a need to encourage government authorities to share decision-making capacity with other stakeholders, and also to successfully engage the private sector like the tourism industry in financing and implementing adaptation activities, particularly those related to the restoration of coastal areas.

The second in-depth analysis evaluates carbon-sequestration opportunities in the agriculture, livestock, and forestry sectors, which are responsible for more than 80% of GHG emissions. Uruguay has enacted a number of sectoral policies that were driven by conservation or economic development objectives, which have already had significant climate change benefits. For example, the Soil Management Law passed in 1982 fostering the widespread application of soil conservation techniques has resulted in the sequestration of 1.8 million ton C/year over the last 20 years. Another key policy innovation was the Forestry Promotion Policy of 1987, which encouraged plantations on soils with low agricultural productivity and/or high susceptibility to erosion through a comprehensive package of financial incentives. The impact of this law has been remarkable - forest plantation area increased from about 200km^2 in 1987 to over 6,500 km^2 in 2000 and the cumulative net carbon sequestration during 1988 to 2000 was estimated at of 27.4 Mt CO_2. While sectoral policies in agriculture and forestry already encourage the sequestration of about 2.5 times of the annual CO_2 emissions in Uruguay, there is still further potential to sequester carbon and to continue meeting national development and conservation priorities through better silvicultural management practices, policies facilitating the substitution of energy intensive products by durable wood products and policies promoting wood and rice husks in electricity generation. Thus, the key message from the Uruguay case study is that strategic sectoral policies can in fact create considerable synergies between climate change objectives and natural resource management and economic development priorities.

LIST OF ACRONYMS

ADM	Adaptation Decision Matrix
BCM	Billion Cubic Meters
CIDA	The Canadian International Development Agency
CAS	World Bank's Country Assistance Strategy
CRS	Creditor Reporting System
DAC	Development Assistance Committee
DFID	Department for International Development, UK
DINAMA	National Environment Directorate, Uruguay
ECOPLATA	Integrated Uruguayan Coastal Zone Management of the Río de la Plata Support Program
ENSO	El Niño/Southern Oscillation
EU	European Union
FAO	United Nations Food and Agricultural Organisation
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GIS	Geographic Information System
GNI	Gross National Income
GNP	Gross National Product
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IBRD	International Bank for Reconstruction and Development
ICZM	Integrated Coastal Zone Management
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
kPa	kiloPascal
MERCOSUR	Common Market of the South
MVOTMA	Ministry of Housing, Land Management and Environment, Uruguay
MW	Mega Watt
NGO	Non-Governmental Organization
OA	Official Aid
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
SLR	Sea Level Rise
UN	United Nations
UNCBD	United Nations Convention on Biodiversity
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO-MAB	United Nations Educational, Scientific and Cultural Organization - Man and Biosphere Programme
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

This report presents the integrated case study for Uruguay for the OECD Development and Climate Change Project, an activity jointly overseen by the Working Party on Global and Structural Policies (WPGSP), and the DAC network on Environment and Development Co-operation (DAC-Environet). The overall objective of the project is to provide guidance on how to mainstream responses to climate change within economic development planning and assistance policies, with natural resource management as an overarching theme. The Uruguay case study was conducted in parallel with five other country case studies[1] in Africa, Asia and the Pacific.

Each case study is based upon a three-tiered framework for analysis (Agrawala and Berg 2002):

1. Review of climate trends and scenarios at the country level based upon an examination of results from seventeen recent general circulation models, as well as empirical observations and results published as part of national communications, country studies, and scientific literature. The goal of this tier is to present a framework to establish priorities for adaptation.

2. Review of economic, environmental, and social plans and projects of both the government and international donors that bear upon the sectors and regions identified as being particularly vulnerable to climate change. The purpose of this analysis is to assess the degree of exposure of current development activities and projects to climate risks, as well as the degree of current attention by the government and donors to incorporating such risks in their planning. This section will review donor portfolios and projects, as well as development priorities of the Government of Uruguay to determine the degree of attention to potential risks posed by climate change on relevant sectors.

3. In-depth analyses at a thematic, sectoral, regional or project level on how to incorporate climate responses within economic development plans and projects. This report identifies two natural resource management themes for in-depth analysis. The first theme focuses on adaptation responses and the opportunities and challenges facing their integration in development priorities for Uruguay's coastal zones, which are particularly vulnerable to climate change. The second theme focuses on initiatives in the Agriculture and Forestry sectors which have opened up opportunities for significant greenhouse gas (GHG) mitigation, while promoting sound natural resource management and economic development priorities. These analyses were conducted in-country, based on a review of past, ongoing, and planned activities and supplemented by discussions between consultant experts and individuals from key government agencies, NGOs, as well as local stakeholders.

2. Country background

Uruguay is situated in the south-eastern part of South America, located between 30^o to 35^o South and 53^o to 58^o West. It is bordered on the west by Argentina, on the north and north-east by Brazil, on the south by the Río de la Plata, and on the east by the Atlantic Ocean (Figure 1), covering 176,000 km^2. The country consists mostly (75%) of gently rolling plateau, interrupted at two points by low hilly ridges. The remainder of the country is fertile coastal lowlands, including a narrow coastal plain and the somewhat broader littorals of the Río de la Plata and Río Uruguay. Montevideo, the capital city, and most of Uruguay's population are located on the coast of the Río de la Plata.

1 Bangladesh, Tanzania, Egypt, Fiji, and Nepal

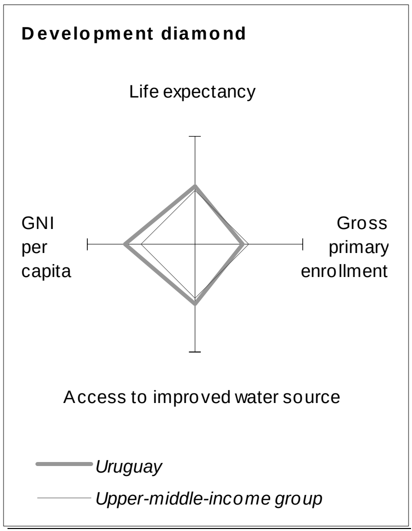
Figure 1. Map of Uruguay

Uruguay has some demographic characteristics that are similar to those of the industrialized countries. For example in 2001, its population was 3.4 million and the annual growth rate of the population was 1%, life expectancy at birth was 74 years and the infant mortality rate per 1,000 live births was 14 (World Bank 2002). The UN Human Development Index of 1994 placed Uruguay 32nd in the ranking. The country's GDP for 2000 was a little over $20 billion, or roughly $6,000 per capita (World Bank 2002).

Uruguay's economy is largely dependent – directly or indirectly – on the agriculture and livestock sector. Although the contribution of agriculture to the GDP is only 9%, agricultural products constitute about 65% of the value of the total exports. If manufactured goods from agriculture are included, this contribution increases to 85%. Meanwhile, in terms of direct contribution to GDP, Uruguay's economy depends to a large extent on the service sector, including trade, tourism, financial and insurance services, real estate, and services to companies. Tourism generated an estimated US$300 million in 1989, equivalent to 22% of merchandise exports, and depended mainly on visitors from Argentina (Hudson and Meditz 1990). Changes are currently underway in the energy structure of the country, mainly related to the development of regional interconnections in natural gas and electricity with neighboring countries.

Uruguay's adaptive capacity is relatively high compared to that of most developing countries and economies in transition. Therefore, it offers an interesting contrast to the other case studies in this project which focused on low income developing countries, generally with high population densities. Figure 2 provides an indication of how Uruguay compares to other upper-middle income countries in terms of four key indices of development.

Figure 2. Development diamond for Uruguay



Source: World Bank 2002

3. Climate: baseline, scenarios, and priority sectors for adaptation

Located entirely within the temperate zone, Uruguay has a climate that is fairly uniform. Seasonal variations are pronounced, but extremes in temperature are rare. Precipitation is fairly evenly distributed throughout the year, and annual amounts increase from southeast to northwest. Montevideo averages 950 mm annually. High winds are common during the winter and spring, and wind shifts are sudden and pronounced. Summer winds off the ocean, however, have the salutary effect of tempering warm daytime temperatures (Hudson and Meditz 1990). Natural hazards in Uruguay are mainly linked to climate events.

Recent studies have documented changes in both the coastal climate and the environment, although no cause has been identified (UNFCCC, 1999). These changes include: a) an increase of 200 mm in precipitation in Montevideo since 1883, which became more evident during the period 1961-1990 (Bidegain and Deshayes, 1992); b) an increase of 0.5°C in air temperature and a decrease of 0.07 kPa in mean atmospheric pressure (Nagy et al., 1996); c) for the period 1961-1990, an increase in mean summer temperatures (Panario and Bidegain, 1996); and d) during the last decades, an increase of 30% in the streamflow of the Río de la Plata and a decrease in mean annual salinity along the coast (Nagy et al., 1996).

3.1 Climate change projections

Changes in area averaged temperature and precipitation over Uruguay were assessed in this study based upon over a dozen recent General Circulation Models (GCM) using a new version of MAGICC/SCENGEN. MAGICC/SCENGEN is briefly described in Box 1. The first results for Uruguay for 17 GCMs developed since 1995 were examined. Then, 11 of the 17 models which best simulate current precipitation for Uruguay were selected. The models were run with the IPCC B2 SRES scenario (Nakicenovic and Swart 2000)[2].

2 The IPCC SRES B2 scenario assumes a world of moderate population growth and intermediate level of economic development and technological change. SCENGEN estimates a global mean temperature increase of 0.8 °C by 2030, 1.2 °C by 2050, and 2 °C by 2100 for the B2 scenario.

Box 1. A brief description of MAGICC/SCENGEN

MAGICC/SCENGEN is a coupled gas-cycle/climate model (MAGICC) that drives a spatial climate-change scenario generator (SCENGEN). MAGICC is a Simple Climate Model that computes the mean global surface air temperature and sea-level rise for particular emissions scenarios for GHGs and sulphur dioxide (Raper et al., 1996). MAGICC has been the primary model used by IPCC to produce projections of future global-mean temperature and sea level rise (see Houghton et al., 2001). SCENGEN is a database that contains the results of a large number of GCM experiments. SCENGEN constructs a range of geographically-explicit climate change scenarios for the world by exploiting the results from MAGICC and a set of GCM experiments, and combining these with observed global and regional climate data sets. SCENGEN uses the scaling method of Santer et al. (1990) to produce spatial pattern of change from an extensive data base of atmosphere ocean GCM – AOGCM (atmosphere ocean general circulation models) data. Spatial patterns are "normalized" and expressed as changes per 1°C change in global-mean temperature. The greenhouse-gas and aerosol components are appropriately weighted, added, and scaled up to the actual global-mean temperature. The user can select from a number of different AOGCMs for the greenhouse-gas component. For the aerosol component there is currently only a single set of model results. This approach assumes that regional patterns of climate change will be consistent at varying levels of atmospheric GHG concentrations. The MAGICC component employs IPCC Third Assessment Report (TAR) science (Houghton et al., 2001). The SCENGEN component allows users to investigate only changes in the mean climate state in response to external forcing. It relies mainly on climate models run in the latter half of the 1990s.

Source: National Communications Support Program Workbook

The spread in temperature and precipitation projections of these 11 GCMs for various years in the future provides an estimate of the degree of agreement across various models for particular projections. The most consistent projections across various models have lower scores for the standard deviation, relative to the value of the mean. The results of the MAGICC/SCENGEN analysis for Uruguay are shown in Table 1.

Table 1. GCM estimates of temperature and precipitation changes[3]

Year	Temperature change (°C) mean (standard deviation)			Precipitation change (%) mean (standard deviation)		
	Annual	DJF[4]	JJA[5]	Annual	DJF	JJA
Baseline average				1252.8 mm	332.0 mm	284.9 mm
2030	0.8 (0.16)	0.7 (0.18)	0.7 (0.22)	+4% (4)	+5% (9)	+4% (3)
2050	1.1 (0.23)	1.1 (0.26)	1.1 (0.31)	+6% (5)	+7% (12)	+5% (5)
2100	1.9 (0.40)	1.8 (0.44)	1.9 (0.55)	+10% (9)	+12% (22)	+9% (9)

3 This analysis uses a combination of the 11 best Scengen models (CCC1TR99, CCSRTR96, CERFTR98, CSM_TR98, ECH4TR98, GISSTR95, HAD2TR95, HAD3TR00, LMD_TR98, MRI_TR96, PCM_TR00) based on their predictive error for annual precipitation levels. Errors were calculated for each of the models, and for an average of the 17 models. Each model was ranked by its error score, which was computed using the formula 100*[(MODEL-MEAN BASELINE /OBSERVED) - 1.0]. Error scores closest to zero are optimal. The error score for an average of the 17 models was 45%, the error score for an average of the 11 models was 44%. See Appendix A for details.

4 DJF is December, January, and February, the summer months in Uruguay.

5 JJA is June, July, and August, the winter months in Uruguay.

The climate models all estimate a steady increase in temperatures for Uruguay with low inter-model variance.[6] The winter and summer months are predicted to have almost equal increases. The models estimate that annual precipitation will rise as will precipitation in both winter (JJA) and summer (DJF). The estimated increases in annual and winter precipitation are slightly larger than the inter-model variance, suggesting a relatively higher degree of confidence in projections of precipitation increase. However, the estimate of increased summer precipitation is lower than the inter-model variance, suggesting low confidence that precipitation will increase in this season. Even where the mean is slightly greater than the inter-model variance, a number of models estimate change in the opposite direction. The results obtained in this study are consistent with scenarios examined in the Uruguay country study (CNCG 1997). One difference is that the GCM runs since 1995 tend to estimate positive increases in precipitation whereas the CNCG examined both increases and decreases in precipitation.

3.2 Synthesis of impacts and priority sectors for mainstreaming adaptation

The most significant impacts of climate change on Uruguay are projected to be on its coastal resources. Uruguay's coastline is of particular importance since it contains most of the cities and infrastructure of the country. In addition, the coastal areas most endangered from sea level rise include the most expensive land in the country. The risks of impacts on coastal resources are substantially higher than for the other sectors, both because of the high certainty of sea level rise and the high exposure of critical economic and natural resources on the coastline.

Potential impacts of climate change on other sectors are considerably less certain than for coastal resources. Some of the principal crops in Uruguay are projected to be impacted negatively, but there is low confidence on the certainty of the impacts. The impacts of climate change on biodiversity could also be adverse, but uncertainties are again considerable. Further, Uruguay has only a few endemic species. Water resources are critical for Uruguay as it receives 93% of its power from hydro-electricity, and agriculture relies on 90% of Uruguay's water supply. However they are ranked below the sectors mainly because there appears to be relatively less likelihood of significant adverse impacts happening in the near term. GCM estimates presented in Table 1 show a tendency toward wetter conditions but the certainty of such is very low. Further research however might show that this sector should rank higher in vulnerability.

Thus, coastal resources are the principal sector where there is a need to implement and mainstream adaptation responses within development plans and activities. This sector will be examined in Section 7.

4. Greenhouse gas emissions and priority sectors for mainstreaming mitigation

The Government of Uruguay has published national inventories of GHG emissions for 1990, 1994 and 1998, following IPCC guidelines and methodology. The most important emissions for Uruguay are methane (CH_4) and nitrous oxide (N_2O) representing 57% and 42% respectively of the total GHG emissions in 1998. More than 92% of the CH_4 emissions and almost all N_2O emissions come from the agricultural sector, and more specifically from the livestock production systems. The livestock population includes almost 11 million cattle and 13 million sheep.

While emissions of CO_2 increased significantly during 1990-1998, policies since 1990 have encouraged new tree plantations, increases in area under improved pastures and no-tilled annual crops, which resulted in increased amounts of sequestered carbon. Consequently, in 1998 the amounts of sequestered CO_2 were almost the same as the total CO_2 emissions from the energy and industrial processes

6 Note that each GCM is scaled (i.e. regional changes are expressed relative to each model's estimate of mean global temperature change). Since the GCMs have different estimates of change in global mean temperature, this overstates intermodel agreement.

sectors together. Thus, while CO_2 emissions from the energy and industrial sectors increased by 54% during 1990-1998, net CO_2 emissions for the same period decreased by 88% (Table 2).

Table 2. Comparative greenhouse gas national inventories for 1990, 1994 and 1998

Sources and Sinks	CO_2 (kTon gas/year)			CH_4 (kTon gas/year)			N_2O (kTon gas/year)		
	1990	**1994**	**1998**	**1990**	**1994**	**1998**	**1990**	**1994**	**1998**
Energy	3608	3930	5384	0.71	0.7	0.89	0.06	0.08	0.11
Industrial Processes	230	279	518						
Agriculture				612	678	698	31.5	32.4	37.5
Land Use Change and Forestry	1972	-865	-3945						
Changes in soil Carbon content	-3357	-3808	-1662						
Waste				51.82	58.13	60.13	0.22	0.22	0.22
Total	**2453**	**-464**	**295**	**665**	**737**	**759**	**31.8**	**32.5**	**37.6**

Agriculture is the sector responsible for most of the country's GHG emissions. At the same time, agriculture and forestry have shown to be the sectors with the strongest ability to reduce net emissions through CO_2 sequestration. The structural changes resulting from recent economic difficulties offer the opportunity for considering new alternatives for development programs, including those that reflect changes in traditional paradigms. In this sense Uruguay can offer a number of environmental services of global relevance that can also contribute to the country's development.

It is in this context that the current report discusses opportunities in the agricultural, forestry and energy sectors that may help to mitigate global climate change and at the same time contribute to the country's social and economical development. Consequently, these two sectors are key to an assessment of plans and programs that can be directed to ensure the country's development, and at the same time mitigate the impacts of GHG emissions – and therefore are examined in Section 8.

5. Attention to climate concerns in donor activities

As previously discussed, Uruguay is an advanced developing country and consequently receives only limited amounts of donor (grant) aid (around US$ 20 million per year). The largest donors are Japan, Germany, Spain, the European Commission, and France. Figure 3 displays the distribution of aid by development sector and by donor. In addition, the country receives a much larger amount of multilateral assistance in the form of loans (more than US$ 300 million per year) particularly from the Inter American Development Bank and World Bank (Table 3).

Figure 3. Development aid to Uruguay (1998-2000)

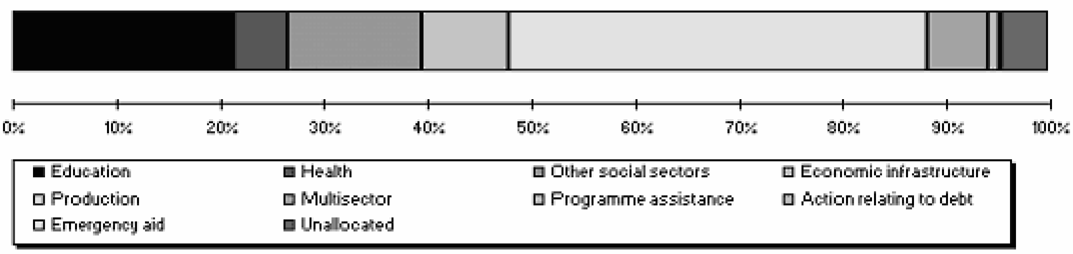
Uruguay

Receipts	1998	1999	2000
Net ODA (USD million)	26	22	17
Bilateral share (gross ODA)	73%	80%	80%
Net ODA / GNI	0.1%	0.1%	0.1%
Net Private flows (USD million)	317	- 53	310

For reference	1998	1999	2000
Population (million)	3.3	3.3	3.3
GNI per capita (Atlas USD)	6 550	6 240	6 090

Top Ten Donors of gross ODA (1999-2000 average)		(USD m)
1	JAPAN	8
2	GERMANY	7
3	SPAIN	3
4	EC	3
5	FRANCE	2
6	CANADA	1
7	UNICEF	1
8	BELGIUM	1
9	ITALY	1
10	UNTA	1

Bilateral ODA by Sector (1999-2000)



Sources: OECD, World Bank[7]

The following sections highlight the possible extent of climate risks to development investments in Uruguay, and examines to what extent current and future climate risks are factored into development strategies and plans, as well as individual development projects.[8,9]

7 GNI is measured using the Atlas conversion factor, which aims to reduce the impact of exchange rate fluctuations in cross-country comparison of national incomes. The Atlas conversion factor for any year is the average of a country's exchange rate (or alternative conversion factor) for that year and its exchange rates for the two preceding years, adjusted for the difference between the rate of inflation in the country, and through 2000, that in the G-5 countries (France, Germany, Japan, the United Kingdom, and the United States). For 2001 onwards, these countries include the Euro Zone, Japan, the United Kingdom, and the United States. A country's inflation rate is measured by the change in its GDP deflator.

8 Given the large quantity of strategies and projects, the analysis is limited to a selection. This selection was made in three ways: (i) a direct request to all OECD DAC members to submit documentation of relevant national and sectoral strategies, as well as individual projects (ii) a direct search for some of the most important documents (including for instance submissions to the various UN conventions, country and sector strategies from multilateral donors like UNDP, the World Bank and the IDB, and some of the larger projects in climate-sensitive sectors), and (iii) a pragmatic search (by availability) for further documentation that would be of interest to the analysis (mainly in development databases and on donors' external websites). Hence, the analysis is not comprehensive, and its conclusions are not necessarily valid for a wider array of development strategies and activities. Nevertheless, the limited set allows an identification of some common patterns and questions that might be relevant for broader development planning.

9 The phrase "climate risk" or "climate-related risk" is used here for all risks that are related to climatic circumstances, including weather phenomena and climate variability on various timescales. In the case of Uruguay, these risks include the effects of seasonal climate anomalies, extreme weather events,

5.1 Donor activities affected by climate risks

This section explores the extent to which development activities in Uruguay are affected by climate risks, which gives an indication of the importance of climate considerations in development planning. The extent to which climate risks affect development assistance activities can be gauged by examining the sectoral composition of the total aid portfolio. Development assistance activities in sectors such as agriculture, infectious diseases, or water resources could clearly be affected by current climate variability and weather extremes, and consequently also by changing climatic conditions. At the other end of the spectrum, development activities relating to education, gender equality, and governance reform are much less directly affected by climatic circumstances.

In principle, the sectoral selection should include all development activities that might be designed differently, depending on whether or not climate risks are taken into account. In that sense, the label “affected by climate risks” has two dimensions. It includes projects that are at risk themselves, such as an investment that could be destroyed by flooding, as well as projects that affect the vulnerability of other natural or human systems. For instance, new roads might be fully weatherproof from an engineering standpoint (even for climatic conditions in the far future), but they might also trigger new settlements in high-risk areas, or they might have negative effects on the resilience of the natural environment, thus exposing the area to increased climate risks. These considerations should be taken into account in project design and implementation. Hence, these projects are also affected by climate risks.

Clearly, any classification that is based solely on sectors suffers from oversimplification. In reality, there is a wide spectrum of exposure to climate risks even within particular sectors. For instance, rain-fed agriculture projects might be much more vulnerable than projects in areas with reliable irrigation. At the same time, the irrigation systems themselves may also be at risk, further complicating the picture. Similarly, most education projects would hardly be affected by climatic circumstances, but school buildings in flood-prone areas might well be at risk. Without an in-depth examination of risks to individual projects, it is impossible to capture such differences. Hence, the sectoral classification only provides a rough first sense about the share of development activities that might be affected by climate risks. A comprehensive evaluation of the extent to which development activities are affected by climate change would require detailed assessments of all relevant development projects as well as analysis of site specific climate change impacts, which was beyond the scope of this analysis. This study instead assesses activities affected by climate risks on the basis of CRS purpose codes (see Appendix B, which identifies “the specific area of the recipient’s economic or social structure which the transfer is intended to foster”)[10, 11].

To capture some of the uncertainty inherent in the sectoral classification, the share of development activities affected by climate change was calculated in two ways, a rather broad selection, and a more restrictive one. The first selection (“high estimate”) includes projects dealing with infectious diseases, water supply and sanitation, transport infrastructure, agriculture, forestry and fisheries, renewable

and risks due to sea level rise. “Current climate risks” refer to climate risks under current climatic conditions, and “future climate risks” to climate risks under future climatic conditions, including climate change and sea level rise.

10 Each activity can be assigned only one such code; projects spanning several sectors are listed under a multi-sector code, or in the sector corresponding to the largest component.

11 The OECD study “Aid Activities Targeting the Objectives of the Rio Conventions, 1998-2000” provides a similar, but much more extensive database analysis. It aimed to identify the commitments of ODA that targeted to objectives of the Rio Conventions. For this purpose, a selection was made of those projects in the CRS database that targeted the Conventions as either their “principal objective”, or “significant objective”.

energy and hydropower[12], tourism, urban and rural development, environmental protection, food security, and emergency assistance. The second classification ("low estimate") is more restricted. First of all, it excludes projects related to transport and storage. In many countries, these projects make up a relatively large share of the development portfolio, simply due to the large size of individual investments (contrary to investments in softer sectors such as environment, education and health). At the same time, infrastructure projects are usually designed on the basis of detailed engineering studies, which should include attention at least to current climate risks to the project.[13] Moreover, the second selection excludes food aid and emergency assistance projects. Except for disaster mitigation components (generally a very minor portion of overall emergency aid), these activities are generally responsive and planned at short notice. The treatment of risks is thus rather different from well-planned projects intended to have long-term development benefits. Together, the first and the second selection give an indication of the range of the share of climate-affected development activities.

In addition, the share of emergency-related activities was calculated. This category includes emergency response and disaster mitigation projects, as well as flood control. The size of this selection gives an indication of the development efforts that are spent on dealing with natural hazards, including, often prominently, climate and weather related disasters. The implications of this classification should not be overstated. If an activity falls in the "*climate-affected*" basket, which does not mean that it would always need to be redesigned in the light of climate change or even that one would be able to quantify the extent of current and future climate risks. Instead, the only implication is that climate risks could well be a factor to consider among many other factors to be taken into account in the design of development activities. In some cases, this factor could be marginal while in others, it may well be substantial. In any case, these activities would benefit from a consideration of these risks in their design phase. Hence, one would expect to see some attention being paid to them in project documents, and related sector strategies or parts of national development plans. Figures 4 and 5 show the results of these selections, for the three years 1998, 1999, and 2000.[14]

12 Traditional power plants are not included. Despite their long lifetime, these facilities are so localized (contrary to e.g. roads and other transport infrastructure) that climate risks will generally be more limited. Due to the generally large investments involved in such plants, they could have a relatively large influence on the sample, not in proportion with the level of risk involved.

13 Note however, that they often lack attention to trends in climate records, and do not take into account indirect risks of infrastructure projects on the vulnerability of natural and human systems.

14 The three-year sample is intended to even out year-to-year variability in donor commitments. At the time of writing, 2000 was the most recent year for which final CRS data were available. Note that coverage of the CRS is not yet complete. Overall coverage ratios were 83% in 1998, 90% in 1999, and 95% in 2000. Coverage ratios of less than 100% mean that not all ODA/OA activities have been reported in the CRS. For example, data on technical co-operation are missing for Germany and Portugal (except since 1999), and partly missing for France and Japan. Some aid extending agencies of the United States prior to 1999 do not report their activities to the CRS. Greece, Luxembourg and New Zealand do not report to the CRS. Ireland has started to report in 2000. Data are complete on loans by the World Bank, the regional banks (the Inter-American Development Bank, the Asian Development Bank, the African Development Bank) and the International Fund for Agricultural Development. For the Commission of the European Communities, the data cover grant commitments by the European Development Fund, but are missing for grants financed from the Commission budget and loans by the European Investment Bank (EIB). For the United Nations, the data cover the United Nations Children's Fund (UNICEF) since 2000 and a significant proportion of aid activities of the United Nations Development Programme (UNDP) for 1999. No data are yet available on aid extended through other United Nations agencies. Note also that total aid commitments in the CRS are not directly comparable to the total ODA figures in Figure 3, which exclude most loans.

Figure 4. Share of aid amounts committed to activities affected by climate risk and to emergency activities in Uruguay (1998-2000)

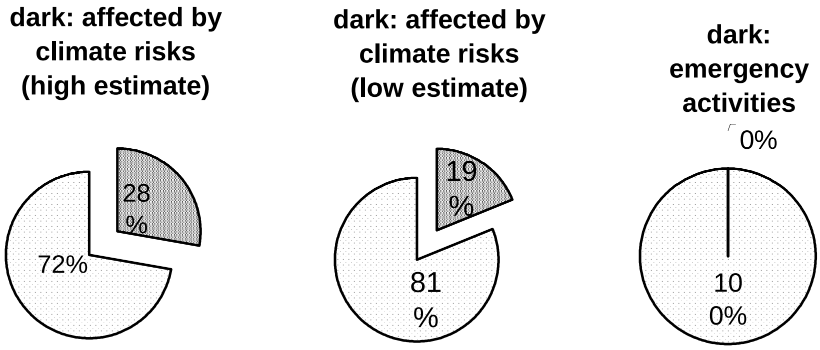
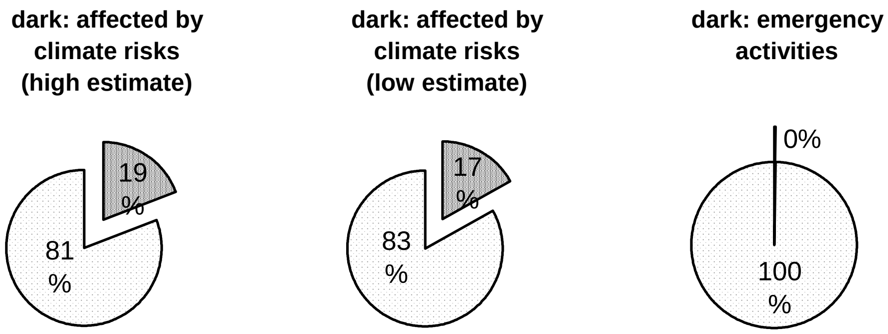


Figure 5. Share (by number) committed to activities affected by climate risk and to emergency activities in Uruguay (1998-2000)



In monetary terms, about a quarter of all donor aid in Uruguay could be affected by climate change. By number, the share is about one fifth.[15] Emergency projects make up only a minimal percentage of amount and numbers of development projects. In addition to providing insight on the sensitivity of development activities as a whole, the classification also gives a sense of the relative exposure of various donors.[16] These results are listed in Table 3 and 4 (again in the years 1998, 1999, and 2000).

Table 3. Relative shares of CRS activities, by total disbursed aid amounts, for the top-five donors in Uruguay (1998-2000)

Amounts of activities (millions US$)	Activities affected by climate risks	Activities affected by climate risks	Emergency activities

15 Note that the number of activities gives a less straightforward indication than the dollar amounts. First of all, activities are listed in the CRS in each year when a transfer of aid has occurred. Hence, when a donor disburses a particular project in three tranches, that project counts three times in our three-year sample. If the financing for a similar three-year project is transferred entirely in the first year, it only counts once. Secondly, the CRS contains a lot of non-activities, including items like "administrative costs of donors". Moreover, some bilateral donors list individual consultant assignments as separate development activities. In most cases, such transactions will fall outside of the "climate-affected" category. Hence, the share of climate-affected activities relative to the total number of activities (which is diluted by these non-items) is lower. On the other hand, the shares by total amount tend to be dominated by structural investments (which tend to be more costly than projects in sectors such as health, education, or environmental management).

16 Caveat: note that the CRS is not entirely complete; see footnote 13.

			(high estimate)			(low estimate)					
Donor	Amount	%	Donor	Amount	%	Donor	Amount	%	Donor	Amount	%
Total	1007.7	100%	Total	279.9	100%	Total	190.1	100%	Total	0.025	100%
IBRD	630.4	63%	IDB	163.3	58%	IDB	138.3	73%	Netherl.	0.025	100%
IDB	336.6	33%	IBRD	96.5	34%	IBRD	32.0	17%			
IFAD	14.0	1%	IFAD	14.0	5%	IFAD	14.0	7%			
Spain	8.7	1%	Spain	3.4	1%	Spain	3.3	2%			
Germany	7.7	1%	Italy	0.6	0%	Germany	0.5	0%			

Table 4. Relative shares (by number) of CRS activities, for the top-five donors in Uruguay (1998-2000)

Numbers of activities			Activities affected by climate risks (high estimate)			Activities affected by climate risks (low estimate)			Emergency activities		
Donor	Number	%	Donor	Number	%	Donor	Number	%	Donor	Number	%
Total	365	100%	Total	70	100%	Total	62	100%	Total	1	100%
Spain	126	35%	Spain	18	26%	Spain	16	26%	Netherl.	1	100%
France	64	18%	Canada	15	21%	Canada	15	24%			
Canada	62	17%	IDB	7	10%	France	6	10%			
Germany	26	7%	France	6	9%	IDB	5	8%			
Belgium	24	7%	Italy	5	7%	Belgium	5	8%			

5.2 Climate risks in selected donor strategies

Both the 2000 World Bank *Country Assistance Strategy* (CAS) and the European Commission's *Country Strategy Paper 2001-2006 and National Indicative Program 2002-2006 (2001)* reflect Uruguay's high level of economic and social development. The EC has only a limited program. The World Bank was reducing its lending by focusing only on projects with social or environmental dimensions, but has raised its lending levels again following the regional economic crisis and now also focuses on adjustment lending and social protection. None of the strategies of the Inter American Development Bank (IDB), the World Bank, and the European Commission explicitly addresses vulnerability to climate change and sea level rise, but they differ sharply in their attention to current natural hazards. The IDB *Country Paper* focuses mostly on economic development issues, and does not mention any climate-related hazards. Nevertheless, some of the IDB's activities in agriculture,[17] and environment[18] are likely to contribute to a higher resilience against the potential impacts of climate change.

In contrast to the IDB, the World Bank and EC pay ample attention to weather- and climate-related risks. For instance, the final section of the CAS, on risks facing World Bank operations in Uruguay, explicitly states: "Climate and natural disasters have to be considered as potentially very damaging." A footnote highlights the fact that a significant shock, such as a change in commodity prices, a natural disaster, or a bank run, could pose serious financing constraints for Uruguay, despite its investment grade. The EC *Strategy Paper* also acknowledges the impacts of extreme weather on Uruguay's economy: "weak performance continued throughout 2000, mainly as a result of the economic developments in its two neighbouring countries, Brazil and Argentina, a severe drought and the sharp rise in international oil prices."

Both the World Bank and the EC highlight the intimate connections between the country's natural environment and its economic performance: "Uruguay's traditional livestock and agricultural sectors depend on the country's fertile soil, while important foreign exchange earnings from tourism depend on the natural beauty of the coastline […]. In other words, Uruguay is a country where the link between environmental-natural resource conservation and the economy are direct and obvious." The World

17 These activities focus on productive chains, improvement of sanitary standards to facilitate access to international markets, support infrastructure (including roads, power, and irrigation) and ensuring that the benefits of sectoral growth are equally distributed.

18 Mainly environmental land management, together with measures to reform and consolidate public administration.

Bank also highlights the linkages between inadequate natural resources management and vulnerability to drought: "Inadequate natural resource management could jeopardize the otherwise promising performance of the livestock and agricultural sectors during the last decade. Poor water resource management is still widespread, leading to inefficient water use and increased pressure on water resources. This results in an increasing exposure of these sectors to recurrent dry spells. In addition, there are water quality problems in some sub-sectors. Livestock production, which has been dominated by extensive, low profit production systems, represented until recently little or no threat to natural resources management. However, exposure to prolonged periods of economic hardship and frequent weather-related difficulties are resulting in an over exploitation, and consequent deterioration, of the natural resource base. The attention for these concerns may have been triggered by the Bank's experience during the droughts in 1997 and 1999/2000, which severely affected its operations in Uruguay.[19]

The EC and the World Bank both identify a number of environmental and natural resource management issues that deserve priority attention, including inadequate natural resource management in the livestock and agriculture sectors, poor water resource management, threats to marine and coastal biota, problems caused by urban and tourism development, and poor policies for sustainable forestry. Many activities to address these concerns would make the country more resilient to climate change. Some programs, for instance those related to coastal wetlands management, could benefit from an explicit consideration of climate change and sea level rise. However, neither the World Bank CAS nor the EC *Strategy Paper* mentions climate change either as an additional risk factor for weather-related disasters or in relation to coastal resources, agriculture and forestry. Calling for improvements in water management, the EC Paper does highlight the need for a "water and climate" agenda, but without further details.

Regarding climate change mitigation, both the EC and the World Bank mention energy conservation and abatement of methane emissions from solid waste landfills. The IDB *Country Paper* does not discuss climate change mitigation at all. Hence, all three neglect mitigation opportunities in agriculture and forestry.[20]

5.3 Climate risk in selected development programs and projects

5.3.1 Activities dealing explicitly with climate risks

During the 1990s, the United States Country Studies Program (USCSP) supported the preparation of Uruguay's Climate Change Country Study, which included plans for adaptation to climate change in two sectors: a) agriculture (crops, as well as related issues in soils and water resources), and b) coastal resources.[21] Based on preliminary impact analyses, the study evaluated several adaptation options, and proposed a list of five priority measures, such as seed bank development, soil conservation and minimum tillage, Integrated Coastal Zone Management (ICZM) and coastal development planning, coastal monitoring, and dissemination of information. For each of these measures, the report presented (limited) evaluations of economic, environmental and social impacts, and works out implementation schemes, including the identification of government agencies that should take up the various tasks. Following the US Country Study, a Program of General Measures for Mitigation and Adaptation to Climate Change (PEMEGEMA) was implemented, which involved a wide range of stakeholders and was an effective instrument for both dissemination and raising of awareness.

19 See the discussion of the World Bank's Natural Resources Management and Irrigation Development Project in Section 5.3.2

20 The EC's Strategy does address deforestation and forest degradation in a general sense. Such activities, if planned well, could contribute to climate change mitigation, adaptation, and biodiversity conservation at once (but this is not made explicit).

21 The results of these studies were incorporated in Uruguay’s first National Communication to the UNFCCC.

Currently, UNDP/GEF is supporting preparations for Uruguay's Second National Communication to the UNFCCC. This includes a third national greenhouse gas inventory, and the identification and evaluation of mitigation and adaptation measures in several sectors (including energy, transportation, waste, agriculture, fisheries, biodiversity, water resources, and health).[22]

5.3.2 Other development activities

1. Almost all of the reviewed development projects[23] in transport, port development, environmental management, and even agriculture pay no attention at all to current climate-related hazards or climate change. Nevertheless, some of these sectors are clearly vulnerable to climate change, and certainly to current weather- and climate-related risks. This vulnerability is illustrated in the Implementation Completion Report of the World Bank's *Natural Resources Management and Irrigation Development Project*. The principal objective of this project was to develop and implement a soil and water management strategy with a combination of investments and policy support.[24] While the project was generally successful, climatic circumstances severely affected its implementation. In May 1997, the government formally requested a loan amendment to mitigate the effects of that year's serious and long-lasting drought. The modifications mainly targeted livestock producers, and included the drilling of wells and the provision of pumping systems, reservoirs and dairy equipment. The need to concentrate on such emergency activities caused significant delays in the implementation of the irrigation works. Only two years later, the project experienced adverse climatic conditions again: the impacts of the drought experienced in the spring of 1999, followed by the excessive rainfall of the winter of 2000, were observed in all of the technical and financial indicators. These climatic circumstances are listed as factors "outside the control of government or implementing agency." While this may be true for the amount of rainfall itself, the vulnerability of the sector to such conditions is neither an issue that is beyond the government's control nor an issue which the Bank can ignore.

2. However, despite this lack of explicit attention, many development activities are still likely to increase Uruguay's resilience to climate change. For instance, the IDB *Programa de Apoyo a la Gestión Ambiental* (environmental management support program) will improve environmental management to address problems such as environmental degradation around urban centers, coastal degradation (partly due to coastal development for tourism) and land degradation (due to erosion and pollution with agrochemicals). Such capacity building will also enhance the country's capacity to deal with climate change.

3. None of the projects in agriculture discuss mitigation options, including win-win options related to tillage practices. Several subcomponents of the World Bank Natural Resources Management and Irrigation Development Project (the development of pilot micro-catchment areas; the soil and water management demonstration farms; and the subcomponent on applied research) included activities on conservation tillage, in partnership with the Uruguayan No Tillage Association (*Asociación Uruguaya Pro Siembra Directa* - AUSID), but the linkage between tillage practices and climate change mitigation is not mentioned.

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22 No results were yet available for this review.

23 Projects include: World Bank Second Transport Project, IDB M'Bopicua Port Project, IDB Programa de Apoyo a la Gestión Ambiental (environmental management support program), IDB Farm Modernization and Development Program, IDB Agricultural Services Program, IFAD National Smallholder Support Programme

24 Including rehabilitation and development of irrigation and drainage schemes, improved water management, establishment of cost recovery policies for infrastructure investments and maintenance, agricultural diversification, and the establishment of a good natural resources management framework.

6. Attention to climate concerns in national planning

6.1 National communications to international environmental agreements

Uruguay ratified the UNFCCC in 1994 and became a party to the Kyoto Protocol in 2001. It was also one of the first Non-Annex-1 countries to submit its National Communication to the UNFCCC. The vulnerability and adaptation assessments focused on two sectors: agriculture and coastal resources. In the agriculture sector, the main national crops were seen to be vulnerable to increases in temperature, while the effects of precipitation changes are uncertain. Coastal areas are also at risk, particularly if sea level rise exceeds 0.5 m. In economic terms, the most vulnerable coastal areas are those with the highest population density. The National Communication notes that changes in the coastal climate and environment have already been observed, but cannot be attributed with certainty to global climate change. In the light of these projections, and also given that Uruguay's current natural hazards are already predominantly climate-related; climate change is considered a serious threat.

The National Communication proposes several adaptation options for the agriculture sector, some even crop-specific. Examples include better modeling, genetic improvement, and monitoring of pests and diseases. For coastal resources, the main adaptation options include integrated coastal management, land zoning (no development, or reconstruction, close to the coastline). For certain sections of coastal land, it is concluded that structural protection costs are lower than the costs of not taking measures.

Regarding mitigation, the National Communication identifies opportunities for improvements in the agriculture sector, including efficiency in fertilizer use, and particularly direct sowing (zero-tilling). In many cases, zero tilling practices yield economic benefits for agricultural producers, and also contribute to adaptation to climate change by reducing erosion. Hence, it offers "win-win" options, with economic, adaptation, and mitigation benefits. The forestry sector also accounts for an increasing number of sinks, and further emissions reduction programs are underway in waste management and cement and lime production.

Further, in its report to the World Summit on Sustainable Development, the government outlined a strategy aimed at providing a healthy environment, capable of productively sustaining quality of life. The strategy includes scientific and technological proposals, proposals for managing natural risks and reducing vulnerability as well as a proposal for the recovery and management of coastal areas.

Reports and strategies relating to other environmental conventions pay little attention to adaptation to climate change. The National Biodiversity Strategy and reports to the Ramsar Convention on Wetlands do not mention climate change at all, despite clear vulnerabilities in these areas. The Second National Communication to the UN Convention to Combat Desertification (UNCCD) does raise concern about climate change, particularly given the impacts of current weather and climate events (including the effects of El Niño and La Niña) but in response only draws attention to mitigation activities and new opportunities to utilize the Clean Development Mechanism. While reports to both the Ramsar Convention and the UNCCD highlight the need for more synergies between the environmental conventions, they do not put that into practice in relation to adaptation to climate change. Despite this lack of explicit attention, many activities under these conventions will in fact improve Uruguay's resilience to climate change.

6.2 National policies of relevance to climate change

There is no specific, government document on national policies regarding the environment. They must therefore be inferred from the various pieces of legislation that have been enacted, particularly in the last decade. Government authorities are now placing a higher priority on environmental issues, probably in response to a growing public awareness of and support for these issues and an increasing interest in environmental issues of international organizations and donor agencies. At the departmental level, however, only a few municipal governments have issued draft documents outlining their policies regarding the protection of the environment.

A key step towards the prioritization of environmental concerns in national policy making was the creation of the Ministry of Housing, Land Management and Environment (MVOTMA) and its National Environment Directorate (DINAMA) in 1990. Subsequently, in 1994, a Climate Change Unit was created within the framework of DINAMA. The same year also marked the passage of an Environmental Impact Assessment Law. The purpose of this law is to prevent any negative impact that proposed activities may have on the environment. Before initiating certain activities, construction work or other types of work, the interested parties must obtain a previous environmental authorization from the Ministry of Housing, Land Management and Environment.

In 2000, the government enacted the General Environmental Protection Act, thus making a significant move towards the incorporation of environmental issues into national policies. This law serves as a formal framework for environmental management and protection and, at the same time, includes specific provisions for issues not regulated previously, such as climate change. The Law appoints MVOTMA as the agency in charge of identifying climate change mitigation and adaptation measures, and regulating the release of GHG emissions.

Since 2001, the National Environment Directorate is implementing a GEF-funded program with the purpose of advancing mitigation and adaptation analysis leading to the development of a comprehensive Program of General Climate Change Mitigation and Adaptation Measures. Vulnerability and adaptation assessments have been carried out for a wide range of sectors including the agricultural sector, forestry, coastal resources, biodiversity, waste, energy, water resources, fisheries, human health, and transportation. Cross-sectoral measures were also developed and included in the Program. The results of this effort will be reflected in Uruguay’s Second National Communication to the UNFCCC, to be released in 2004. The potential implementation of the Program may be affected by financial constraints resulting from the acute economic crisis that the country is currently undergoing.

In addition, the government started promoting the establishment of new forests with a Forestry Law passed in 1989 which included subsidies, tax cuts and other financial incentives to farmers who would plant new forests. As a result of this law, the area of new forests has increased almost 8-fold in the last 10 years (Baethgen and Martino, 2000). In order to take advantage of the benefits included in the Forestry law, farmers must plant new forests in soils which the law defined as “forestry priority”. These are soils that are currently under low-production natural grasslands. Given Uruguay’s climate conditions the tree species included in the Forestry Law (Eucalyptus, Pine) show very high growth rates, and therefore, the newly planted trees in these same soils are now sequestering up to 8 ton C per ha per year as compared to 2-4 ton C per ha per year previously sequestered by the grassland.

The synergies between GHG mitigation and natural resource management policies in the forestry as well as agricultural sectors will be further examined in-depth in Section 8. The next section will examine the potential for adaptation in Uruguay’s coastal resources and the opportunities and challenges for integrating such responses within development priorities.

7. Climate change and coastal zones

The coastal area of Uruguay is approximately 680 km long. An important portion of it (452 km) is located on the Río de la Plata and the remaining section (228 km) is located on the Atlantic Ocean. The coastal area includes portions of six out of the 19 departments into which the country is divided[25]. The most prominent coastal formations are sandy beaches surrounded by rocky headlands. They comprise about 65% of Uruguay's coastline. The extension of beach arcs varies ranging from pocket beaches to long beach arcs having almost straight stretches. Sand pits and dunes are found at several sites. Cliffs originating from various geologic formations are often situated right behind sandy beaches (Ecoplata 2000). The coastline is frequently affected by storms, which cause strong wave conditions and an increase in mean sea-level (storm surge) particularly when southeastern winds are prevailing (CNCG 1997).

7.1 Climate change impacts

In its most recent assessment, the Intergovernmental Panel on Climate Change (IPCC 2001) projects a rise in global mean sea level of 0.09 to 0.88 m between 1990 and 2100. The average estimate is 0.48 m for the full range of projected climate change scenarios, but with significant regional variations.[26] Urban growth increases pressures on coastal areas since 70% of the population resides in coastal areas. Some of the most valuable real estate can be found in the coastal zone (Volonté & Nicholls 1995). Coastal areas play also a critical role in the national economy. According to Ecoplata (2001), 77.6% of the country's GDP is generated from activities taking place in the six coastal departments. The most important sectors of the coastal economy include tourism, construction industry (for urban, commercial, and industrial development purposes), shipping, and fishing. Loss of land from sea level rise would have a major impact on the vital international tourist industry. Every year, the country's coastal resorts attract millions of visitors from the region and overseas. In 1997, a total of 2,462,532 tourists came into the country, 79% of which headed for the coastal areas, generating US$ 760 million in revenue, about 3.8% of Uruguay's GDP (Ramos Mañé et al. 2002). Domestic use of the beaches is also high.

Nicholls (1994) classified Uruguay's vulnerability to sea-level rise. He concluded that Uruguay had a low vulnerability in three categories: people affected, people at risk and risk of dryland loss; whereas it had a critical vulnerability in two categories: capital value at risk and risk of wetland loss. The economic damages resulting from various amounts of sea level rise were estimated by Volonté and Nicholls (1995), Nicholls and Leatherman (1995), and the CNCG (1997), and all values dramatically increased above 0.5 m. In terms of population affected, a 1 m increase threatens to displace a minimum of 13,000 people (Volonté and Nicholls, 1995). Whether the erosion of beaches would result in a reduction in tourism was not studied. Protection costs for coastal areas have also been examined. For a 1 m rise in sea level, these costs could range from more than US$1 billion (1990$) to over US$1.8 billion (year unknown but study completed in 1997) (Volonté and Nicholls, 1995; Benioff et al., 1997). In terms of value at risk - agreeing with Volonté & Nicholls (1995) - the urbanized coastal areas with higher market values (Maldonado, Montevideo and Canelones) were found to be most vulnerable. The capital at risk per unit of coast length associated with areas at risk for erosion was evaluated on the basis of the land value as well as constructions and infrastructure. The study reported the capital at risk for the different sea level rise scenarios to be US$ 45, 75 and 220 million/km for the Punta del Este international resort area (Maldonado) and US$ 15, 25 and 80 million/km for the Montevideo-Canelones urbanized coastal area[27].

It should be noted that the above-mentioned estimates of value at risk only include values of land, property and other infrastructures. None of the studies have considered the value that natural coastal

25 The departments are, from west to east, Colonia, San José, Montevideo, Canelones, Maldonado, and Rocha.

26 The CNCG (1997) reports that mean sea level rise values recorded for Montevideo have increased by 0.7 mm/year during the 20th century, which is lower than the global mean as well as values recorded at other sites of the South-Atlantic Ocean. Also, the IPCC (2001) reported that a trend of extreme sea level rise at Buenos Aires of 2.8 mm/year was observed during that same period. A possible explanation for Uruguay's deviation from these trends would be the occurrence of an up-lift process of the Uruguayan coast. However, there is no further clear evidence of such a process.

27 Note that the economic growth assumptions used for these assessments should be considered non-realistic in light of Uruguay's current financial crisis.

resources have for the inhabitants and the country for aesthetic reasons or for their role in coastal ecological dynamics, production systems or as requirements for the existence of coastal dependent industries like tourism. To consider the value of the full system would be important for a complete accounting of the impacts from any climate change strategy.

7.2 Identification of coastal areas that might be particularly vulnerable to sea level rise

The coastal zone is shaped by the interaction of two systems: a natural system and a socio-economic system. Sea-level rise affects the natural system through erosion and morphological changes, increased flood risk, wetland loss or change, salinization and saltwater intrusion of surface and ground waters and raised water tables. Impacts depend not only on the amount of sea-level rise but also on anthropogenic factors such as land use and management approaches. These biophysical impacts of sea-level rise have a number of associated socio-economic impacts such as loss of property and coastal habitats; flood risk and potential loss of life; damage to coastal infrastructure; loss of natural resources, tourism, recreation, and transportation functions; and finally the loss of other non-monetary cultural values (Klein and Nicholls 1999). The two systems continuously adjust and adapt to reduce the magnitude of potential impacts. Adaptation can be spontaneous (autonomous adaptation) or human-triggered (planned adaptation). The vulnerability of the coastal system depends on two factors: the level of socio-economic activities and infrastructure and the ability of the system to cope with and to reduce potential damages (McCarthy et al. 2001).

Locations that might be vulnerable to sea-level rise - either from a social, economic, or ecological point of view - include sandy beaches, urban coastal areas and coastal lagoons and wetlands.

Sandy beaches may diminish or disappear as a consequence of increased erosion rates due to climate change with important potential impacts on the income from tourism. Loss of property and damage to infrastructure appear to be low in the most conservative scenarios (up to 0.5 m of sea-level rise) due to the existence of extensive areas that would act as "buffers" or due to the presence of ample strips that separate constructions from the sea. However, losses quickly increase under scenarios with sea level rise greater than 0.5 m. The coastal storm regime could also be modified as a result of climatic change causing mainly increased erosion and altered coastal morphology. Projected impacts also include floods, localized salinization of low-land areas and the possible salinization of the main source of drinking water for Montevideo and its surroundings, which would entail serious socio-economic consequences.

The modifications of littoral bars at the coastal lagoons and their surrounding wetlands can be potentially significant due to their ecological value and their role in coastal dynamics. However, it can be expected that in case of a 0.5 m sea-level rise a reconfiguration of the lagoons and their neighboring wetlands would take place rather than completely disappearing. Besides climate change, other factors such as the artificial opening of littoral bars, urban development, pressures from tourism and excessive afforestation with foreign species have to be considered in order to ensure the successful conservation of littoral lagoon bars and wetlands. Moreover, wetland losses are more sensitive to the rate of sea-level rise rather than to the absolute changes, since they have autonomous capacity to respond to inundation (Nicholls 2003). Uruguay’s vulnerability studies have not yet considered transient sea-level rise scenarios although they are needed to increase confidence in the obtained impact results.

7.3 Identification of potential adaptation options

Vulnerability assessments for Uruguay’s coastal zones suggest that adaptation to climate change should focus on anticipatory measures. The implementation of anticipatory measures would also help facilitate the future adoption of reactive ones. The study by CNCG (1997) suggested the adoption of the following anticipatory adaptation measures: 1) planning of urban development in non-vulnerable areas; 2) preventing the establishment of new buildings at vulnerable sites along the coast; 3) setting conditions for a gradual retreat; and 4) expropriating critical zones. In a later study carried out by CNCG (1998) authorities and technical staff from environmental and coastal related institutions discussed potential and priority adaptation measures. This survey identified five preferred adaptation measures: 1) plan coastal development, including urban growth; 2) revise existing setback regulations according to coastal vulnerability and ensure their enforcement; 3) identify the main areas that should be incorporated into a national system of natural protected areas; 4) develop an institutional and legal framework for the integrated management of the coastal zone; and finally 5) establish a regular monitoring system of the coastline, including the development of a Geographic Information System (GIS). Based upon the previous studies a preliminary identification of potential adaptation options for Uruguay's coastal zones yields 12 adaptation measures such as coastal monitoring, and restoration of degraded areas, which are outlined in Table 6. The definition of "adaptation" used in this analysis includes both actions that somehow directly reduce net adverse impacts, as well as measures which help generate information or establish institutions that could eventually help reduce adverse impacts. This broader definition is necessary because in many developing countries even basic monitoring information, which might be a prerequisite for appropriate response measures, is lacking.

7.3.1 Screening of measures

After the initial identification, the twelve measures were screened by comparing one another with regards to the following criteria (Benioff and Warren 1996):

- "High priority" evaluates whether the measure involves long-term decisions or whether it modifies unfavorable tendencies for posterior adaptation to climate change.
- "Opportunity" evaluates whether the measure accomplishes the objectives.
- "Effectiveness" evaluates whether the measure can be effective, given a wide range of potential climate changes.
- "Other benefits" considers whether benefits can be derived from the implementation even without climate change.
- "Low costs" considers implementation costs based on preliminary cost estimations.
- "Low barriers" evaluates potential barriers to implementation.

Three categories were used for each criterion: Yes, No, and +/- when qualification was rather uncertain. Since not all criteria were considered equally relevant, different numerical weights were established based on the significance of the various criteria. The final value for each measure is the sum of its values for each criterion. The following table shows the adopted weights:

Table 5. Weights adopted for criteria used in the screening matrix methodology

	High priority	Target of opportunity	Other benefits	Low costs	Low barriers	Effectiveness
Yes	1	1	2	0	0	1
+/-	0.5	0.5	1	-0.5	-1	0.5
No	0	0	0	-1	-2	0

Table 6 shows the 12 adaptation measures ranked from high to low preference as well as their overall score and the criteria used.

Table 6. Screening matrix for potential adaptation options

Adaptation Measures	Overall Score	High priority	Target of opportunity	Other benefits	Low costs	Low barriers	Effectiveness
Implement a regular coastal monitoring system to track impacts of climate change on the coastline	4.5	yes	yes	yes	yes	yes	+/-
Restore degraded coastal areas	4	yes	yes	yes	no	yes	yes
Implement integrated coastal zone management	4	yes	yes	yes	yes	+/-	yes
Plan coastal development	3.5	yes	yes	yes	yes	+/-	+/-
Develop an institutional framework for integrated coastal zone management	3	yes	yes	yes	+/-	+/-	+/-
Protect and reinforce littoral dunes	3	yes	yes	+/-	+/-	yes	+/-
Define setback regulations according to the vulnerability of each coastal stretch	2.5	yes	yes	yes	+/-	no	yes
Improve local knowledge on artificial beach nourishment for restoration of the coast	2.5	no	+/-	+/-	yes	yes	yes
Develop contingency plans against flooding for more vulnerable zones	2.5	+/-	yes	+/-	+/-	yes	+/-
Disseminate the latest knowledge about appropriate strategies and mechanisms to prevent beach erosion	1.5	no	no	yes	yes	+/-	+/-
Restructure competences of all different coastal-related institutions	0	+/-	+/-	+/-	yes	no	no
Control division of land in the coastal zone	-0.5	no	+/-	+/-	+/-	no	+/-

7.3.2 Evaluation of measures

After the screening process, the three prioritized adaptation measures have been selected for further analysis in order to establish a ranking based on their "efficiency". Different methodologies can be used for this purpose. Here, the cost-effectiveness analysis is chosen over cost-benefit analysis, since it is not possible to estimate monetary benefits for implementing each adaptation measure. The direct and indirect costs of each measure - from its proper development to its implementation - are estimated over a period of 10 years. This timeframe is considered to be long enough to fully implement the adaptation measures and to complete a full cycle of the multi-stage, iterative process of coastal adaptation to climate change (awareness raising, design, implementation, monitoring and evaluation). Moreover, after 10 years new measures might be needed to adapt to the prevailing conditions at that time. Considering the timeframe for this cost-effectiveness analysis and the current international financial rates a 6% annual discount rate was used to update costs values.[28] The results for the three measures are presented in Table 7.

28 The 6% discount rate constitutes a compromise for Uruguay given that the IPCC has recommended a 5 % discount rate for developed and a 10% discount rate for less developed countries for economic evaluations concerning measures to adapt to climate change. In addition, Uruguay's country risk or "spread" (Uruguay Bond Index) has been about 700 points since June 2003, which means a discount rate above 9%. Nevertheless, the consultant assumed soft credits to be available from international aid sources, so a lower rate was considered.

Table 7. Evaluation of adaptation measures

	PV of total costs (US$)	Cost estimates include:
Coastal monitoring	980,000	investments in equipment and installation (wave buoys, computer hard- and software, vehicles, topographic equipment) and corresponding operation and maintenance costs aerial photography for monitoring shoreline evolution every three years monthly salaries for technical staff responsible for the acquisition and processing of data scientific training of staff survey expenses other administrative expenses (including the editing and diffusion of obtained results)
Restore areas*	6,400,000	150 m^3 sand to nourish one meter of coast. maintenance requirements of around 25% (37.5 m3/m) every five years complementary work (such as building groins and jetties) protection of littoral dunes using sand fences; it is assumed that bulldozers and similar machinery from municipalities would be available for some dune restoration activities. monitoring and control investments in equipment (computer hard- and software, vehicles, topographic equipments) monthly salaries for technical staff scientific training of staff other administrative expenses
Coastal management	2,400,000	implementation of an appropriate framework for coastal zone management monthly salaries for technical staff at the local committees and other salary complements for delegates from the coastal-related institutions administrative costs and provisions for some specific consultancy and environmental education activities investments in equipment (computer hard- and software and vehicles), operation and maintenance costs, and a small operational budget for conflict resolution for each sub-committee costs deriving from management activities are not considered (compensations for expropriations in the course of setting up natural protected areas or setback regulations)

* The cost-effectiveness analysis was made based on the idea of restoring approximately 2000m of beach every two years given a 30m advancement of dry-beach. Costs estimations for beach nourishment are based on two preliminary assessments conducted during the 1990's for Pocitos beach (Montevideo) and El Emir beach (Punta del Este).

7.3.3 Synergy with sustainable development objectives

This analysis uses an adaptation decision matrix to assess the effectiveness of the three identified adaptation measures in meeting four relevant sustainable development objectives: preserving beaches; protecting ecosystems; promoting sustainable development; and maintaining present infrastructure and economic activities at the coast.

- *Preserving beaches:* This objective is important given that highly valued sandy beaches sustain the tourist industry and the subsequent significant country income. Besides beaches have a high recreational value for the population.
- *Protecting ecosystems:* In addition to beaches climate change will affect other ecosystems, which have a high ecological and aesthetic value.
- *Promoting sustainable development:* It is of high importance for the coast that future development does not cause the loss or degradation of coastal resources but instead contributes to their sustainability even beyond climate change issues.

- *Maintaining infrastructure and economic activities:* Every policy that will be applied should maintain present infrastructures and promote their associated economic activities.

Each considered objective was weighted on the basis of its relative importance, rather than its absolute value. Weights range from one (low importance) to five (high importance). The most important objective is the promotion of sustainable development (5) and the least important is the protection of ecosystems (3). The other two objectives were considered to be equally important at an intermediate level (4). The current policy (applying no adaptation measures) and the three identified adaptation measures were evaluated using a decision matrix (see Table 8). In order to fully cover the range of projected climate change scenarios the decision matrix considers one low impact scenario (increase of mean sea-level below 30cm) and one high impact scenario (increase of mean sea-level above 30cm)[29]. In addition, scores were assigned for each measure ranging from one (poor) to five (excellent) reflecting how well they perform in achieving each relevant objective. These values were then multiplied with the corresponding weights. Thus, the quantified benefits of each measure (total score) are the sum of the partial scores for each objective and each climate change scenario. The last column of the matrix (differences) is the incremental benefit of each measure compared to the no-adaptation situation. Based on this adaptation decision matrix analysis, the measure performing best seems to be to "Restore areas" closely followed by "Coastal management".

Table 8. Adaptation decision matrix

Adaptation Measure	Objectives					Score		
	Sea level rise scenario*	Preserving beaches (4)	Protecting ecosystems (3)	Promoting Sustainable Development (5)	Maintaining Infrastructure (4)	Partial	Total	Diff.
Actual Policy (no measures)							**53**	
	low	2	2	2	2	32		
	high	1	1	2	1	21		
1. Coastal Monitoring							**80**	**27**
	low	3	3	3	3	48		
	high	2	2	2	2	32		
2. Restore areas							**123**	**70**
	low	5	4	3	5	67		
	high	4	3	3	4	56		
3. Coastal Management							**119**	**66**
	low	3	4	5	4	65		
	high	2	3	5	3	54		

* low = (sea level rise ≤ 30cm), high = (sea level rise > 30cm)

7.3.4 Cost-effectiveness analysis

Having estimated the costs and the effectiveness of individual adaptation measures, the cost-effectiveness analysis is conducted by dividing its 10-year present value costs with its incremental benefits compared to the no-adaptation situation (see Table 9). The most cost-efficient adaptation measure is the one with the best marginal benefit – that is, the one which produces one unit of incremental benefit at the least cost.

29 In this report sea-level rise scenarios are less significant when considering adaptation options because adaptation measures examined are mainly proactive either to reduce vulnerability to climate change and to increase the resilience of the affected systems (Smith and Hitz, 2003) or to create "win-win" situations which are worthy of implementation even without any climate change.

Table 9. Cost-effectiveness matrix

Adaptation measure	Score		Cost	
	Total	Difference	Total Cost US$	Cost-effectiveness US$ / unit of incremental benefit
Actual policy (no measures)	53	-	NA	NA
1. Coastal monitoring	80	27	980,000	36,296
2. Restore areas	123	70	6,400,000	91,429
3. Coastal management	119	66	2,400,000	36,364

From Table 9 it becomes apparent that coastal monitoring and coastal management have similar cost-effectiveness values which are much lower than restoration of areas. This leads to the following priority ranking of adaptation measures:

1. Implement a regular coastal monitoring system to track impacts of climate change on the coastline.
2. Implement an appropriate framework for integrated coastal zone management, considering climate change effects as one of its pressing issues.
3. Restore degradated coastal areas and protect littoral dunes by soft engineering alternatives such as beach nourishment.

7.4 Towards implementation and mainstreaming of coastal adaptation measures

There are a number of policy initiatives related to coastal zones that bear upon the implementation and mainstreaming of adaptation options that have been identified in preceding sections. In 1984 Uruguay ratified the Convention on Wetlands of International Importance Especially as Waterfowl Habitat known as the Ramsar Convention. Uruguay listed the “Eastern Wetlands and its Coastal Zone” as its first Ramsar site. Sharing the border with Brazil, this vast complex of coastal wetlands includes lagoons and parts of several rivers and supports a rich biodiversity. Lagoons and wetlands have suffered due to extended development of rice production fields. The site in which the Jose Ignacio, Garzón and Rocha lagoons are located was declared a National Lakes Park and Multiple Use Area by the Government in 1977. Further, UNESCO-MAB designated the eastern wetlands as a national reserve. So far, Uruguay has not formulated domestic legislation for regulating wetland ecosystems. Until recently, wetlands were basically regulated by national laws and decrees. However, regulations for specific wetlands of importance have been lately developed through their designation as Natural Protected Area. Their status varies according to the National Protected Areas System. Although the major lagoons are state-owned, more than 85% of the wetland habitats are privately owned.

The Government of Uruguay does not have any other policies that are specific to coastal zones. However, guidelines on national environmental goals, as they apply to the coastal resources, can be derived from existing legislation applicable to the coastal zone and from the programs that are currently being implemented. For example, the Urban Center Law of 1948 requires a 150m setback from the shoreline of any land plotting for urbanization purposes. An even stricter legislative 250m setback requirement was set up in the Water Act of 1978. Uruguay also has a practice of building a coastal boulevard seaward of the first development row, adding another 100 to 200m to the setback. However, setback regulation is not directly related to beach recession rates (Volonté and Nicholls 1995). The primary purpose is to preserve the coastal zone for the Uruguayans, but it will also be beneficial in reducing the country’s vulnerability to erosion and sea-level rise. Thus, the regulation provides an excellent basis to move towards integrated coastal zone management and minimizing future vulnerability to climate change.

One of the most relevant long-term programs that have been implemented in connection with the coastal zone is the Ecoplata Program. This Program is the result of an inter-institutional agreement in support of integrated coastal zone management of the Uruguayan portion of the Rio de la Plata. It is partially funded by the Canadian Government. Ecoplata prepared an environmental and socio-demographic diagnosis of the Rio de la Plata area. Two areas were identified as targets for the pilot application of a coastal zone management approach. In 2001, mayors of the six coastal departments agreed upon a "Coastal Declaration", which commits national and departmental level authorities to undertake joint efforts in the coastal areas. An Integrated Coastal Zone Management Coordinating Commission was created subsequently with the purpose of facilitating the implementation of proposals generated within the framework of Ecoplata. This commission could take corrective measures in critical areas, where coastal resources are threatened resulting from inadequate uses (ECOPLATA 2001).

Another major program having an impact on the coastal zone is the Biodiversity Conservation and Sustainable Development Program for the Eastern Wetlands (PROBIDES) which started in 1993 as part of a GEF-funded project. This Program is also supported by a European Union grant and has received the ongoing support of the Spanish Government. The Program involves three main areas of work: 1) wetland management and research, 2) sustainable development, and 3) education and training. PROBIDES has developed an Integrated Management Program for the Atlantic Coastal Zone aiming at planning and the sustainable usage of coastal resources through an integrated management strategy.

More recently, Uruguay and Argentina have embarked on a joint effort to carry out an environmental assessment of the Rio de la Plata estuary. The estuary is formed by the confluence of the Paraná and Uruguay rivers, whose management is shared by both countries. This activity is being implemented within the framework of the GEF-funded project "Environmental Protection of the Rio de la Plata and its Maritime Front: Pollution Prevention and Control and Habitat Restoration (FREPLATA)". The long-term objective of this activity is to generate information on the environmental conditions of the Río de la Plata that can be further integrated with social and legal aspects in order to implement a management plan.

Regarding climate action plans, the sectoral adaptation plan developed by the National Committee on Global Change (CNCG 1998) included two adaptation measures for the coastal resources sector: 1) coastal development planning for the San José department - including urban growth - and initiation of the process leading to an integrated management of its coastal zone, and 2) the establishment of a continuing monitoring system of the shoreline and related variables. The Program of General Climate Change Mitigation and Adaptation Measures, which has been recently developed by the National Environment Directorate, includes three adaptation measures targeting coastal zones: 1) the promotion of integrated management of the coastal zone, 2) the establishment of a continuing monitoring system of waves, the climate and beach profiles, and 3) the study of deteriorated coastal areas.

During the last decade, the government has carried out a number of activities directed at preserving coastal ecosystems. Some examples include:

- Protection of coastal ecosystems (demolition of illegal constructions in Cabo Polonio, Department of Rocha) in fulfilling national regulations regarding coastal protection and as an initial step in implementing a management plan for this protected area.
- Preparation of an "excellence plan" for the Punta del Diablo area (Rocha) including management plans, tourist development, and environmental protection of this area.
- General guidelines for land planning projects on the Atlantic coast and for coastal management, which have been developed within the framework of the PROBIDES program in cooperation with the European Union.

- Dune recovery in coastal areas conducted by the Municipalities of Montevideo, Canelones, Maldonado, and Rocha.
- Implementation of the ECOPLATA Program.

The three adaptation measures which have been proposed in this report are fully consistent with the national actions and strategies outlined in section 6.2, and no general conflict between them is identified. Moreover, a significant level of synergy among some activities is evident. For instance, the "coastal monitoring" adaptation measure for example could offer synergies with the project "Monitoring impacts on hydrological conditions in South America: remote sensing and numerical modeling". This is a regional project with participation of governmental institutions and universities, funded by the EC. It aims at creating a network for monitoring climate variability impacts in the southern parts of South America. Also the "coastal monitoring" adaptation measure could positively interact with some monitoring actions that are currently undertaken such as those within the FREPLATA project or others that are currently planned like the wave measurement campaign by the Municipality of Montevideo for the construction of a new submerged discharge for Montevideo's sewer system. The only potential problem of the "coastal monitoring" adaptation measure is the fact that Uruguay has already a national network for meteorological, climatic and environmental observations operated by the National Directorate of Meteorology. However, the proposed adaptation measure would monitor aspects which are not being covered by this national network. Thus this potential conflict could be turned into a synergy if adequate institutional arrangements are made between the leading institutions of both activities to allow the exchange of complementary information.

The "coastal management" adaptation measure could have a significant level of synergy with an educational project recently elaborated by eight Schools of the University of the Republic and Dalhousie University in Canada. It proposes to build up tertiary educational capacity in integrated coastal management for government managers, community leaders, and private sector personnel. One of its objectives is the design and delivery of an inter-disciplinary Master's degree - Master of Integrated Coastal Management. The "restore areas" adaptation measure is not only in line with the national strategy for the recovery of coastal areas but also with an unofficial though popular tourism theme ("Uruguay Natural") in which high quality sandy beaches play a significant role. The "restore areas" adaptation measure is also in agreement with the concept of preserving the environmental quality, which is included in the Environmental Impact Assessment Law and the General Environmental Protection Act.

There are nevertheless some significant barriers facing the successful implementation and mainstreaming of coastal adaptation options. However, unlike many other developing countries, economic resources and lack of domestic technical capacity are not usually the key constraints. Rather, institutional factors which inhibit co-ordination across multiple stakeholder groups – as would be necessary for coastal monitoring and management activities – are often the most critical. In particular further efforts might be required to encourage government authorities to share decision-making capacity with other stakeholders, and also to successfully engage private sector stakeholders such as the tourism industry in financing and implementing adaptation activities, particularly those related to the restoration of coastal areas.

8. Mainstreaming greenhouse gas mitigation in the agriculture and forestry sectors

Within the context of mainstreaming responses to climate change in development in Uruguay, it is important to recall that agriculture is the sector responsible for most of the global warming potential of all emissions in the country. At the same time, agriculture and forestry have shown to be the sectors with the strongest ability to reduce net emissions (through carbon sequestration). This section therefore focuses on these two key sectors to assess plans and programs that have the potential to meet the country's priorities for development, while at the same time to mitigate GHG emissions.

8.1 Agriculture sector: overview and implications of current policies for GHG mitigation

Uruguay's economy is largely dependent, directly or indirectly, on agriculture (crops and livestock). For example, although the contribution of agriculture to its GDP is about 10%, agricultural exports represent about 65% of the total value exported by Uruguay (45% from livestock origin and 20% from crops). If manufactured goods originated in agriculture are considered, the contribution of this sector increases to 85% of all Uruguayan exports. Crop and livestock production satisfies almost the entire domestic demand for food, and supports an agro-industrial sector that generates about 60% of the total industrial product. Agricultural production is based on the highly fertile soils of the Pampas, an ecosystem in which native temperate and subtropical grasslands are used for livestock production or have been converted to improved pastures (grasses/legumes) and to croplands.

Livestock production is the most important agricultural activity, covering 90% of the land, and generating 60% of the total agricultural value and 70% of the total agricultural exports. Even in the areas with deep, fertile soils where the annual crops are grown, the current production systems include rotations with 3-4 years of cereals and oil crops and 3-4 years of sown pastures (grasses and legumes) which are used for more intensive beef production.

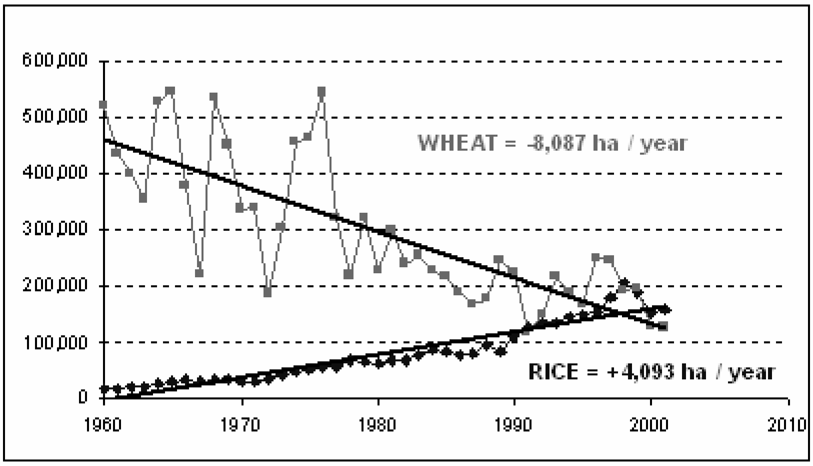
8.1.1 Policies and trends in agriculture and livestock production

Approximately 85% of the land is suitable for agricultural production, one of the largest proportions in the world. Main crops include wheat and barley in winter, and rice, maize, sorghum, sunflower and soybeans in the summer. The sown area with wheat, traditionally the most important annual crop, peaked in 1965 at almost 550 thousand ha. Most of the other main crops (except for rice and barley) also had their highest sown areas during the 1960s and early 1970s. Technology use during these decades was quite low: farmers preferred the traditional, stable but low yielding varieties and fertilizers were used rarely. As the main objective during this early stage was to supply the internal market and limit imports, the increase in production was mainly due to the availability of low interest credit programs (often of negative real terms) and benefits related to price policies for import substitution.

Two important changes occurred during the late 1970s and the 1980s that drastically affected the production of annual crops. First, the national research centers developed technology packages (rotation with pastures, fertilizer use, high-yield and disease resistant crop varieties) that allowed farmers to obtain much higher yields. Second, markets started to be liberalized, subsidies and low-cost credits were cut, and domestic market prices started to follow international prices. Consequently, most of the small and medium-size farmers stopped producing annual crops and the sown areas of most crops started to decline. This was the case for wheat, which saw its area decrease in the last 40 years from about 500 thousand ha to about 200 thousand ha (Figure 6), but the total national production remained around 400 thousand tons due to increased productivity. Similar trends are found in most of the other annual crops, with the exception of rice and barley. These two crops increased their total sown areas consistently (Figure 6). Most of the remaining crop producers are large and medium-size farmers using improved technology, and although the areas decreased, national total production tended to remain about the same.

Over the last 10-15 years the Soil Conservation Law has played an important role in encouraging reduced or conservationist tillage which has had the ancillary benefit of boosting the potential for soil carbon sequestration. During the 1990s the area of annual crops under no-tillage systems grew from zero to more than 50% of the summer crop sown area.

Figure 6. Development of areas cultivated with wheat and rice (1960-2001)



The agricultural land is also extremely suitable for livestock and dairy production. Only 17% of the livestock producing areas include some type of improvement in the pastures: either no-till sown legumes and fertilized with phosphate fertilizers, and/or sown with annual grasses (ryegrass and oats) or mixtures of grasses and legumes (such as ryegrass, fescue, white and red clover, birdsfoot trefoil). The remaining land is still under natural grasslands. Feedlots or other types of animal confinements are almost non-existent and the use of hormones in any animal species is forbidden by law (Decree 915/988, December 1988). This results in one of the most "natural" beef and wool production systems of the world, and constitutes a great economic opportunity in the global market for Uruguay that has yet to be realized. However, on the other hand such extensive livestock production systems have also led to very low productivity levels. Consequently, national development programs over the past few decades have been oriented at intensifying the beef and wool production. The main challenge in this respect is to envision systems resulting in higher productivity while maintaining the natural characteristic of the livestock production and preserving or improving the natural resource base.

In the 1960s, the government initiated a large program funded by the World Bank to increase beef and wool productivity. The program involved introducing grasses and legumes as well as applying phosphate fertilizers. These measures resulted in an increase in the breeding rate and a reduction in the slaughtering age. However, the results did not meet expectations since, in some cases, the introduced pasture species did not persist as long as expected. In other cases, other species took advantage of the increased nitrogen content of the soils caused by the introduction of legumes. Also, where the pastures were well established, the management practices were often aimed at short-term economic gain and not at optimal pasture use. By doing this, farmers optimized the financial return in the short term sacrificing the longer term production stability. Finally, the vast majority of the improved pastures were used for the fattening process and very few to the breeding stage, and therefore, there was an unbalanced development of the entire beef production process. Although some technological limitations still need to be overcome (e.g. the increase in the persistence of the improved pastures), the areas of improved pastures in Uruguay seem to be more dependent on economic circumstances, namely the low price of beef received by farmers for a long period. During the 1990s, when internal prices improved and the regional and international markets opened, the area of improved pastures increased rapidly and consistently. Consequently, all beef production indicators improved, such as early slaughtering age, higher pregnancy rate, higher proportion of productive categories.

Similar to agriculture, dairy production was also initially directed at the domestic market. The opening of markets in the 1970s led to drastic changes in the sector: total national production increased from 700 million liters in the early 1970s to almost 1,500 million liters by 2000. The improved systems are based on sown pasture mixtures of grasses and legumes, and on the use of silage and some concentrates. Productivity also improved by increasing the proportion in the herd of milking cows in production. 90% of the total produced milk is processed in farmers cooperatives spread all over the country but more concentrated in the southern and western regions. All the production exceeding domestic demand is exported, and Uruguay is now one of the largest dairy exporters of the developing world. The exported products that generate the largest income are cheeses and powdered milk, followed by butter, fresh milk and cream.

The final component of Uruguay's agriculture and livestock sector is sheep farming, which is traditionally aimed at wool production. Until the 1980s the national sheep herd used to include more than 20 million heads, but has been continuously decreasing due to unfavorable wool prices. Sheep production has also been changing and is being more oriented at producing meat. During periods of high wool prices, 70% of the sheep farming income came from wool production and 30% from meat. In recent years, given the low wool prices, the proportion has changed to 55% and 45% respectively.

8.1.2 Impact of sectoral policies on GHG emissions

Early government actions (laws, regulations, programs) in the agriculture and livestock sector were oriented at improving the existing natural grasslands, the backbone of the livestock production. The most common means were tax exemptions and low-interest credit programs for introducing legumes, grasses and phosphate fertilizers. These actions had significant impacts on the areas with improved pastures, which doubled between the 1950s and the late 1970s. However, as discussed earlier, these actions were not followed by similar increases in livestock productivity, mainly due to economic reasons. For example, the prices that farmers received for beef during the early 1970s were less than 60% of the corresponding international market price. Consequently farmers were not stimulated to invest in technological improvements and the new improved pastures were often managed in ways that did not optimize their stability and long term productivity. Also, during the 1970s and until the mid 1980s, the total area of improved pastures remained about the same.

Although livestock productivity did not change substantially, government plans and regulations had an important impact on the increased capacity of the agricultural soils to sequester carbon. The increase in the area under sown pastures (mixtures of grasses and legumes), and the improvement of large areas of natural grasslands (introducing legume species and phosphorous fertilizers) raised the soil nitrogen content increasing the soil carbon levels in the previously nitrogen-limited grassland soils. From the perspective of GHG emissions these early stages were characterized by a) an increases in the amount of carbon sequestered in the soils mainly due to an increase in the nitrogen content of the grasslands soils; and b) small or no changes in the methane emissions from livestock since the beef and wool productivity stagnated between the 1960s and the early 1980s.

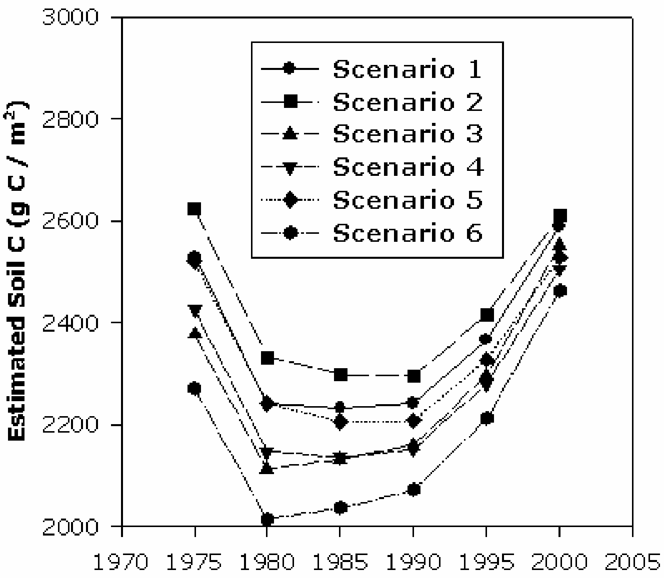
With regard to annual crop production, the early national policies were aimed at substituting imports through low interest loans and other incentives. Consequently, the area of most crops increased consistently since the turn of the last century and reached a maximum in the late 1970s. As discussed earlier, farmers typically used low technology packages (few or no fertilizers, low-yielding varieties). Although the vast majority of the farmers involved in annual crop production were also livestock producers, they used to manage each production type in separate areas of their farms. It was therefore common to have fields that were sown to annual crops year after year, and once in a while the fields were left in fallow. Finally, all the tillage was done with conventional equipment, and there was a tendency to over till the fields in order to eliminate competing weeds and to create fine seedbeds. Until the late 1980s, when rural credit was conditioned to soil conservation practices, no actions were taken to prevent or avoid soil erosion or degradation.

The combination of conventional tillage, continuous crops in the same fields, and low crop yields with consequent low residues returning to the soils had devastating consequences for the soils. A study conducted by Baethgen et al. (2001) for the World Bank estimated that by the 1980s soils in Uruguay had probably lost 50-60% of their original carbon content due to these agronomic practices. This period was thus characterized by strongly negative soil carbon balances, and soils acted as net sources of CO_2.

A combination of improvements in internal prices of livestock products and opening of the regional and international markets during the late 1980s and 1990s resulted in a rapid increase in the area of improved pastures. Considering the whole effect of early and recent actions on the pastures, the total area of improved and sown pastures during 1966-2000 increased at an average annual rate of 35,000 ha/year. However, the annual rate for the last 10 years was more than 3 times higher: 117,000 ha/year.

As regards annual crop production, during the period 1966-2000 the total sown area decreased at an annual rate of 14 thousand ha/year, and in 2000 the total area was less than half that of the early 1970s. In addition, the Soil Conservation Law passed in 1982, allowed the National Bank (Banco de la República) to condition its rural credit program to the application of soil conservationist technologies. This resulted in a wide application of soil management techniques aimed at avoiding and/or reverting soil degradation and erosion, as well as at reducing soil organic matter decomposition, which also increased soil carbon levels. For example, the increase in annual crop areas with reduced tillage (up to early 1990s) and with no till (since mid 1990s) resulted in increases in carbon sequestered in soils since the 1990s at an estimated rate of 200 – 600 kg C / ha per year or 700 – 2,200 kg CO_2 / ha per year (Figure 7), where the estimated range depends on the soil texture and previous land use (Baethgen et al., 2001). It should be noted that this estimated increase in C sequestration is the cumulative effect of improving tillage methods and including pastures in rotation with annual crops.

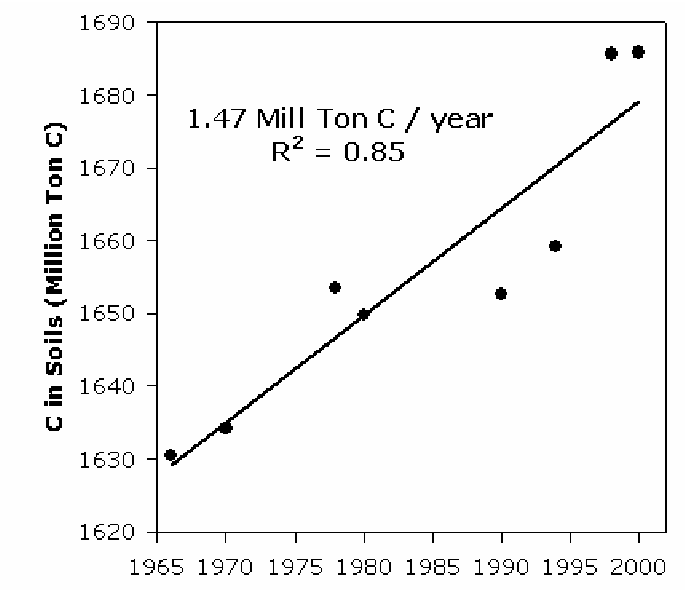
Figure 7. Estimated changes in soil carbon content during 1970-2000 for different scenarios (combinations of soil types and previous land uses, pristine soil carbon content was approximately 5,000 g C/m2)



Source: Baethgen et al. 2001

As a result of the new improved pastures and the use of conservationist techniques of soil tillage, the estimated amount of carbon sequestered in soils during 1966-2000 increased at an average rate of 1.5 million ton C/year. Due to the recent legal actions and programs, however, the rate of soil carbon sequestration for the last 20 years was about 1.8 million ton C/year (Figure 8 and Table 10).

Figure 8. Changes in the soil carbon content due to changes in the land uses (improved pastures and no-tilled crops)



Source: Baethgen et al. 2001

Table 10. Annual rate of change in the soil carbon content in four periods of approximately 20 years (expressed in million ton C/year and in million ton CO_2 equivalent/year)

Period	1966-78	1970-90	1978-98	1980-2000	Average	Regression
(Million Ton/year)						
Soil Carbon	1.04	0.91	1.61	1.80	1.34	1.47
CO_2 Equivalent	3.83	3.35	5.90	6.60	4.92	5.40

Source: Baethgen et al. 2001

8.2 Forestry sector: overview and implications of current policies for GHG mitigation

Tree planting was first introduced in the country in the late nineteenth century. Small areas of *Eucalyptus* were established in ranch farms, with the objective of providing shade and shelter for the cattle, and obtaining wood for building fences and for cooking. Today, thousands of these small patches of trees are found all over the country. At the same time, pine trees, and to a lesser extent eucalypts, were established on coastal areas in the south to stabilize sand dunes. These coastal forests are not harvested, although they are frequently disrupted by summer fires mainly caused by tourists. Together, forests planted in ranch farms and in coastal dunes add up to an area of 90 thousand ha.

Commercial forestry did not start until the middle of the twentieth century, when the first large scale plantations were established. These first investors included pension funds, small pulp mills, other private investors, and the national utility company (UTE). In 1967, the first regulation on commercial forest plantations was enacted (Law No. 13723) to provide incentives to invest in plantations through a partial exemption on income tax proportional to the annually planted area. This resulted in a doubling of annual planting rate to 2,750 ha/yr during the period from 1968 to 1979, after which the law was abolished.

Demand for wood also increased significantly as a result of the oil crises of the 1970's and 1980's as most industries in the country switched from fossil fuels to firewood. This exerted a large pressure on native forests (Uruguay 1992). Demand for firewood increased from 1.3 million m^3/year in 1973 to 3.0 million m^3/year in 1987 (FAO, 1987). By 1988, commercial forest plantations covered 31 thousand ha distributed all over the country. Most of this area consisted of short rotation eucalypts (10-12 years) and pines (25-30 years), planted with very precarious technology based on poor genetic materials, intensive soil tillage, mechanical weeding, and lack of use of fertilizers. These plantations frequently suffered from damage caused by cattle grazing on young stands. Growth rates were relatively low, with mean annual increments ranging between 15 and 25 m^3/ha/yr for eucalypts and from 15 to 20 m^3/ha/yr for pines. A large proportion of low grade timber was usually obtained, and firewood and pulplogs were the main products.

In 1987, the adoption of a forestry promotion policy, based on a set of instruments contained in Law No. 15939, boosted forestry activities in the country (see box 2). The central objectives of this policy were to create new sources for exports and a sustainable supply of firewood while stopping the deforestation process that was taking place at increasing rates. This policy was highly successful, and resulted in a remarkable growth of forested area (Figure 9), with an estimated total investment, including a significant amount from foreign sources, of more than US$ 1 billion in the 1990's.[30] This new policy also changed the traditional forestry. New technological practices were adopted, resulting in better quality, more vigorous, and more homogeneous tree stands. Productivity was increased by up to 100% as compared to pre-1987 forestry. Modern concepts, such as long-term planning, environmental management systems and high concerns for working conditions and other social impacts were introduced in forest company management. Good sustainability standards were achieved, and several companies have obtained, or are in the process of obtaining, FSC or ISO 14,000 certification.[31]

30 Plantation subsidies were only a part of this new policy that also included tax exemptions and soft credits. It is very difficult to assess whether these subsidies were really necessary to achieve the amount of plantation because their effect cannot be isolated from the other incentives. The studies that have been conducted (e.g., Ramos and Cabrera 2001) have shown high returns of the investment by the Uruguayan State, in terms of benefits to the society. Therefore, one can safely assume that subsidies and other benefits were already paid off without considering the environmental benefits (i.e., carbon sequestration). In spite of that it is useful to compare the cost of the subsidies with the amount of carbon sequestered by the forests that received the subsidy (which was not financed by exterior funds, but by government budget funds). The law allowed the government to give a subsidy equivalent to up to 50% of the plantation cost. In practice, the real figure was close to 35 % of cost (ca. US$ 150/ha effectively planted and in good condition after one year of age), and not all plantations received a subsidy. The total cost for the State was in the order of US$ 55 million. This figure has to be compared with the total amount of carbon to be sequestered by plantations receiving the subsidy (over 100 Mt CO2 by 2012). If the entire subsidy were to be attributed to C sequestration, which is an unrealistic assumption, it would have implied a cost of US$ 0.5/t CO2 plus financial costs.

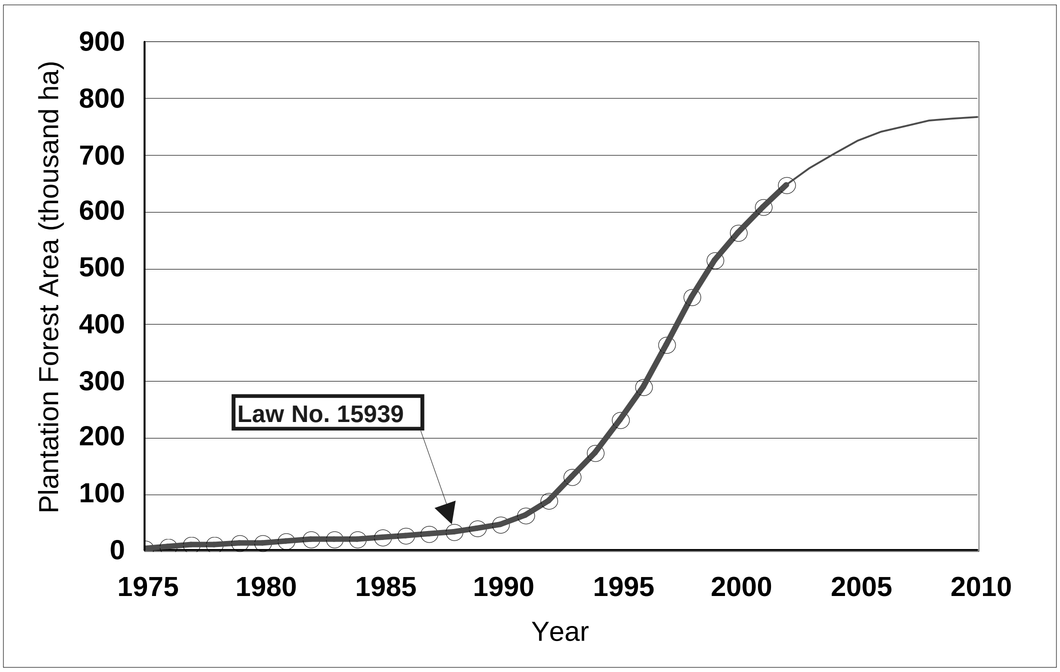
31 The Forest Stewardship Council (FSC) certification is a voluntary procedure in which the ecological, economic and social aspects of forest management are evaluated against a global set of 10 principles and criteria for good forest stewardship. Forest enterprises that meet these criteria are awarded with a certificate. The International Organization for Standardization (ISO) 14000 standard is primarily concerned with "environmental management" meaning the certified organization tries to minimize harmful effects on the environment caused by its activities.

Box 2. Forestry promotion policy based on Law No. 15939

This policy adopted in 1987 had the following main features:

- Forestry growth to be based on projects subject to approval by Forestry Bureau (Dirección Forestal), designated as the National Forestry Authority. Eligibility criteria include location, tree species and planting density, among others.
- The regulation promotes forests to be established on “Forestry Priority Soils” (location criterion). These soils include 3.6 million ha of low agricultural productivity and/or high susceptibility to erosion or degradation, located in certain areas of the country with potential to develop timber production, transport and manufacturing centres. A package of financial incentives was offered to prospect investors, including:
  - land property tax exemption for all planted areas;
  - permanent exemption of income tax and other taxes and levies;
  - 12-year exemption of any new taxes or levies to be created;
  - a cash subsidy equivalent to 50% of estimated plantation cost;
  - duty free imports of goods to be applied to approved projects;
  - soft credits for planting, with a grace period of 10 years for both principal and interests;
  - corporations allowed to buy land if forestry is their main activity (otherwise, land property is nominative in Uruguay);
  - forest ownership is separated from land ownership, which provides flexibility for using financial mechanisms; a later regulation allowed land rental contracts for up to 30 years for forestry activity (for other purposes, maximum legal is 15 years);
  - investors allowed to deduct up to 30% of their income tax payments from other activities for investments made in forestry projects; similar benefit is provided to buyers of Uruguay’s external debt bonds.
- **Prohibition of harvesting native forests**, with the exception of wood supply for farms, and properly justified cases, subject to approval by Forestry Bureau.
- Enforcement of a number of **fire and pest prevention** measures.
- **“Climate benefits” of forests** to be promoted recognized in introductory message of the Executive Power to Parliament, and in article 4 of Law No. 15939. A study made by JICA (1991) estimated that planting 100,000 ha over the period 1991-95 would offset approximately 50% of CO2 emissions by burning fossil fuels in Uruguay.

Figure 9. Evolution of commercial forest plantation area in Uruguay during the period from 1975 to 2002, and projected business-as-usual new plantations until 2010



According to Forestry Bureau projections, timber harvest from plantations is expected to reach 10 million m^3/year by 2008. The annual planting rate has been decreasing during the last few years, and the announced gradual suppression of government subsidy will probably reduce it further. A plausible scenario is to reach an area of 800 thousand ha by 2010, with a timber harvest of 18-20 million m^3/year by 2020. Given the current species composition, rotation length and management systems 59% of the annual production are used as pulpwood, whereas 11 and 22% constitutes high and low grade saw-logs/veneer-logs, respectively (van Hoff, 2001).

Forestry development has already had a very positive socio-economic impact. According to Ramos and Cabrera (2001), 3,000 new jobs were created in the 1990's, and this figure is expected to increase to 18, 000 by 2020. State revenues from taxes during the period 1990-2020 would average US$ 22 million/year. Gross sectoral product is expected to increase from US$ 100 million/year between 1990 and 1999 to US$ 600 million/yr by 2015. These figures consider all production phases from planting through first processing. Another important consideration with regard to commercial plantations is whether they result in a decline in the natural, biodiversity and ecosystem value of the land through the introduction of alien species and monoculture. This has been a particular concern with eucalyptus plantations in other parts of the world. However, in the case of Uruguay, the concept of "alien species" referring to eucalypts and pines is misleading. Plantations in Uruguay are established not on forest lands but on pastures that had been already disturbed by introduction of cattle 300 years ago, and by tillage agriculture during the 20th Century. Therefore, there is very little left of the natural "biodiversity". Moreover, since forest plantations must leave (by law) buffer zones and fire-prevention areas, the result has been highly positive in terms of native flora and fauna richness. There are even reports of sightings of animals species that were considered to be extinct in the region. These animals may have thrived in the protective environment offered by trees. Uruguayan forestry policy (see Box 2) has also included prohibition of harvesting of native forests. This measure resulted in an increase in native forest area from 667,000 ha in 1970 to its current level of 810,000 ha. This is probably highly significant in terms of preservation of biodiversity. Finally, with regard to potential adverse impacts of eucalyptus plantations on soil acidity, the eventual increase in soil acidity due to tree plantation is not related with growth inhibition of other plants, and is not perceived as a problem.

Most of the soils that are eligible for forest plantations are acidic (ph near 5) and scientific studies have not shown a significant increase in acidity. But this is also of little relevance, since it is an objective of forest growers to prevent other species from growing, in order to eliminate competition for light, water and nutrients. They even use herbicides to ensure a weed-free environment (defining weeds as any unintended plant species).

8.3 Future options for mitigation in agriculture and forestry

The increase in the area of improved pastures, the decrease in the area of annual crops, and the use of better tillage practices in the remaining area of crop production have already resulted in increases in the soil carbon sequestration that compensated the total CO_2 emissions from the energy and industrial processes sectors. In addition, the large growth of forest plantation area after 1990, combined with very high tree biomass productivity and relatively low initial soil carbon contents, resulted in significant removal of atmospheric CO_2. A study by Uruguay's Ministry of Environment (Uruguay, 2002a) estimated that the cumulative net carbon sequestration[32] by forestry during the period 1988-2000 was 27.4 Mt CO_2. The same study projected an additional net sequestration of 108.6 Mt CO_2 during the period 2001-2012.

The vigorous forestry development achieved in the last few years will have climate change implications beyond the removal of CO_2 from the atmosphere. One of them is the creation of a new, abundant and clean source of energy. Further, residues from forest harvesting and wood manufacturing could be used for heat and power generation, and eventually, for biofuel production, offsetting GHG emissions from fossil fuel burning. In addition, the large timber production expected for coming years has the potential to induce cultural changes related with construction materials. Construction in Uruguay is largely based on energy-intensive materials, such as bricks, cement, metals and plastic. Availability of wood products of acceptable quality, combined with development of wood manufacturing capacity, may result in an increased use of wood as a construction material. This will extend the time residence of carbon in wood products and will have a positive impact on energy efficiency due to higher thermal insulation and lower energy use in production of wood, as compared to currently used materials. Also, the use of locally produced wood products would reduce emissions associated with international freight.

Total carbon sequestration, pooling all land-based activities (grasslands, agricultural soils and forests) amounts at present to an estimated 14-15 Mt CO_2 per year, or about 2.5 times total annual CO_2 emissions in the country. Considering all GHGs, carbon sequestration offsets approximately 50% of emissions. An ambitious challenge now is to identify activities that would contribute to the sustainable development of the country, and at the same time increase the country's ability to contribute to net mitigation of climate change. The next sections explore both options, detailing activities that are components of an integrated approach, rather than individual options.

8.3.1 Future options for forestry

8.3.1.1 Carbon sequestration by forest plantations

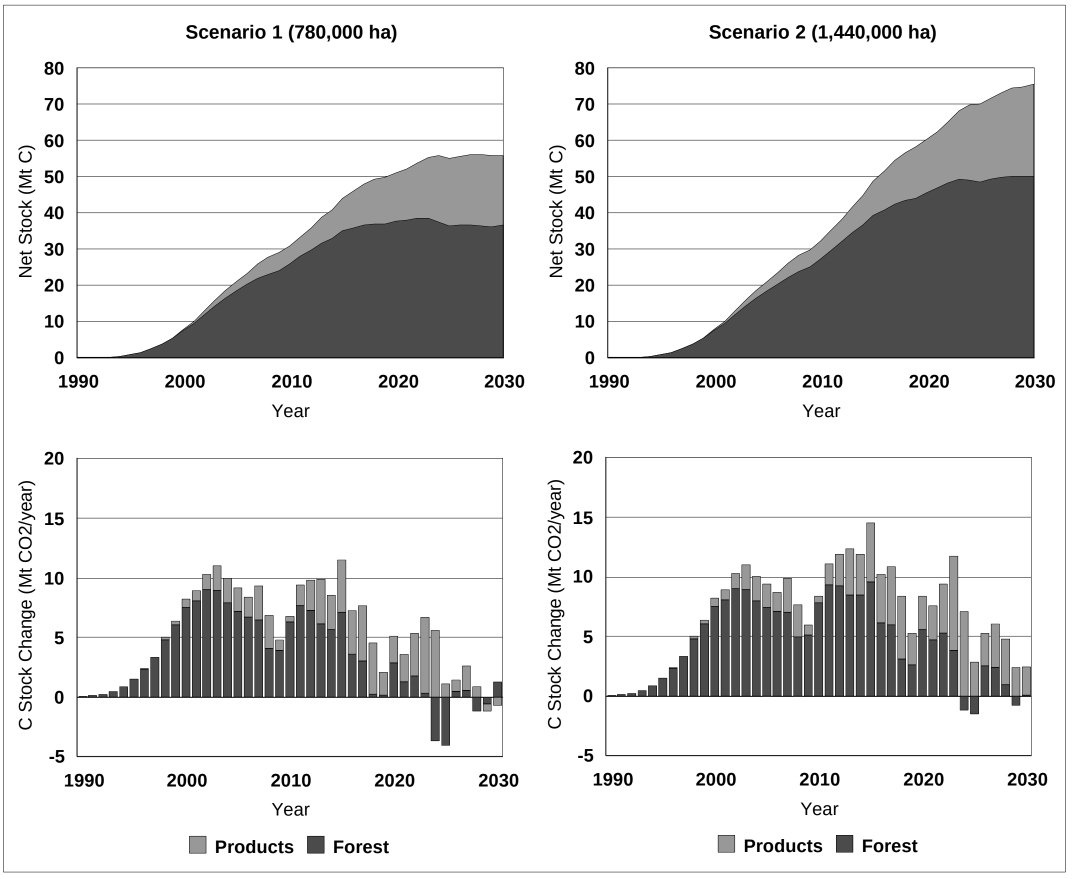
The current forestry area (0.7 million ha) covers only about one fifth of total area of soils designated for forestry priority (3.6 million ha). These soils have relatively low agricultural productivity, and to some extent have been subjected to management practices, such as overgrazing and tillage, leading to degradation and erosion processes. A large part of the remaining forestry priority area (2.9 million ha) is suitable for implementing commercially viable forestry projects. Forestry policy has recently been modified. Plantation subsidy, one of the key incentives offered by the government, will be gradually suppressed, starting in 2004, until its complete elimination in 2007. On the one hand, the phasing out of

32 The net carbon sequestration is the stock change minus additional emissions due to site preparation and additional use of fossil fuels.

subsidies will likely result in reduced establishment of new plantations. On the other hand, prospects for carbon markets may act as an incentive for attracting new investors, with potential to offset the negative consequences of subsidy suppression.

For this study, the extent of carbon sequestration by plantation forests was estimated for two scenarios: first, a conservative scenario (1), which is characterized by a virtual termination of afforestation with plantation areas reaching 780 thousand ha by 2030; and second, an alternative scenario (2), which represents the case in which carbon finance induces a flow of investment into new plantations, with forest areas reaching 1,440 thousand ha in 2030. Estimations were based on the model developed by Loza-Balbuena (2002), modified to consider: a) soil and litter carbon stocks; b) harvested wood products pool; c) additional CO_2 emissions due to fossil fuel burning; and d) reduction of methane and nitrous oxide emissions due to displacement of cattle production. Carbon sequestration during 1990-2030 was estimated at 207 and 280 Mt CO_2 for scenarios 1 and 2, respectively. This would be equivalent to offsetting 17% and 23%, respectively, of total GHG emissions in Uruguay during that same period, assuming there is no increase in those emissions with time. Results of the simulations are shown in Figure 10.

Figure 10. Estimated evolution of carbon stocks in forests and harvested wood products under two scenarios



As stated before, there is potentially available land to significantly increase the forested area, well beyond the one assumed for scenario 2. With current silvicultural and industrial technology, and assuming forestry is restricted to areas eligible for the remaining government incentives, the potential for carbon sequestration by forestry could be in the order of more than 10 Mt CO_2 per year for the next 40 to 50 years, equivalent to more than one third of current total emissions in the country. As shown in Figure 10, approximately two thirds of carbon sequestered would remain in forests, whereas the other third will be in the form of harvested wood products. This was based on the assumption that harvested timber will be processed to obtain an ideal mix of products according to forest species, rotation length, management and productivity. The real mix of products will depend, to a large extent, on factors such as timber production, industrial development and consumer demand of wood products. There is a potential role of government policy in regulating these factors and, therefore, in determining the extent of climate change mitigation by forestry.

8.3.1.2 Timber production and industrial development

There is currently a large imbalance between timber production and demand by the domestic manufacturing industry, and consequently most wood is exported as pulplogs. According to qualified informants, pulp-log export reached a historical maximum in 2002, with a total of 1 million solid cubic meters, which, excluding firewood, accounts for more than 80% of harvested wood in that year. This situation will likely worsen in coming years due to exponential increase in timber harvest, unless a significant flow of investments in industrial capacity for solid wood product and board manufacturing can be attracted. The installation of solid wood product industrial facilities strongly depends on the offer of high quality saw logs and veneer logs. Many producers have been managing their forests with pruning and thinning to obtain knot-free, high diameter logs, suitable for high-value wood products. The availability of these logs is now becoming significant in volume. There are already plans for creating new industrial capacity in the coming years. However, for the sake of both economic development and climate change mitigation, it would be necessary to promote a much more aggressive industrial investment flow, including manufacturing of products using sawmill residues.

To pursue such large industrial investment, a much more rapid increase in the volume of high quality logs would be necessary. There are currently no specific policies in place to promote forest management practices aimed at that objective. One major obstacle is the inexistence of long-term (i.e. 20+ year) loans that would fit biological with financial cycles. State-owned *Banco de la República* could consider implementing such loans. Alternatively, a government subsidy, similar to the former plantation subsidy, could be implemented to promote silvicultural management practices that would result in future larger fiscal returns, along with short-term socio-economic development. There are at least two factors that could lead to greater productivities and, therefore, increased carbon sequestration rates. The first factor is the increase in spring-summer rainfall that has been occurring in the SE region of South America during the last 20 years. If permanent, this would cause large increases in net primary productivity of the region’s ecosystems. The other factor, which can be influenced by government policy, is silvicultural technology development. Research programs in the areas of plant breeding, fertilizer use, silviculture management and forest diversification could be strengthened.

8.3.1.3 Consumer demand for wood products

Demand for wood products will be increasingly driven by foreign markets. The expected high availability of nationally produced wood provides the opportunity for stimulating demand for wood products in the local market, which would bring about positive contributions to the global climate change mitigation effort and, at the same time, would have positive associated socio-economic effects. Use of wood for structural rather than just decorative components of home construction has the potential to be a major driving force for increased demand. The major challenge for achieving this will be to break deep-rooted cultural barriers related to the absence of natural suitable wood resources in Uruguay, and to the fact that migrants, who originally made up more than 90% of the country’s population came from sites in Spain, Italy and other places, where wood was not used as a construction material. Two components of cultural barriers against use of wood in homes are the generalized perception that wood construction is of poor quality and short-lived; and concerns about the risk of home fires. Policies for increasing use of wood should thus aim at breaking those barriers, and be designed to produce significant results in the long run.

One step towards this long-term objective would involve the use of wood to substitute for cement, bricks and metals, for road signaling and fencing, bridges, public walkways and playgrounds. Wood use could also be encouraged for construction of public buildings and of state-promoted homes. Also, the use of wood in private homes could be encouraged by means of specific policies addressing special conditions for mortgages and fire insurance. Education and research should be two key components of any policies promoting the use of wood in construction and other uses of long-life products. Universities and technical schools could play an important role in emphasizing the benefits of wood materials in their teaching and research programs. It is proposed that a government promoted system for standardization of wood products be implemented. Last, but not least, there is a need to have fire prevention included in primary schools and general public education programs.

8.3.2 Future options for agriculture

8.3.2.1 Livestock production systems

A recent study conducted by the World Bank (Rosegrant et al. 2001) describes the trends in meat consumption during the last few decades as a "revolution." The report states that the magnitude of changes occurring in the developing world in the last 20-30 years indicate an extraordinary dietary change for the emerging middle class in developing countries. Per capita meat consumption in the developed world rose from 59 kg in 1967 to 78 kg in 1997, while it more than doubled in the developing world, from 11 kg in 1967 to 24 kg in 1997. Rosegrant et al. (2001) also studied the projected demand for meat during the next two decades, and estimated that it will rise by 92% in the developing countries, led by Asia and Latin America. It is expected that China alone will account for more than 40% of additional meat demand worldwide. The report also states that the projected international meat trade will expand tremendously in the next 20 years. The United States, Latin America, and the member countries of the European Union are expected to be the three main meat exporters by 2020, and all will experience significant increases in the value of their meat exports. For example the projected Latin American meat exports will expand by 80% by 2020.

These results suggest that Uruguay, a net beef exporter, will confront a scenario with good opportunities to expand its meat production and trade during the next 20 years. Expanding beef production will require maintaining or even accelerating the current rates of pasture improvement (currently 117,000 ha per year of new improved pastures are sown). Therefore, this favorable future scenario alone significantly improves carbon sequestration in pastures. As discussed earlier the changes in land use during the last 20 years resulted in net carbon sequestration rates of 6.6 million tons CO_2/year. This figure is the result of simultaneous changes in the areas under improved pastures, natural grasslands and annual crops, some resulting in increases and some resulting in decreases of the soil carbon content. In order to study possible responses of the livestock production sector to this growth in meat demand, the in-depth study defines a possible scenario by 2020 of doubling the area of improved pastures (124, thousand ha per year, compared to 117, thousand ha per year of the last 10 years). This doubling of improved pasture was estimated as if it was to be done at the expense of natural grasslands. It should be noted that from the carbon balance stand point this is a very conservative estimation, since the carbon content of soils under natural grasslands is higher than for example of soils under annual crops. The estimated increase in improved pastures would result in net carbon sequestration rates of 5.02 million CO_2 tons/year (compared to the estimated 6.6 ton CO_2 / year for the period 1980-2000).

The increased area of improved pastures would also result in a higher carrying capacity of the land and a new composition of the national herd. It should be noted that the dairy production in Uruguay is currently quite intensive, and therefore no major changes were expected for the next 20 years. However, major changes are expected in the beef and wool sub-sectors. The expected new herd composition will result from an increase in bovines of more than 30%, and of sheep of 39%. Since the diet of a portion of the national herd would improve given the increases in improved pastures, the scenario also included better productivity indexes (higher birth rates, weaning rates, earlier average slaughtering age, etc.). Thus, livestock production was estimated to be 70% higher than the current production by 2020. [33]

However, higher livestock populations would also result in higher methane emissions. In order to estimate the increased methane emissions, current emission factors (in kg CH_4/head per year) for each animal category were used. Given 30% more cattle and 40% more sheep, methane emissions would increase by 64,700 ton/year. Thus, the projected changes in improved pastures, the consequent increase in the carrying capacity and the new herd composition would allow for a growth in 70% in livestock production, but only a 10% increase in methane emissions. Using the IPCC global warming potential for methane (56 times higher than CO_2) the increased emissions of methane for the improved pasture scenario is equivalent to 3.6 million Ton CO_2/year. The net CO_2 balance after subtracting the carbon sequestered by the new improved pastures is negative by about 1.4 million Ton CO_2/year (see Table 11).

In addition, the level of methane emissions from ruminants is mainly dependent on the quality of their diet: the lower the quality the higher the amount of produced methane. The animal age also affects the methane emission level: usually the younger and more efficient animals produce less methane per kg of live weight than the older ones. The 2020 scenario for improved pasture would lead to a better ruminant diet and a higher proportion of younger animals in the national herd. Therefore, it is reasonable to assume that the emission factor (CH_4 per head per year) in the new scenario would be lower than currently. Presently, there are no measured values of methane emissions from ruminants fed with different types of pastures. A new research project is currently being conducted by INIA (Uruguay) and EPA (USA) to measure these emissions. Table 11 shows that if the emission factor of cattle and sheep in the new scenario were reduced by 5% or 10%, the new CO_2 balance would be a net sequestration of 3.15 million and 4.91 Ton CO_2/year, respectively.

Table 11. Estimated CO_2 balance for a doubling in the area under improved pastures by 2020 with current CH_4 emission factor and with 5% and 10% decrease

	With current CH4 emission factor	With 5% reduction CH4 emission factor	With 10% reduction CH4 emission factor
Increased C in new pastures (Ton CO2/year)	-5,021,500	-5,021,500	-5,021,500
Increased CH4 in new herd (Ton CO2 /year)*	3,624,829	1,868,868	112,907
Balance (Ton CO2 /year)	-1,396,671	-3,152,632	-4,908,593

Note: a negative CO_2 balance indicates net sequestration.

A final note should be made regarding the impact of improved pastures on the soil carbon balances: the expected changes in soil carbon due to the increase in the area of new pastures were calculated with current pasture composition. The changes in soil carbon under improved pastures depend on the botanical composition and on the persistence of the pastures. As discussed in section 8.1.1, pastures have been managed in ways that do not optimize their persistence due to unbalanced botanical composition (i.e., legumes tend to disappear after the second year). It can reasonably be assumed that in the next 20

33 These estimates are derived from discussions with experts from the Ministry of Agriculture of Uruguay (M.Methol and J.Peyrou, OPYPA, MAF)

years research will come up with better technologies and better adapted pastures and farmers will improve pasture management. Therefore, it can be expected that the amount of carbon in soils under improved pastures will also increase. Assuming that the newly improved pastures result in a 5% higher uptake of carbon in the soil than under current pastures, the new CO_2 balance for the national livestock production system would result in net sequestration of 5 million Ton CO_2/year.

The results of this exercise provide pointers for the direction of future policies and development plans. If the World Bank's predictions are correct, and world meat demand increases in the next 20 years, it is logical to expect that the market will stimulate farmers to improve the productivity of their herds. Therefore, the area of improved pastures is likely to increase without any governmental actions. However, the government can undertake policy measures in two areas, which can result in increased net sequestration. On the one hand, research should be aimed at technologies improving the productivity and persistence of the sown pastures. This would improve livestock productivity and also increase the amount of carbon stored in the soils. On the other hand, there is a need to address the issue of methane emissions from livestock. First, Uruguay needs sufficient national data on emissions from different animal species fed with different diets. Second, technologies should be explored that reduce the amount of methane emitted by ruminants.

8.3.2.2 Annual crops

According to the study conducted by the World Bank discussed earlier (Rosegrant et al. 2001), global cereal demand is also expected to grow within the next 20 years: 49% in the developing and 13 % in the developed world. This increase in cereal production is expected to be due to higher yields, since cereal areas are expected to grow only in Sub-Saharan Africa and Latin America. An addition, soybean production is expected to grow in Latin America by more than 80% in next two decades as a result of increases in Brazil and Argentina. The World Bank study points at MERCOSUR as one of the regions with best potential to increase its grain production. Given the expected rise in demand, it is estimated that the annual crop area will increase. The arable land in Uruguay is approximately 3.5 million hectares (OPP 1992). Historically, the maximum area of the country sown with annual crops has been approximately 1.4 million, indicating a large potential for growth. It is also expected that the mean yields obtained by farmers will continue to grow, thanks to the application of new technologies, including the expansion of irrigated crop areas.

While increasing the annual crop area, it is important to ensure the conservation of soils. Development plans and legal actions must aim at stimulating the use of minimum or no-till practices. The characteristic mixed crop-livestock production systems of Uruguay are expected to be maintained during coming decades. Therefore, it is also expected that annual crops will alternate with sown pastures (grasses and legumes), a key condition to ensure adequate return levels of carbon and plant nutrients to the soils. The cumulative effect of applying improved technologies and increasing the area of no-till cropping systems rotating with sown pastures is expected to be higher crop yields and more sustainable production systems. At the same time, if growth in the no-tilled cropping areas is accompanied by a proportional growth in the area of sown pastures, these same actions would enhance the carbon sequestration capacity of the agricultural soils. Finally, in case of a global carbon market, these practices could also generate additional income to farmers through carbon certificate trading.

Two paths are possible to ensure an enhancement or maintenance of the carbon sequestration capacity of the agricultural soils: (a) convert as much area as possible of the croplands that are currently under conventional tillage to no-till systems, and (b) ensure that the growth in new areas of annual crops is followed by a proportional increase in the areas with sown improved pastures.

No-till practices have already been adopted in more than 30 % of agricultural areas, mainly due to economic advantages (reduced cost of production) and practical reasons (better opportunities to perform field operations on time). The Soil Conservation Law (passed in 1982) and the accompanying education campaign on preventing soil erosion were also driving factors. Further adoption of the no-till system may be stimulated by recognizing its environmental services such as carbon sequestration or biodiversity enhancement. For example, at current annual crop yield levels, the conversion of soils under conventional tillage to no-till enhances the soil carbon content by about 10%.[34] However, increasing crop yields with improved cultivars, adequate fertility and water management would also increase the amount of residues left in the soil, and therefore the carbon content would also be higher. During the last 20 years, most crop yields have increased by 30-80%, and maize and sunflower have increased by 100-200%. It is therefore reasonable to expect that the crop yields will continue to increase, although at lower rates. In order to estimate the impact of different agricultural practices, four possible scenarios were envisioned for 2020, given a doubling of the 2000 annual crop areas (to 1.06 million ha).

Table 12. Net carbon and CO_2 balances for four scenarios varying in crop productivity, annual crop areas under no-till and conventional tillage, and area under improved pastures

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Crop productivity	as of 2000	+20%	+20%	+20%
Annual crop areas under conventional tillage	50%	50%	25%	25%
Annual crop areas under no-till	50%	50%	75%	75%
Area under improved pastures	as of 2000	as of 2000	as of 2000	+100%
Million t C/year	0.725	-0.131	-0.264	-1.633
Million t CO_2/year	2.660	-0.480	-0.966	-5.988

Note: positive values indicate net emission and negative values indicate net sequestration.

The results shown in Table 12 indicate the importance of both, increasing the crop productivity which results in increased crop residues returning to the soil (moving from scenario 1 to scenario 2), and the importance of increasing the area under no-till systems (moving from scenario 2 to scenario 3). However, the largest impact on the ability to sequester carbon is achieved by increasing the area under improved pastures (moving from scenario 3 to 4). Adding the increased methane emissions due to changes in the national herd as discussed in the previous section will result in net CO_2 sequestration of 2.37 million tons CO_2/year (under current CH_4 emission factors) or 4.12 million tons CO_2/year (under 5% reduction of current CH_4 emission factors). In addition, increasing the area under no till would have positive impacts on the whole agricultural sector. First, no-till would lead to a decline in fuel use (which would further reduce CO_2 emissions), and a decline in production costs. Second, losses from soil erosion could be reduced and less sediment would drift into streams and rivers.

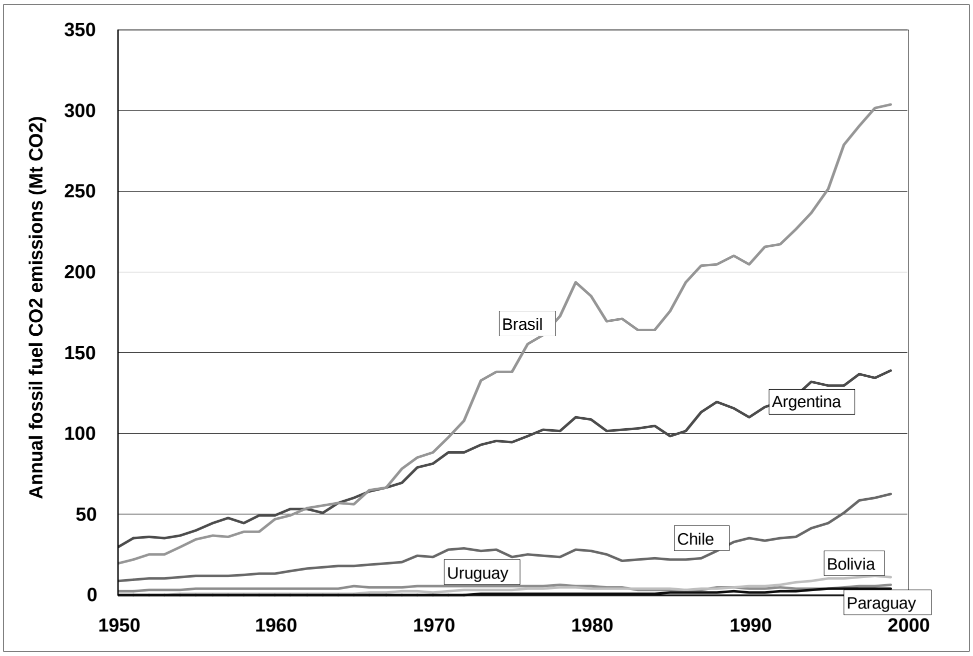
8.4 Increasing the use of renewable energy sources from agriculture and forestry

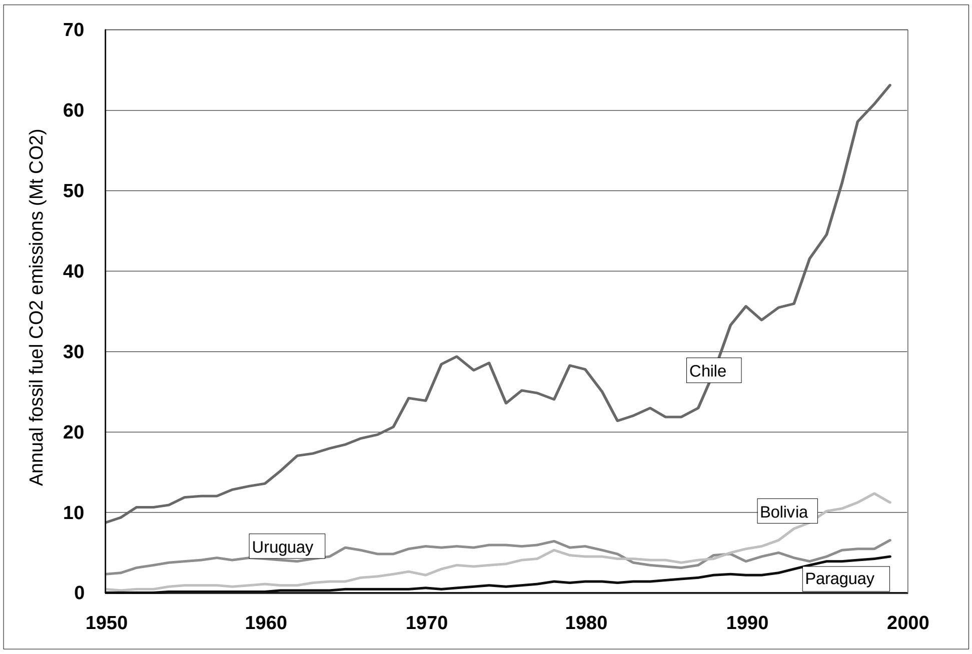
Uruguay's economic growth during the last 40 years displayed a decreasing correlation with its energy use, although energy consumption has been rising over the last 15 years by 2.3% annually, mainly driven by a rise in electricity and diesel fuel consumption. These trends are expected to continue (Uruguay

34 The 10% increase in soil carbon when switching from conventional tillage to no-till comes from IPCC methods. All croplands soils in Uruguay are high activity clay soils. IPCC estimates that for these soils, when natural vegetation is converted to crops, soil carbon is reduced by a factor of 0.7. If the crops are sown with conventional tillage the IPCC tillage factor is 1.0, and if the crops are sown under no-till the tillage factor is 1.1. In other words, cropping systems in equilibrium under no-till are expected to have 10% more carbon than cropping systems under conventional tillage. On the other hand, work conducted in Uruguay with the Century model also shows that switching from conventional tillage to no-till systems, results in increases in soil carbon that are often more than 10% (depending on the soil type, the crop/pasture rotation, and the previous management). When erosion losses are considered, the estimated gains in soil carbon under no-till (very little or no erosion) are often larger than 10% increase over conventional tillage. In summary, the 10% increase in soil Carbon expected when switching from conventional to no-till may be in fact conservative.

2002b). During the period 1965-2000 Uruguay's economy grew by 120%, whereas CO_2 emissions remained stable at 4-6 Mt CO_2/year (ca. 2 t CO_2/person/year), with a slight increasing trend in the last few years (figure 11).

Figure 11. Evolution of fossil-fuel related CO_2 emissions in Uruguay and several South American countries





Source: adapted from Marland et al. 2003

Energy consumption is expected to increase in the next 12 years at a rate of at least 2% per year (Uruguay 2002b) mainly driven by the services sector, residential consumers and agri-industry (including wood manufacturing). Since hydroelectricity capacity is fully utilized, additional demand will likely be satisfied by natural gas. The government is planning to promote the construction of a new 150 MW thermal plant based on natural gas. This plant alone, when in full operation, would increase emissions by 0.8 Mt CO_2/year i.e. an increase of 10% in the current emission level. Using natural gas to meet the additional demands for electricity would entail other problems besides the associated increase in GHG emissions. Uruguay has already a large dependence on foreign energy sources (60% of the total energy is imported), which would worsen in case of an extensive use of natural gas. Also gas supply may be erratic with frequent shortages in winter months, precisely when demand is highest. Finally, centralized electricity generation based on large thermal plants is inefficient and may cause negative environmental impacts.[35] The government should therefore consider reducing, and eventually eliminating, the country's dependence on imported fossil fuels. Agriculture and forestry activities provide two major options, towards that objective, through substitution of fossil fuels with fast growing energy sources: mineral diesel and electricity.

8.4.1 Electricity from biomass

Wood and crop residues could provide enough energy to meet the increases in demand and thus, help maintain Uruguay's energy-related emissions at its currently low levels. Since 1997, private-company electricity generation has been possible, although transmission and distribution remain State monopolies. Private generators can sell electricity only to large consumers (i.e., consumers with installed capacity of more than 0.5 MW), paying a transmission fee to *UTE*, the State utility. Wood for energy could be obtained from harvest residues (i.e., logs with reduced diameters), from industry residues (sawdust, chips, etc.), or from plantations specifically designed for energy purposes. By 2008, total supply from these three sources could amount to more than 5 million m^3/year, which is enough to feed electricity generation units with a total power of 150 MW, plus a variable supply of heat in cogeneration facilities. Unlike the projected gas-fueled electricity plant, biomass-fueled generation will be highly decentralized, with several small plants of 1-5 MW dispersed over the territory, at short distances from forests or industrial sites.

Rice husks could be an additional raw material for electricity. As shown in Figure 6, rice production has been continually increasing over the last 40 years, having reached 1 million ton per year. There are several rice mills in the East and North West regions, where most rice fields are located. A small, but increasing, proportion of produced rice is being exported without local processing. There are approximately 120 thousand tons of husks potentially available for electricity generation each year. This could supply a few generation plants of 1-5 MW. Electricity production from wood and rice husks would have positive effects in terms of national trade balance, GDP, rural development, and employment. It would also improve the logistics of transmission and distribution, thus reducing energy losses due to long-distance transportation. Also, given the lack of investment capital, the gradual creation of biomass-fueled electricity generation is more feasible and seems more adequate than investing in a large natural gas plant right away.

The main obstacle facing electricity from biomass is its relatively high costs compared to hydro or electricity imported from Argentina. Thus, there is a need for policy development that recognizes the positive environmental and socio-economic impacts of biomass electricity, which are currently not considered by the market. One possible measure is the creation of a subsidy for renewable energy. Another measure to promote the production of biomass electricity could be to add transmission fees according to

35 The inefficiency of large thermal plants is related with distance between a) primary sources and generation facilities; and b) generation facilities and users.a) Transportation of natural gas over long distances implies losses due to gas leakage; transportation of fuel oil or wood over long distances implies high use of energy; etc.b) Transportation of electricity over long distances implies losses of energy due to heating of transmission lines; also, decentralized bioenergy generation allows for local utilization of heat besides power, so that the efficiency measured in terms of energy used/energy contained in raw material can be greatly increased.

real electricity transportation distances. In this way, a private generator would be able to optimize location of the generation site according to the distance to potential buyers.

8.4.2 Biofuels

Diesel oil is the preferred fuel used in the transport and agriculture sectors in Uruguay. Annual consumption is approximately 750 million liters, causing emissions of 1.9 Mt CO_2 per year. Almost one half of the diesel used is imported, whereas the other half is produced locally from imported oil. Thus, fuel is completely obtained from foreign sources. Therefore, the national economy is quite vulnerable to fluctuations in international oil prices. Oil crops have traditionally been planted in the Western region of Uruguay. Sunflower and soybean are currently the main crops, covering an area of 250 thousand ha (2002/03 season). Vegetable oil is also obtained from rice industry residues. Other oil crops such as canola may become significant in coming years. Total grain production for the 2002/03 season is expected to be 200 thousand tons of sunflowers and 150 thousand tons of soybeans. A fraction of this production (50 thousand tons of sunflowers) is processed by the local oil industry, the rest being exported with little added value. Bio-diesel could be produced from nationally produced vegetable oil, and blended with mineral diesel. Trucks and farm tractors are designed for using mineral diesel fuel. Bio-diesel mixtures of up to 20% (B20 grade) could be used without any engine adaptations. The use of higher-grade mixtures or even pure bio-diesel would require new engines, or engine modifications in currently used equipment. Producing enough bio-diesel to mix with the entire diesel fuel consumed in the country would take a large oil crop area (more than 300 thousand ha of soybean or 220 thousand ha of sunflower exclusively for fuel production). Achieving this objective would take a period of possibly more than ten years, and would avoid the emission of 0.4 Mt CO_2/year, or 7% of the current CO_2 emissions from fossil-fuel burning.

Besides climate change mitigation, a policy aiming at the complete adoption of B20 bio-diesel would have positive environmental and socio-economic impacts such as the creation of jobs, particularly in rural areas, thus contributing to stopping or reversing current migration trends from these areas to cities; the reduction of Uruguay’s dependence on foreign oil; the improvement of the agricultural sector through the diversification of markets for oil grains; extended lifetime of tractor and truck engines by using bio-diesel; and finally reduced emissions of fine-particulate matter, ozone and sulfur oxides resulting from fuel burning, thus reducing incidence of cardio-respiratory and other diseases, particularly in populated centers. Similar to biomass electricity, the adoption of bio-diesel while desirable in terms of sustainable development faces high costs relative to mineral diesel. A study by OPYPA (2001) showed that only when the ratio of mineral oil to oil grain prices is extraordinarily high, as witnessed during early 2001, bio-diesel would be competitive under free market conditions. A recently passed law (No. 17567) entitles the Executive Power to grant tax exemptions to nationally produced alternative fuels. This may become a good policy tool, since mineral diesel is already heavily taxed. One possible measure would be to reduce taxes on the mineral diesel component of bio-diesel mixtures.

9. Concluding remarks

Uruguay has several contextual characteristics that differentiate it from most other developing countries. It is located in a temperate region, has a relatively low population and population density, and at the same time its per-capita income and social infrastructure are closer to many industrialized countries than to the developing world. Nevertheless, Uruguay still has considerable exposure to climatic risks, with most of the current hazards being climatic in origin. Further, like many developing countries, a significant part of its national economy is dependent – directly or indirectly – on natural resources. Coastal resources are particularly vulnerable to climate change impacts through sea level rise and storm surges that directly affect wetlands, human settlements and critical economic activity in the coastal region. On the other hand, many other sectors dependent on natural resources – including forestry, agriculture and livestock – offer considerable potential for mitigating climate change through carbon sequestration. Natural resource management therefore is a critical link in Uruguay's efforts to both adapt to and help mitigate climate change. The synergies and conflicts faced in reconciling these climate change goals with development priorities in coastal zones, agriculture and forestry are therefore the primary focus of this analysis.

9.1 Climate trends, scenarios, and impacts

Uruguay has already witnessed several long term trends in climatic variables, although no attribution has been made. These include an increase of 200mm in annual precipitation in Montevideo since 1883, an increase of 0.5°C in air temperature, and during the last few decades an increase of 30% in the stream flow of the Rio de la Plata. Climate change scenarios from multiple general circulation models meanwhile show considerable convergence on continued warming, with country averaged temperature increases of 1.1°C by 2050 and 1.9°C by 2100. Climate models also project increased precipitation both in summer and winter, although there is considerably less agreement across climate models on such projections. The most significant impacts of climate change are projected to be on its coastal zones, both because of the higher certainty of sea level rise and the high exposure of critical economic and natural resources on the coastline. Impacts of climate change are considerably less certain – though still plausible – for agriculture, biodiversity, and water resources. Coastal zones therefore are the principal sector where there is a need to implement and mainstream adaptation measures.

9.2 Attention to climate concerns in development assistance and national planning

Being a relatively advanced country, Uruguay receives only limited amounts of development assistance – of the order of about US$ 20 million a year. In addition, the country receives a much larger amount of multilateral assistance in the form of loans (around US$ 300 million a year), particularly from the Inter American Development Bank and World Bank. An analysis of donor projects in Uruguay using the OECD/World bank Creditor Reporting System (CRS) database reveals that roughly 19-28% (in terms of investment dollars) and 17-19% (in terms of number of projects) of donor portfolios in Uruguay are affected by climate risks. This includes both activities in sectors which might be impacted by climate change and variability, as well as those development activities which may influence the vulnerability of natural or human systems to climate change. These numbers are only indicative, given that any classification based on sectors suffers from problems of over-simplification. Nevertheless, such estimates can serve as a crude barometer to assess the degree to which particular projects or development strategies may need to take climate concerns into account.

The strategy documents of most principal donors do not explicitly address climate change and sea level rise concerns. Several donors do however pay ample attention to weather and climate related risks. There are also a range of activities in key natural resource management sectors that serve to enhance adaptive capacity to climatic risks, even if they are not mentioned explicitly. Nevertheless, some programs, particularly related to coastal resource management could benefit from a more explicit consideration of climate change risks, particularly sea level rise. On the mitigation side meanwhile, there are at least a few donor programs that promote practices like conservation tillage in agriculture which could also play a role in carbon-sequestration.

Uruguay ratified the UNFCCC in 1994 and the Kyoto Protocol in 2001, and was among the first non-Annex 1 countries to submit its National Communication to the UNFCCC. National reports relating to other environmental conventions however pay little attention to climate change. This is particularly notable for the National Biodiversity Strategy and reports to the Ramsar Convention, despite clear climate change related vulnerabilities in these areas. A key step in the prioritization of environmental concerns in national policymaking was the creation of the Ministry of Housing, Land management and Environment and its National Environment Directorate in 1990, followed by the creation of a Climate Change Unit in 1994. The same year also marked the passage of an Environmental Impact Assessment Law. In 2000, the government enacted the General Environmental Protection Act, which not only serves as a formal framework for environmental protection but, at the same time, includes specific provisions for concerns such as climate change.

9.3 Towards mainstreaming of climate change responses in coastal zones, agriculture and forestry

The real opportunities for mainstreaming responses to climate change in national planning lie within the context of broader sectoral, environmental, and economic policies. This is true both for adaptation in vulnerable sectors such as coastal zones, as well as for mainstreaming carbon-sequestration within the agricultural, forestry, and energy sectors.

With regard to coastal zones, the in-depth analysis in this report identifies several adaptation responses and prioritizes three of them – coastal monitoring, restoration of coastal areas, and coastal management - following a screening and cost effectiveness analysis. The definition of "adaptation" used in this analysis includes both actions that somehow directly reduce net adverse impacts, as well as measures which help generate information or establish institutions that could eventually help reduce adverse impacts. This broader definition is necessary because in many developing countries even basic information such as monitoring data, which might be a prerequisite for appropriate response measures, is lacking. The measures identified have considerable synergies with existing regulations, such as the requirement of 250m setbacks under the Water Act of 1978, the Ecoplata program which has been initiated to promote integrated coastal zone management of the Rio de la Plata, the Biodiversity Conservation and Sustainable Development Program for the Eastern Wetlands, and the recent joint Uruguayan-Argentine initiative to carry out an environmental assessment of the Rio de la Plata estuary. The government has also carried out a number of activities over the past decade aimed at protecting coastal systems, including the demolition of illegal constructions in certain areas, preparation of an excellence plan for the Punta del Diablo, dune recovery programs in several municipalities, and establishing guidelines for land planning projects on the Atlantic coast. There are nevertheless some significant barriers facing the successful implementation and mainstreaming of coastal adaptation options – although, unlike many other developing countries, economic resources and lack of domestic technical capacity are not usually the key constraints. Rather, institutional factors which inhibit co-ordination across multiple stakeholder groups – as would be necessary for coastal monitoring and management activities – are often the most critical. In particular, further efforts might be required to encourage government authorities to share decision-making capacity with other stakeholders, and also to successfully engage private sector stakeholders such as the tourism industry in financing and implementing adaptation activities, particularly those related to the restoration of coastal areas.

Perhaps an even more significant intersection between sectoral and climate change priorities can be seen in the area of carbon-sequestration in the agriculture and livestock, and forestry sectors which are responsible for more than 80% of GHG emissions. What has been remarkable in the case of Uruguay is the impact of sectoral policies that were driven by conservation or economic development objectives on carbon-sequestration. Policies like the Soil Management Law passed in 1982 allowed the National Bank to condition its rural credit program to the application of soil conservation technologies, which had the ancillary benefit of significantly improving soil carbon levels. As a result of improved pastures and the use of conservation techniques in tillage, the amount of carbon sequestered in soil over the last twenty years has been at the rate of 1.8 million ton C/year or 6.6 million ton CO_2 equivalent/year.

Another key policy innovation was the Forestry promotion policy based on Law 15939 that was adopted in 1987. A key feature of this law – passed even before climate change became an international policy concern – was an explicit mention of the promotion of the "climate benefits" of forests. This law promoted plantations on "forestry priority soils" including soils with low agricultural productivity and/or high susceptibility to erosion through a comprehensive package of financial incentives including tax exemptions, subsidies, soft credits, and flexible rental contracts. The impact of this law has been remarkable – forest plantation area has increased from about 20 thousand hectares in 1987 to over 650 thousand hectares in 2000. The cumulative net carbon sequestration by forestry during 1988-2000 was 27.4 Mt CO_2, and an additional net sequestration of 108.6 Mt CO_2 is projected for the period 2001-2012. They have also resulted in the creation of 3000 new jobs during the 1990s (expected to increase to 18, 000 by 2020), and increased state revenues from taxes by $22 million/year.

Total carbon sequestration from sectoral policies in agriculture and forestry already sequester about 2.5 times the annual CO_2 emissions in Uruguay. There is at the same time further potential to sequester carbon while continuing to meet national development and conservation priorities. Better silvicultural management practices coupled with financial incentives such as long term loans have the potential to significantly improve forest productivity and carbon sequestration rates. Government policies could also facilitate the substitution of energy intensive products such as cement by durable wood products in construction activity. Meanwhile further increasing the area of improved pastures and better soil conservation can further boost carbon sequestration in soils, while better feed and a younger herd composition can reduce the methane emissions from livestock. There is also considerable potential to promote wood and rice husks in electricity generation, substitution of 20% of mineral diesel by bio-diesel produced from locally grown oilseed crops.

Thus the key message from the Uruguay case study is that strategic sectoral policies can in fact create considerable synergies between climate change objectives and natural resource management and economic development priorities.

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APPENDIX A. GCM PREDICTIVE ERRORS FOR EACH SCENGEN MODEL FOR URUGUAY

These tables show the predictive error for annual precipitation levels for each SCENGEN model. Each model is ranked by its error score, which was computed using the formula 100*[(MODEL MEAN BASELINE / OBSERVED) - 1.0]. Error scores closest to zero are optimal. For Uruguay, the first eleven models had significantly lower error scores than the remaining six; therefore, the latter six were dropped from the analysis.

Table A.1 Predictive errors for each SCENGEN model for Uruguay

	Average[a] error	Minimum error	Maximum error
Models to be kept for estimation			
MRI_TR96	29%	6%	46%
HAD3TR00	33%	28%	40%
CSM_TR98	40%	38%	45%
HAD2TR95	41%	34%	48%
ECH4TR98	41%	34%	49%
CCC1TR99	45%	32%	52%
LMD_TR98	46%	36%	58%
PCM_TR00	50%	42%	56%
CERFTR98	53%	45%	59%
CCSRTR96	53%	50%	58%
GISSTR95	56%	51%	61%
Models to be dropped from estimation			
GFDLTR90	57%	47%	69%
ECH3TR95	59%	48%	73%
IAP_TR97	61%	57%	64%
CSI2TR96	64%	63%	66%
BMRCTR98	81%	76%	87%
W&M_TR95	92%	0%	227%

a. SCENGEN outputs data for 5×5 degree grids. To estimate for an entire country, a 10×10 degree area was used and the data output from the resulting four 5×5 grids were averaged. The maximum and minimum of these four 5×5 grids are also reported.

APPENDIX B. LIST OF PURPOSE CODES INCLUDED IN THE SELECTION OF CLIMATE-AFFECTED PROJECTS, ORGANIZED BY THE DAC SECTOR CODE

DAC code	General sector name	Purpose codes that are included in the selection
110	Education	-
120	Health	12250 (infectious disease control)
130	Population	-
140	Water supply and Sanitation	14000 14010 14015 14020 (water supply and sanitation – large systems) 14030 (water supply and sanitation – small systems) 14040 (river development) 14050 (waste management/disposal) 14081 (education/training: water supply and sanitation)
150	Government & civil society	15010 (economic & development policy/planning)
160	Other social infrastructure and services	16330 (settlement) and 16340 (reconstruction relief)
210*	Transport and storage	All purpose codes
220	Communications	-
230	Energy	23030 (renewable energy) 23065 (hydro-electric power plants) [23067 (solar energy)] 23068 (wind power) 23069 (ocean power)
240	Banking and financial services	-
250	Business and other services	-
310	Agriculture, forestry, fishing	All purpose codes
320	Industry, mining, construction	-
330	Trade and tourism	33200 (tourism, general) 33210 (tourism policy and admin. management)
410	General environment protection	41000 (general environmental protection) 41010 (environmental policy and management) 41020 (biosphere protection) 41030 (biodiversity) 41040 (site preservation) 41050 (flood prevention/control)# 41081 (environmental education/training) 41082 (environmental research)
420	Women in development	-
430	Other multi-sector	43030 (urban development) 43040 (rural development)
510	Structural adjustment	-
520*	Food aid excluding relief aid	52000 (dev. food aid/food security assist.) 52010 (food security programmes/food aid)
530	Other general programme and commodity assistance	-
600	Action relating to debt	-
700*	Emergency relief	70000 (emergency assistance, general) #
710*	Relief food aid	71000 (emergency food aid, general) # 71010 (emergency food aid) #
720*	Non-food emergency and distress relief	72000 (other emergency and distress relief) # 72010 (emergency/distress relief) #
910	Administrative costs of donors	-
920	Support to NGOs	-
930	Unallocated/unspecified	-

* sector codes that are excluded in the second selection (low estimate).
# purpose codes that are included in the emergency selection

APPENDIX C. REVIEW OF NATIONAL AND INTERNATIONAL STRATEGIES AND REPORTS

C.1 UN Framework Convention on Climate Change (UNFCCC)

First National Communication to the UNFCCC (1997)

Uruguay was one of the first non-annex-1 (non-industrialized) countries to submit its National Communication to the United Nations Framework Convention on Climate Change. The vulnerability and adaptation assessments focused on two sectors: agriculture and coastal resources. In the agriculture sector, the main national crops would be vulnerable to increases in temperature, while the effects of precipitation changes are uncertain. Coastal areas are also at risk (particularly if sea level rise would exceed 0.5 m). In economic terms, the most vulnerable coastal areas are those with the highest population density. The National Communication also notes that changes in the coastal climate and environment have already been observed (but cannot be attributed with certainty to global climate change). In the light of these projections, and also given that Uruguay's current natural hazards are already predominantly climate-related, climate change is considered a serious threat.

For the agriculture sector, the National Communication proposes several adaptation options, some even crop-specific. Examples include better modeling, genetic improvement, and monitoring of pests and diseases. For coastal resources, the main adaptation options include integrated coastal management, land zoning (no development, or reconstruction, close to the coastline). For certain sections of coastal land, it is concluded that structural protection costs are lower than the costs of not taking measures.

Regarding mitigation, the National Communication identifies opportunities for improvements in the agriculture sector, including efficiency in fertilizer use, and particularly direct sowing (zero-tilling). In many cases, zero tilling practices yield economic benefits for agricultural producers, and also contribute to adaptation to climate change by reducing erosion risks. Hence, it offers win-win-win options, with economic, adaptation, and mitigation benefits. The forestry sector also accounts for an increasing number of sinks, and further emissions reduction programs are underway in waste management and cement and lime production.

C.2 UN Convention on Biodiversity (UNCBD)

Propuesta de estrategia nacional para la conservaction y uso sostenible de la diversidad biologica del Uruguay (1999)

Climate change is not mentioned in Uruguay's National Biodiversity Strategy. The second report to the UN convention on biodiversity mentions (in response to a question in the standard reporting format) that there have been initiatives to look at opportunities to utilize the Kyoto mechanisms under the UNFCCC to help protect biodiversity, but no details are given.

C.3 UN Convention to Combat Desertification (UNCCD)

2nd National Communication to the UNCCD (2002)

Uruguay's Communication to the UNCCD underlines the need for synergies between global environmental conventions (desertification, biodiversity and climate change). Concerns about climate change are put in the context of current weather –related risks, partly related to El Nino and La Nina. Adapting to, or absorbing the consequences of future climate changes would come at a high price. Its concern for climate change results in particular attention for mitigation, as well as the use of the Clean Development Mechanism. Adaptation does not receive much attention.

C.4 Ramsar Convention on Wetlands

National planning tool for the implementation of the Ramsar Convention on Wetlands (And the approved format for National Reports to be submitted for the 8th Meeting of the Conference of the Contracting Parties) (2002)

National report to the Seventh Conference of the Parties of the Ramsar Convention on Wetlands (1999)

Despite the vulnerability of Uruguay's wetlands to climate change and sea level rise, neither of these two documents for the Ramsar Convention mentions climate change. While the National Planning tool puts a high priority on cooperation between conventions, there are no linkages with the UNFCCC.

C.5 WSSD

Uruguay Country Profile (2002)

Climate change is not discussed in the WSSD country profile for Uruguay.

APPENDIX D. REVIEW OF SELECTED DONOR STRATEGIES

D.1 IDB Country Paper (2000)

The IDB Country Paper focuses mostly on economic development issues. In agriculture, the Bank will support (i) the development of productive chains in the livestock and crop-growing segments; (ii) the application of policies to control, oversee and unify sanitary standards, to facilitate access to regional and world markets; (iii) development of productive infrastructure (roads, electric power and irrigation); and (iv) implementation of programs to promote a more equitable distribution of the benefits of sectoral growth among the rural population. The paper does not identify potential opportunities for climate change mitigation in agriculture or forestry. In the environment sector, the IDB focuses on environmental land management, together with measures to reform and consolidate public administration. The Country Paper does not mention climate change, or current climate-related hazards. Coastal management is not discussed either.

D.2 World Bank

Country Assistance Strategy (2000)

At the time of this Country Assistance Strategy, the World Bank was reducing its lending program in Uruguay, essentially because the country had become too developed: "Given Uruguay's relatively high level of social and economic development, the time has come to consider a gradual reduction in support, reflecting the evolving nature of Uruguay's development challenges and the Bank's role. Uruguay has an income per capita of $6,180 (Atlas methodology), the sixth highest among active IBRD borrowers, and about 20 percent above the Bank's indicative threshold for initiating graduation. In PPP estimates, its income per capita rises to $9,480. Uruguay's social development indicators, in general, are among the highest in Latin America -- particularly in terms of poverty and income distribution. Still, there are areas in which more attention is needed, as employment opportunities shift to higher skills, pockets of poverty continue to exist and marginal zones where basic services are not yet up to standard, leading to an increased sense of exclusion among the poor segments of the population."

In the limited program that is proposed for the period 2001-2005, the Bank would focus its investment lending in areas where there is an important social or environmental dimension, and where the Bank's international knowledge would be crucial to project success. In terms of environmental issues, the World Bank notes the strong links between the natural resource base and Uruguay's economic performance: "Uruguay is blessed with a rich natural endowment. The natural soil quality and favorable climate facilitated the country's early accumulation of wealth during the late nineteenth and early twentieth, centuries. In addition to traditional livestock and agricultural sectors, important foreign exchange earnings from tourism depend on the natural beauty of the coastline. In brief, Uruguay is a country where the link between environmental-natural resource conservation and the economy are direct and obvious."

With these issues in mind, the country has been relatively successful in avoiding serious environmental degradation. Nevertheless, the strategy highlights a number or remaining issues, including pollution, particularly at the coast and contaminated river basins, and unsustainable natural resources management. Measures to address these problems will also contribute to adaptation to climate change. Nevertheless, priorities like management of coastal wetlands would benefit from an explicit consideration of trends in sea level (not mentioned)

Regarding global environmental issues, the strategy notes: "As a signatory to the United Nations Framework Convention on Climate Change, Uruguay has identified areas of opportunity to implement low-cost greenhouse gas mitigation measures. These include abatement of carbon dioxide emissions through energy conservation and of methane emissions from solid waste landfills." Mitigation options in agriculture and forestry are not mentioned.

A section on natural resource management highlights both the threats for the agriculture and livestock sectors, and the role of dry spells and other weather-related problems: "Inadequate natural resource management could jeopardize the otherwise promising performance of the livestock and agricultural sectors during the last decade. Poor water resource management is still widespread, leading to inefficient water use and increased pressure on water resources. The result is that these sectors have become exposed to recurrent dry spells. In addition, there are water quality problems in some sub-sectors. Livestock production, which has been dominated by extensive, low profit production systems, represented until recently little or no threat to natural resources management. However, exposure to prolonged periods of economic hardship and frequent weather-related difficulties are resulting in an over exploitation, and consequent deterioration, of the natural resource base."

The final section, on risks facing Uruguay and the Bank's operations there, highlights climate and natural disasters alongside the risk of economic deterioration (which is a current issue, given the destabilization of Mercosur due to Argentina's difficulties): "*Climate and natural disasters have to be considered as potentially very damaging*." A footnote highlights the fact that a significant shock, such as a change in commodity prices or a natural disaster, or a bank run, could pose serious financing constraints for Uruguay, despite its investment grade. The attention for climate-related natural hazards appears to have been triggered by the droughts in 1997 and 1999/2000, which severely affected some Bank's operations (see the discussion of the *Natural Resources Management and Irrigation Development Project* below).

In the light of all of these risks, the CAS states: "Yet, Uruguay has shown that it can adapt and move forward. The goal of the Bank is to help the country to continue along that path" Nevertheless, natural disasters are not addressed in the CAS or the Bank's assistance to Uruguay.

Country Assistance Strategy Progress Report, and Chairman's concluding remarks, Executive Director's meeting on Country Assistance Strategy Progress Report (2002)

In the light of the continuing regional economic difficulties, the Bank raised lending to Uruguay again, with a focus on adjustment lending, with special attention for social protection networks. Climate-related risks were not raised again.

D.3 European Commission (EC)

Country Strategy Paper 2001-2006 and National Indicative Program 2002-2006 (2001)

Given Uruguay's relatively high level of economic and social development, the EC development assistance is limited. It has three core areas: economic reform, modernizing the State; and social development. Climate risks do not directly affect these core areas. Nevertheless, several elements of the Strategy Paper touch upon climate-related issues.

For instance, the Strategy Paper reflects the impacts of extreme weather on Uruguay's economy: "weak performance continued throughout 2000, mainly as a result of the economic developments in its two neighbouring countries, Brazil and Argentina, a severe drought and the sharp rise in international oil prices." However, it does not address these risks in any other way. However, in a more general context, the Strategy Paper notes that Uruguay should diversify its economy to become less dependent on agriculture (and within agriculture on a few products only).

Regarding environmental problems facing Uruguay, the Strategy Paper notes: "environmental issues are of a cross-cutting nature through their various links to key sectors of the economy. Uruguay’s traditional livestock and agricultural sectors depend on the country’s fertile soil, while important foreign exchange earnings from tourism depend on the natural beauty of the coastline […]. In other words, Uruguay is a country where the link between environmental-natural resource conservation and the economy are direct and obvious."

In particular, for the forestry sector: "A good example of this is the forest situation in Uruguay. As a predominantly grassplains (pampas) country (75%), natural and artificial forests in Uruguay account only for respectively 3.6% and 4% of the total agricultural area (2000). An official policy of “forestry incentives” for industrial uses has been implemented for almost ten years and as a result the forestry industry has grown in this period. However, no governmental policy of “forestry sustenance” has been even discussed."

Furthermore, in a section on sustainable development, the paper identifies the following key issues:

1. Inadequate natural resource management which could jeopardise the otherwise promising performance of the livestock and agricultural sectors during the last decade;
2. Poor water resource management, leading to inefficient water use and increased pressure on water resources;
3. Threats to marine and coastal biota along the Uruguayan coastline (a.o.due to tourism). Marine biodiversity may be threatened by future oil spills and other pollution;
4. Environmental issues related to urban development (including tourism);
5. Strong pressure from private investors in real estate in the tourism sector. Parliament has already approved a general law on coastal areas management, which should regulate the impact of the lack of planning. However, despite the existence of a ministry dealing with the environment, there is no environmental strategy at the national level;
6. Lack of a strategy on water resource development and management, or an agenda on effective water governance (water & poverty, water & climate, water & sustainable development, etc.).

Several of these issues are affected by climate risks. While there is a *water&climat*e reference in item (vi), climate-related risks to agriculture and forestry, marine and coastal resources are not mentioned. Nevertheless, activities to address the problems listed above should also make Uruguay more resilient to climate change.

The EC's own environmental activities will focus on climate change and biodiversity loss, specifically by stopping deforestation and the degradation of forests. Such activities should contribute to both adaptation and mitigation of climate change. Specifically regarding mitigation, the strategy notes: "As a signatory to the United Nations Framework Convention on Climate Change, Uruguay has identified areas of opportunity to implement low-cost greenhouse gas mitigation measures. These include abatement of carbon dioxide emissions through energy conservation and of methane emissions from solid waste landfills." Agriculture- or forestry-based mitigation options are not discussed.

APPENDIX E. REVIEW OF SELECTED DEVELOPMENT PROJECTS/PROGRAMMES

Projects dealing explicitly with climate related risks

E.1 US Country Studies Program (USCSP)

The US Country Studies Program (USCSP) supported the preparation of the first Uruguay Climate Change Country Study, which was initiated in 1994. In particular, it resulted in plans for adaptation to climate change, focused on two sectors: (i) agriculture (crops, as well as related issues in soils and water resources), and (ii) coastal resources. The results of these studies were incorporated in Uruguay's first National Communication to the UNFCCC (see that section in Annex A).

The executing agency was the Comisión Nacional sobre el Cambio Global (CNCG), which was set up in 1992 to coordinate inter-institutional cooperation and development of an integrated national response to global change issues, in particular related to vulnerability and adaptation (mitigation responsibilities are concentrated in the National Environment Office of the Ministry of Housing, Land Management and the Environment).

Based on preliminary impact analyses, the study evaluates several adaptation options, and proposes a list of five priority measures:

1. Enhance seed banks and develop new cultivars;

2. Promote soil conservation and minimum tillage;

3. Plan coastal development in San Jose, and initiate a process of integrated coastal zone management;

4. Establish a regular monitoring system of the evolution of the coastline and related variables in order to track the impacts of climate change on the Uruguayan coast;

5. Disseminate information on climate change and its potential impacts with particular emphasis on adaptation and mitigation options.

For each of these measures, the report presents (limited) evaluations of economic, environmental and social impacts, and works out implementation schemes, including the identification of government agencies potentially responsible for the various tasks. The proposed measures are all no-regrets. For instance, soil erosion is a present problem, which could be exacerbated by higher temperatures (through a decrease in soil organic matter) and particularly higher precipitation and/or higher precipitation variability (although precipitation impacts are rather uncertain). The measures proposed include the promotion of soil erosion control, proper tillage orientation, and minimum-tillage farming options. Incidentally, the latter could also contribute to mitigation of climate change.

Similarly, the planning of coastal development in San Jose would also pay off under current climatic conditions, since retreat of beaches and eroding cliffs are already an issue of concern, particularly because it directly affects sea front houses, roads, and beach access. The study points out that San Jose still has options to plan for sustainable development of its coastline, since development has so far been limited. However, urban and industrial growth are on the rise. Hence, the sensitivity to accelerated sea level rise and other potential consequences of climate change is likely to increase, providing a strong rationale for proper planning. Proposed measures include enforcing setbacks, planning and directing urban growth and industrial development, identifying areas for tourist development, protecting natural areas, developing agriculture and afforestation policy, monitoring fishery development, and developing guidelines for waste disposal. In addition, the study recommends that Uruguay initiate an integrated coastal zone management (ICZM) process. Issues to be addressed by such management arrangements include controlling water runoff, restoring degraded areas of the coast, determining drainage capacity requirements, preserving coastal cliffs, developing emergency plans, and monitoring water quality for contaminants. Furthermore, the local integrated management committees should evaluate the costs and benefits of conflicting uses of the coastal zone and determine a proper balance between the preservation of the coastal environment and the development of its present and future uses for the benefit of the society.

E.2 UNDP/GEF enabling activity for the preparation of Uruguay's Second National Communication to the UNFCCC

UNDP is supporting the preparations of Uruguay's Second National Communication to the UNFCCC, including a third national Greenhouse Gas Inventory. Various sectors are identifying and evaluating mitigation and adaptation measures, including Energy; Transportation; Wastes; Agriculture & Fishing; Biodiversity & Water Resources; and Health.

Other development programmes and projects

E.3 World Bank Natural Resources Management and Irrigation Development Project Implementation Completion Report (2003)

The principal objective of the project was to develop and implement a soil and water management strategy focused on the development of irrigation and intended to increase, diversify and sustain agricultural output and exports. It had several subsidiary objectives:

a) Increasing investments in the sector, through the rehabilitation and development of irrigation and drainage schemes and related service infrastructure;

b) Strengthening the technical foundation and the regulatory framework of water use;

c) Establishing a policy on: (i) the operation and maintenance cost, and (ii) the capital cost recovery of investments;

d) Supporting agricultural diversification; and

e) Establishing the framework to improve the management of natural resources.

According the Implementation Completion Report, "the project's objectives implicitly recognized the importance of the agricultural sector in Uruguay and the need to intensify land use, where appropriate, by addressing one of the major constraints to agricultural development - that of unpredictable rainfall."

The project overall was successful, and progress was made in the areas of all subsidiary objectives. However, climatic circumstances severely affected the implementation of the project. In May

1997, the government formally requested to the Bank that the project would be amended to mitigate the effects of the serious and long-lasting drought that affected Uruguay that year. The modifications to the project mainly targeted livestock producers and included the drilling of wells and the provision of pumping systems, reservoirs and dairy equipment. The need to concentrate on such emergency activities caused significant delays in the implementation of the irrigation works. Just two years later, the project experienced adverse climatic conditions again: all of the technical and financial indicators were badly affected by the drought experienced in the spring of 1999 followed by the excessive rainfall of the winter of 2000

The evaluation notes that the Bank management showed "a pragmatic flexibility in the face of changing circumstances, particularly the exogenous factor of climate and the impact of macroeconomic difficulties of budgetary allocations this resulted in specific amendments which increased the Bank's financial contribution to investments, the extension of the closing date and the necessary adjustments to allow for the financing of specific activities to alleviate the impact of the severe droughts that affected the sector."

Interestingly, these climatic circumstances are listed under "major factors affecting implementation and outcome, outside the control of government or implementing agency". While this may be true for the amount of precipitation as such, the vulnerability of the sector to such conditions is an issue that not beyond the government or the Bank's control. The Project Completion Report does not discuss the potential increase in climate-related risks due to climate change.

Several subcomponents (the development of pilot micro-catchment areas; the soil and water management demonstration farms; and the subcomponent on applied research) included activities on conservation tillage, in partnership with the Uruguayan No Tillage Association (*Asociación Uruguaya Pro Siembra Directa* **-** AUSID). The linkage between tillage practices and GHG mitigation is not mentioned.

E.4 World Bank Second Transport Project, Project Appraisal Document (1998)

The Project Appraisal Document for this infrastructure project, which contains both road management and road upgrading components, makes no reference to natural hazards or climate change.

E.5 IDB M'Bopicua Port Project, Project Abstract and Environmental and Social Impact Report (2002)

This project will assist in the construction of port facilities for the wood and agriculture sectors, on the Uruguay River. No climate risks are mentioned in the project documents.

E.6 IDB Programa de Apoyo a la Gestión Ambiental (environmental management support program), Second project brief (Perfil II) (2001)

The project document highlights a number of environmental issues in Uruguay, which are to be addressed by better environmental management. They key problems are concentrated in the urban centers, but coastal degradation (partly due to coastal development for tourism) as well as land degradation (due to erosion and pollution with agrochemicals) are of increasing concern. This project aims to strengthen Uruguay's environmental agency, improving inter-agency coordination, involving civil society in finding solutions for environmental problems. While climate change, sea level rise are not mentioned in the project brief, the program is likely to contribute to Uruguay's capacity to deal with changing climatic circumstances.

E.7 IDB Farm Modernization and Development Program

Project brief, 1997

This program contains four components: technological development, quality control, marketing development, and institutional strengthening. The technological development component provides subsidies for eligible farmers who improve plant varieties; co-financing to validate and adapt new technology for farm production, market preparation, and processing; technical assistance; and training. Climate related risks are not discussed in the brief project description, but several of the project components would offer opportunities to limit climate risks in the agriculture sector.

Project summary (1997)

The Farm Modernization and Development Program (PREDEG) aims to raise the value of farm products and exports, through four components: (a) technological development; (b) quality control; (c) marketing development; and (d) institutional strengthening. Weather- and climate related risks, including related to water management, are not discussed. Neither are mitigation options, including those related to tillage.

E.8 IDB Agricultural Services Program, Executive Summary (not dated)

The program aims to boost agricultural efficiency to enhance the competitiveness of the sector. The Executive Summary mentions that opportunities to improve natural resources management and environmental conservation will be considered, but contains no further details. There are no references to climate, weather, water .management, or climate change mitigation.

E.9 IFAD National Smallholder Support Programme – Phase II, Report and Recommendation of the President (2000)

Although the causes have varied over time, rural poverty has been a persistent feature of Uruguay’s agricultural sector. Recent problems for agricultural smallholders include fluctuations on international agricultural markets and competition within the Southern Cone Common Market (MERCOSUR). This vulnerability is one of the main causes of rural poverty in the country, together with the fact that smallholder products are not linked to value-added marketing chains. IFAD's National Smallholder Support Programme aims to address these weaknesses, by supporting the creation of a permanent institutional framework to combat and prevent rural poverty, with components at the national and municipal level, including elements to involve beneficiary organizations, to improve support services and access to financial resources, decision-making and coordination mechanisms at the municipal level, and a participatory monitoring and evaluation (M&E) system. Climate-related risks are not mentioned (despite the large impacts of droughts and rainfall on the agriculture sector in the years just before the design of the programme).

APPENDIX F. DOCUMENTATION

Statistics

CRS database, OECD/World Bank http://www.oecd.org/htm/M00005000/M00005347.htm

Government documents

- National Climate Change Program http://www.cambioclimatico.gub.uy

UN Conventions

UN Convention on Climate Change (UNFCCC) www.unfccc.int

- First National Communication (1997)

UN Convention to Combat Desertification (UNCCD) *www.unccd.int*

- 2nd National Communication to the UNCCD (2002)

UN Convention on Biodiversity (UNCBD) *www.biodiv.org*

- Propuesta de estrategia nacional para la conservaction y uso sostenible de la diversidad biologica del Uruguay (1999)

Ramsar Convention on Wetlands www.ramsar.org

- National planning tool for the implementation of the Ramsar Convention on Wetlands (And the approved format for National Reports to be submitted for the 8th Meeting of the Conference of the Contracting Parties) (2002)
- National report to the Seventh Conference of the Parties of the Ramsar Convention on Wetlands (1999)

World Summit on Sustainable Development www.johannesburgsummit.org

- Cumbre de Johannesburgo 2002; Reseña de Uruguay

Donor agencies

EC

- Country Strategy Paper 2001-2006 and National Indicative Program 2002-2006

IDB www.iadb.org

- Country Paper (2000)
- Programa de Apoyo a la Gestión Ambiental (environmental management support program, Second project brief (Perfil II) (2001)
- Farm Modernization and Development Program, Project Brief (1997)
- M'Bopicua Port Project, Project Abstract and Environmental and Social Impact Report (2002)
- IDB Agricultural Services Program, Executive Summary (n.d.)

IFAD

- IFAD National Smallholder Support Programme – Phase II, Report and Recommendation of the President (2000)

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- US Country Studies Program (USCSP): www.gcrio.org/CSP/webpage.html
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- Contribuciones Técnicas, Apéndice B
- Contribuciones Técnicas, Apéndice C

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- Country Assistance Strategy (2000) (online at http://www.item.org.uy/CAS_2000/CAS_2000_0.htm)
- Country Assistance Evaluation, Operations Evaluation Department (2000)
- Country Assistance Strategy Progress Report (2002)
- Chairman's Concluding Remarks, Executive Director's meeting on Country Assistance Strategy Progress Report (2002)
- Second Transport Project, Project Appraisal Document (1998)
- Natural Resources Management and Irrigation Development Project, Implementation Completion Report (2003)