This Country Note briefly summarizes information relevant to both climate change and agriculture in Chile, with focus on policy developments (including action plans and programs) and institutional make-up.

Vulnerability Indicators

Employment in agriculture (%)
Non-insured cropland (%)
Soil degradation (%)
Water usage in agriculture (%)
Risk of extreme weather events (index)

**Note**: Employment in agriculture (% of total employment); Non-irrigated cropland (% of total cropland); Gini; Water usage in agriculture (% of total annual freshwater withdrawals); Insured cultivated land area (% of total cultivated land area); Soil degradation (% of total land); Risk of extreme weather events (index: annual average 1997-2006).

**Sources**: *World Development Indicators 2007, 2000-2007 average; **IADB, IICA, 2002/2003 figures; ***FAO AGL 2005; ****Germanwatch

Percent of GHG emissions in CO$_2$ equivalent, by sector (2000)

Energy 62%
Agriculture 15%
Land-Use Change & Forestry 17%
Industrial Processes 2%
Waste Management 4%

*Sources*: World Resources Institute http://cait.wri.org

Land use (2005)

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Arable</td>
<td>3%</td>
</tr>
<tr>
<td>Forestry</td>
<td>22%</td>
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<tr>
<td>Pasture</td>
<td>18%</td>
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<tr>
<td>Other</td>
<td>57%</td>
</tr>
</tbody>
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*Source*: World Development Indicators

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Relevant Reference Material

Working definitions

**Agriculture** is defined as a managed system of crops, livestock, soil management, forest resources (productive use, goods & services) and water resources (irrigation), including land use and land use change. **Climate change** encompasses both mitigation and adaptation activities within the agricultural sector. On the **mitigation** side, the focus is on the potential to reduce green house gas emissions by the different sub-sectors. On the **adaptation** side, the focus is on the potential to build resilience to climate and to increase the adaptive capacity through sustainable management of agriculture and other complementary factors (e.g. financial instruments). There is no specific **time frame** used in the country notes. An effort was made to collect the most recent available information on country indicators and policy matters.

Feedback

For comments and/or suggestions, please contact Svetlana Edmeades (LCSAR) at sedmeades@worldbank.org
Summary
This note summarizes information on climate change aspects in agriculture in Chile, with a focus on policy developments (including action plans and programs) and institutional make-up. Like most developing countries, Chile has only submitted one national communication to the United Nations Framework Convention on Climate Change (UNFCCC) with a second one being in the works. Agriculture contributes little, in relative terms, to total GHG emissions and the emission reduction potential in the sector is small, though carbon trading opportunities can be pursued. Agriculture is highly vulnerable to weather extremes, in particular in the Central parts of the country, where water scarcity is an issue. Desertification and soil erosion are some of the other major problems facing the country.

1. The Climate Context

Baseline map: Current Major Environmental Constraints related to Agricultural Potential

1.1. Country Projections

According to the First National Communication and to the vulnerability and adaptation to climate change study in Chile, the following future climate change related events are to be expected in the country for the future:

a) **increases in temperature** – in the north of Chile (Region I and II) the temperature will increase by up to 2°C by 2100 while as in the central part and in the South, it could increase by up to 3°C, according to three general circulation models (UKMO, GISS and GFDL);

b) **changes in precipitations** – a future scenario with a doubling of the CO2 concentration shows over a 30% variation in the annual rainfall over the next 40 years, such that an increase of precipitation in the altiplano will be recorded due to tropical cyclone activity, a decrease up to 20-25% in Second Region to Puerto Montt in the Tenth Region and an increase of precipitation from Chiloe to the south;

c) **changes in the water regime** – a decrease in yearly precipitation is expected in the central part of Chile, which, along with temperature increases, will lead to increased evapo-transpiration;

d) **changes in heat regimes** – the climate in the central part of the country will become warmer.

The Global Climate Risk Index constructed for the period 1997 and 2006 and covering both human and economic impact, ranks Chile 82nd out of 191 countries, underscoring the country’s vulnerability to climate related events.
In recent years (between 2000 and 2008), floods and extreme temperatures have had the highest human and economic impact in Chile, with losses for the period 1997-2006 averaging at 0.08% · 558,371 people (around 0.4% of population) have been affected by floods (7 events) with the cost of damages reaching US$ 0.2 billion and 25,000 (around 0.001% of population) people have been affected by extreme temperatures (1 event) with the cost of damages reaching US$ 10 million.

1.2. Agriculture-Related Impacts

El Nino has produced abnormally heavy rainfall, but also drought in some areas, such as Central Chile. The drought in Chile lasted several years, causing the loss of at least 8,000 hectares of wheat in 1998. A number of other crops could not be sown or were sown late because of lack of rainfall.

2. The Policy Context

Chile has submitted only one National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in February 2000. The Communication established the National GHG Inventory with 1994 as its base year, including agriculture, land-use change and forestry, it includes climate vulnerability scenarios for agriculture, water and forestry for the future 40 years as well as vulnerability studies and adaptation and mitigation measures to climate change in the farm, forestry and water sector. It also includes a brief description of the institutions involved in climate change related topics as well as future measures to be taken to improve agricultural and forestry practices.

A Second National Communication is in the works and scheduled to be submitted by 2010. It will contain a revised national GHG inventory, vulnerability studies, strategies and measures for regional and sectoral adaptation and formulation of policies for the development and implementation of adaptation strategies.

Chile is not included in the Climate Change Performance Index of 56 countries responsible for more than 90 percent of global energy related CO2 due to its overall relatively small contribution of GHG emissions to the atmosphere.

2.1. National Climate Change Plans, Strategies and Programs

In 2006, the Executive Council of the National Environmental Commission (CONAMA, Spanish acronym) approved the National Climate Change Strategy. The Strategy allows for a more coordinated, multi-sectoral and multidisciplinary approach to the issue of climate change and consist of three components: adaptation to climate change impacts, mitigation of GHG emissions and creation and fostering of climate change capacity. The Action Plan of the Strategy is in the approval stage by the same Executive Council of CONAMA.

2.2. Agricultural Sector Initiatives

3. The Institutional Context

The National Environmental Commission (CONAMA, Spanish acronym) is the national environmental authority created in 1994 and is also the Designated National Authority (DNA) on climate change to the United Nations Framework Convention on Climate Change in Chile. Its main function is to coordinate the environmental management of the state.

The National Advisory Committee on Global Change (CNAG, Spanish acronym) was created by the Ministry of Foreign Affairs in May 1996 with CONAMA as its Chair and the Ministry of Foreign Affairs as its Vice-Chair. The Committee’s main role is to advise the Ministry of Foreign Affairs on the definition of Chile’s position on the Climate Change Convention, to advise CONAMA on global change in Chile and the application of related plans and programs, to advise institutions working on global change research and to act as a coordinating body among all the organizations whose work is linked to climate change or global change. One of the main duties of the Committee has been the creation of the strategic guidelines on climate change in Chile.
3.1. Inter-Sectoral Coordination

The Climate Change and Agriculture Council\textsuperscript{15} was created in May 2008 under the wing of the Ministry of Agriculture and is comprised 22 professional from the academic, private and public sector. Its main objective is to design Chile’s response to the effects of global climate change by delineating the actions to be considered in an adaptation program to climate change in the agricultural sector, as well as the main mitigation measures to be considered in the same sector.

3.2. Agricultural Sector Institutions

The Ministry of Agriculture\textsuperscript{16} (MINAGRI, Spanish acronym) is responsible for the formulation of policies related to agriculture, livestock and natural resources, including forestry as well as it overseas climate change related programs and activities through its different institutions.

The Institute for Agricultural Research\textsuperscript{17} (INIA, Spanish acronym) is responsible for agricultural research and operates under the Ministry of Agriculture. It performs research and participates in workshops related to climate change and its impact on agriculture in Chile.

The Ministry of Public Works, through its Water Division\textsuperscript{18} (DGA, Spanish acronym) is responsible for the administration of water resources and their use, including in agriculture. Furthermore, it addresses the water scarcity in the country through its Inter-ministerial Committee for addressing drought problems.

The Foundation for Agrarian Innovation\textsuperscript{19} (FIA, Spanish acronym) is a private institution dependent on the Ministry of Agriculture that coordinates the efforts made by the farm sector in innovation activities. As part of this, it recently opened a session of “Studies about the impact, vulnerability and adaptation to climate change in the forestry and agricultural sector of Chile”.

The Chilean Weather Directorate\textsuperscript{20} (DMC, Spanish acronym) is responsible for providing weather information for aeronautical purposes and to other sectors of the economy and to realize research studies, among others on climate change issues as well as produces climate bulletins for the agricultural sector with information about extreme events such as frost periods, extreme temperatures, etc.

The National Forest Corporation\textsuperscript{21} (CONAF, Spanish acronym), under the Ministry of Agriculture is a government institutions responsible for the protection of national forests through various programs and actions (control of desertification, combating of forest fires) as well as conservation and forestation actions. CONAF also coordinates the implementation of the United Nations Convention of the Fight against Drought and Desertification through the National Action Plan against Desertification and Drought\textsuperscript{22} (PANCCD, Spanish acronym) which contains a climate change component.

The Agriculture and Livestock Service\textsuperscript{23} (SAG, Spanish acronym) is responsible, among others, for protecting , preserving and improving the natural resources used in agriculture.

The National Irrigation Commission\textsuperscript{24} (CNR, Spanish acronym) is responsible for implementing its own irrigation and drainage policies, programs and projects and promotes public actions oriented to agricultural development and training in the areas that benefit from irrigation projects.

3.3. Fostering Capacity to Deal with Climate Change

- **Emission inventory**: To date, Chile counts with one National GHG Inventory with 1994 as its base year. The inventory includes information on emissions from agriculture, land-use change and forestry, providing disaggregated information by type of emission and type of agricultural resource. A preliminary inventory to the 1994 one had been done in 1993 and it included non-energy-sectors as well (agriculture, land-use change and forestry) by type of gas.

- **Vulnerability studies**: Two vulnerability studies were conducted under the “Enabling Activities” program sponsored by the Global Environment Fund in preparation for the National Communication, as follows:  
  a) *Vulnerability and adaptation analysis in agriculture, forestry and aquifers* (1998)  
  b) *Vulnerability and adaptation analysis in coastal areas and fisheries* (1998)
c) Institutional adaptation to climate change project: Canada-Chile case study on adaptation to dry-land River basins aimed at developing an understanding of the capacities of regional institutions to formulate and implement strategies of adaptation to climate change risks in dry-land environments in the two region.

d) Climate Variability Study in Chile for the XXI Century (2007) realized by the Geophysics Department of the University of Chile for CONAMA in preparation for the Second National Communication.

4. The Impact of Agriculture on Climate Change - Mitigation Measures

According to the First National Communication, the land used for agriculture and forest plantations represents around 8% of the total surface area of Chile (75,609,600 ha). The forests only of the country cover around 20.7% of the territory. Agriculture accounts for 15% of total GHG emissions in the country in 2000, forests and land-use change for 17%.

Chile’s per capita carbon dioxide emissions in 2004 stand at 3.9 tCO2/capita (representing 0.2% of global emissions), compared to the Latin America region of 2.6 tCO2/capita and the world at 4.5 tCO2/capita.

4.1. Action Frameworks

4.1.1. Forestry and Land Use Change

Chile accounts for 0.5% of forested land worldwide and 1.9% in Latin America. The forests of Chile represent around 20.7% (30 million ha) of the territory: 48% virgin territory, 45% native forest and the rest of 7% forest plantations. Chile has had positive developments in this sector through increased forestation activities leading to an average annual negative deforestation rate (actual reforestation) of -0.4% for the period 1990-2005, as compared to 1990-2000 when deforestation stood at 0.1%.

According to the National Communication, the land-use change and forestry sector in 1994 shows a net capture of 29,709.3 GgCO2, coming mainly from the regeneration of native forests in a huge abandoned area (57.6%) and from the expansion of forest biomass, mainly through planted forests (42.4%). The burning of forest mass and burning of agricultural waste are the main responsible for CO emissions (4.9%). Forest fires in 1994 consumed large areas of forest plantations and native vegetation, leading to emissions of CO2 of 7,856.34 GgCO2 (13.5% of total emissions).

The government of Chile has introduced new measures aimed at improving forest management through a new law which allows for a one time tax credit for the following activities: i) reforestation of fragile soils, marshes or areas threatened by desertification; ii) recovery and forestation activities for eroded non-arable dry soils and iii) sand dune stabilization and forestation.

CONAMA sponsored a few projects in the forest sector aimed at a better understanding of the role of forests in the carbon market:

- “Rio Condor Carbon Sequestration” in collaboration with Fundacion Chile
- “Measuring Carbon Capture in Chilean Forests and its Promotion in the World Carbon Market” in collaboration with the Southern University of Chile and
- “Demonstrating the increase in carbon capture in Chilean forests by inoculating seedlings” in collaboration with the Forestry Institute.

4.1.2. Livestock

Livestock (domestic cattle raising) is the main responsible for the emissions of methane in Chile in 1994, representing 62.2% of total emissions (313Gg CH4) from non-energy related sources and 97% of total emissions from the agricultural sector alone. The main source for this is enteric fermentation from farm animals and emissions from animal manure.

4.2. Carbon Trading and Agriculture
5. Impact of Climate Change on Agriculture - Adaptation Measures

Chile is taking its first steps in implementing adaptation initiatives. A National Adaptation Plan is currently being developed and is scheduled to be implemented by the year 2012. Furthermore, there is an agreement between the Office of Agrarian Studies and Policies (ODEPA, Spanish acronym), FIA and CONAMA to study the adaptation of the forestry sector to climate change leading to the formulation of a specific adaptation policy for the sector by 2009. There are also various studies evaluating the impact of climate change on specific productive sectors of the economy. It is worth mentioning that there are no specific adaptation programs currently in place, designed to address the issue of climate change, but rather sectoral public policies with a climate change component (such as the fight against desertification and drought). These are described in more detail below.

5.1. Action Frameworks

5.1.1. Land Management

The agricultural sector and primarily soil cultivation, is the main responsible for NOx emissions in 1994 with 50.8Gg/year (42.7%). The use of nitrogen based fertilizers is the source of a large part of these emissions. The intensity of fertilizer use in Chile of 207kg fertilizers/hectare of cropland in 1998 is way above the OECD average and the Latin America and the Caribbean average of 74kg/hectare of cropland. In the 1980s the use of fertilizers in Chile increased by more than 223%. Soil erosion is one of the main problems facing the country with 46.8% of the national territory being affected by it and 75% of the productive soil. Some of the main causes for this are deforestation to make space for crop cultivation, overgrazing of livestock, excessive use of land for agriculture and forest fires.

The Institute for Farm Development (INDAP, Spanish acronym) along with the Farm and Livestock Service (SAG, Spanish acronym) administer a program titled Soil Recovery Program aimed at reverting the soil erosion process and the rapid salinity of these by offering cash incentives to producers that execute proper soil management and recovery practices. As a result of this program, around 1.7 million ha were improved for the period 2000-2005, corresponding to 40% of the land with erosion and/or salinity problems and around 30% of the land devoted to agriculture.

For the period 2000-2005, the National Action Plan against Desertification and Drought (PANCCD), aimed at reverting the process of desertification and drought affecting Chile through various government programs and actions, attracted public investments of US$ 480 million, covering an intervened surface of 2.4 million ha benefiting 414,000 persons affected by these events. Desertification currently affects two thirds of the national territory in Chile.

5.1.2. Water Use

Agriculture is responsible for 63.6% of total water withdrawal in the country. Around 1.2 million ha of agricultural land is irrigated, representing 85% of all land devoted to agriculture, and 52% of cropland (around 2.3 million ha).

The Irrigation Development Program for Poor Areas (Programa Desarrollo del Riego en Comunas Pobres) administered by the National Irrigation Commission is designed to provide subsidies for poorer farmers for on-farm irrigation that are received only once the work is done.

The Associative Irrigation Works Program (Programa de Riego Asociativo/Bono al Riego) administered by INDAP provides subsidies for small scale farmers that are associated for the investment in irrigation or drainage work.

The Rural Community Local Conservation Project (CIDA) focuses on the three poorest municipalities in the Coquimbo region of Chile by delivering education and training programs aimed at improving the ability of rural women, non-government organizations and government agencies to address sustainable water management issues for rural communities affected by desertification and the impacts of climate change. Its goal is to improve water security and water quality for the poorest rural communities in the region and to enhance leadership capacity among rural women for water management.
5.3. **Social Aspects**

Chile ranks 40 out of 177 nations in the Human development Index of 2005. In terms on inequality, it ranks 6th in Latin America, amongst the most unequal nations in the region, after Paraguay, Colombia, Brazil, Panama and Guatemala, with 5.6% of the population living on less than $2 per day.\(^4\)

In terms of social vulnerability, the high percentage of migrant and temporary agricultural labor employed in the fruit industry, are the most exposed to any shocks in the industry, including climate risk, given their low capacity to organize themselves and seek social safety either from their employer or from the state (in 1998, only 7% of them were organized in unions). The majority of them do not own their own housing and are solely reliant on the wages they receive. Fruit production has already begun declining since the early 1990s due to drought, soil mismanagement and growing indebtedness among growers\(^4\).

The forestry sector in the South of the country represents another area of potential social vulnerability in that in this region, the forestry sector represents the only employer. Thus, any disruptions in the industry are likely to have negative social impact. Given that this sector often pays sub-standard wages, most of the population employed in it does not have the assets necessary to re-locate or easily change their livelihoods\(^4\). More attention needs to be given to social protection networks in the area.

The **Chile Solidario**\(^4\) program was launched in 2002 by the government and had reached out to 225,000 families by 2005, living in extreme poverty in 13 regions of the country’s 15 regions. It provides a range of services within three main pillars: i) personalized psycho-social and financial support to families for two years, complemented by support in finding employment, housing and other basic necessities, ii) two-year conditional financial support to either families with children under 18 who are enrolled in school, or senior adults or people with disability, who attend medical services regularly; iii) 100% subsidy for potable water consumption of up to 15 cubic meters for eligible families.

The **Local Rural Communities Development Program (PRODESAL)** (Spanish acronym) is executed through rural municipalities with a high incidence of poverty. It consists of a series of subsidies providing technical assistance for primary production, environmental improvement and organizational development.

The **Indigenous Development Program (ORIGENES)** (Spanish acronym) is implemented at the national level with the help of several ministries and is aimed at promoting the economic, social, environmental and cultural development of indigenous areas. INDAP, as a co-executor of the program, participates with subsidies for technical assistance for agricultural, livestock and irrigation activities.

The **Rural Women Training Program (PRODEMU)** (Spanish acronym) designed to promote the participation of poor women in the society. INDAP provides subsidies for training in different areas of agricultural activities.

5.4. **Coping with Risk**

**Relevant Reference Material:**

1. General information on the linkages between climate change and agriculture can be found at http://en.wikipedia.org/wiki/Climate_change_and_agriculture, including the references and links provided.
3. General information on the linkages between climate change and agriculture can be found at http://en.wikipedia.org/wiki/Climate_change_and_agriculture, including the references and links provided.