Plurinational State of Bolivia
Second National Communication
Executive Summary

Summary

1. CONTEXT

The Plurinational State of Bolivia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and recognizes it as an instrument that should provide the basis for fulfilling the responsibilities of all. States have elements in common but are also differentiated, and the UNFCCC can contribute to achieving important common objectives. In this context, Bolivia is pleased to present its Second National Communication with the firm conviction that it is advancing in implementing the Convention, within its capabilities.

In 2000 Bolivia presented its Initial National Communication to the Convention, at the Sixth Conference of the Parties, as an initial effort to assess the implications of climate change in a country with diverse national circumstances.

The Second National Communication (SCN) comes out of the support of multilateral cooperation established for all non-Annex I to the Convention, under the Global Environment Fund (GEF). Bolivia has made use of these resources to strengthen national capacities. For instance, the SCN project was created under the National Program on Climate Change (PNCC), directly linked to the newly created Ministry of Environment, Biodiversity and Climate Change (MEBCC), which demonstrates the importance assigned by the Government to the issue of climate change.

Bolivia is designing and implementing a new economic model in which the state plays a strategic leadership role aimed at generating a surplus for the national benefit of the majority. At the same time Bolivia, through this document, reaffirms its position in relation to the international negotiating process of the Convention, while emphasizing the need to strengthen the level of commitment, to the Convention, of the countries primarily responsible for climate change.

The document presents 2002 and 2004 GHG inventories and also a very detailed report of the evidence of climate change and climate scenarios for the main sectors of the economy of the country, reaffirming clear and scientific evidence of climate change, such as the shrinkage of glaciers, the increase in occurrences of extreme weather events that are causing major economic losses as well as negative impacts on health, agriculture, infrastructure and the economy.

This Second National Communication shows how the Plurinational State has been working on the generation of a National Mechanism for Adaptation to Climate Change, which plays a strategic role in tackling climate change in all sectors of national economy and must transcend the different territorial levels. The SNC also describes actions in capacity building, dissemination, awareness on climate change issues, and the proposal of an Education strategy at all levels to address climate change. Finally, the SNC presents the gaps that need to be addressed to manage climate change. Addressing these needs is recognized as a part of the Convention and are more fully described under Articles 4.3, 4.4 and 4.5.

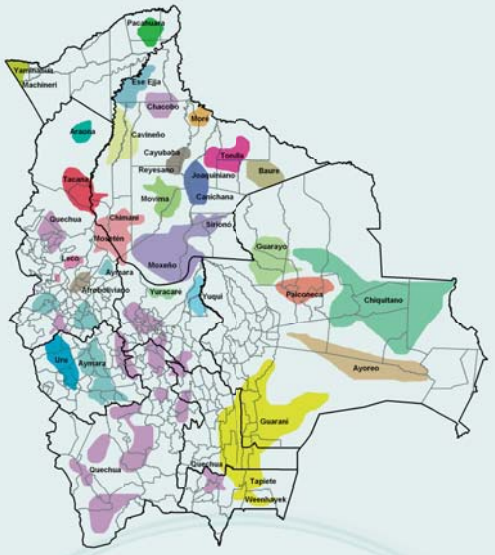
2. NATIONAL CIRCUMSTANCES

2.1. Territorial and Population Characteristics

The Plurinational State of Bolivia is located in the center of South America. It is a large country with an area of 1,098,581 square km. The country has a strong influence of the Eastern Cordillera of the Andes and, to a lesser extent, of the Cordillera Occidental.

The country identifies three major watersheds that divide the mountain water runoff: the River Plate, the Amazon and the "Altiplano" (high plateau) which is a closed basin or endoreic. Each presents diverse ecosystems with clear transition zones characterized by steep gradients and change of vegetation coverage. The watersheds typically begin with high snowy peaks, enter arid and semi-arid mountainous landscapes and descend into the subtropical lowlands of the Yungas.

The New Political Constitution recognizes 36 indigenous nations: Aymara, Araona, Baure, Besir, Canichana, Cavineño, Cayubaba, Chácobobo, Chiman, Ese,Ejja, Guarani, Guaru'suwe, Guarayu, Itonama, Leco, Machajuyai-Kallawaya, machineries, Maropa, Mojeno-Trinitarian Mojeno-Ignatian, More, Moseten, Movima, Pacawara, Puqina, Quechua, Siriono Tacana, Tapiete, Toromona, Uru-Chipaya, Weenhayek, Yaminawa, Yuky, Yuracare and Zamuco.



Location Map of Bolivia's Native People

Bolivia's population is 10,027,643 inhabitants (INE Data, 2008). Economically Active Population (PEA) is primarily in low-tech agriculture with limited access to inputs. Most high-tech, agro-industrial and export crops activities are located in Santa Cruz. This accounts for 80% of the conversion of forest to agricultural land and makes a significant contribution to Gross Domestic Product (GDP) from agriculture. Other economic activities, such as oil, mining, industrial also employ a large part of the economically active population.

2.2. Social Situation & National Response

Bolivia ranked 113 of 118 countries in the 2009 Human Development Index of the United Nations Development Programme (UNDP). Clearly, the country faces challenges in terms of achieving the Millennium Development Goals (MDG's) and, as such, has embarked on an ambitious plan to support the development of the under-privileged majority. In 2006, Bolivia began the process to nationalize natural resources and to redistribute national income. As part of this process a new and inclusive Constitution was drafted, laying the groundwork for the implementation of a new economic model.

The new "National Economic Model" defines as essential the state's participation in food production and in the industrialization of natural resources to supply both internal and external markets. The State now generates 22% of gross domestic product (GDP), of what is produced in the country. The small and medium producers account for 35 percent of GDP. Together the two have 56% of GDP constituting a new power bloc: the state with resources and small and medium producers.

The National Economic Model has five pillars: 1) Expansion of the National State; 2) Industrialization of Natural Resources; 3) Modernization and professionalization of the Medium and Small Enterprises (urban and rural production); 4) Satisfaction of the Domestic Market and Export of residual production; and 5) Redistribution of wealth. In this context, the vision of Plurinational State established in the National Development Plan (NDP)[1], strives to achieve economic, social and community development through application of the following development principles: Dignity in Bolivia, Democratic Bolivia, Sovereign and Productive Bolivia, and Bolivia with macroeconomic sustainability.

2.3. Economic Situation

The Bolivian Gross Domestic Product (GDP) grew from Bs.51.9 million in 2000 to Bs 95.7 million in 2008. The projected real growth in 2009 is between 3 and 4% (IMF)2.This growth has taken place despite the global financial crisis, thanks to

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1 *National Development Plan, approved by Supreme Decree No. 29,272 dated 12 September 2007.*

2 *Gilbert Terrier. Assistant Director Western Hemisphere Department International Monetary Fund (IMF)*

prudent economic policies implemented in the country. For instance, tax revenue and accumulated international reserves from the period 2005-2007 were utilized to soften the impact of global financial crisis.

Bolivia increased per capita GDP from US$ 1,010 (2005) to US$ 1,651 (2009). Public investment increased from US$629 million in 2005 to US$1.8 million in 2009. External debt declined from US$ 4.4 to US$ 2.4 million. In December 2007, net international reserves (NIR) were US$ 1.7 million; in 2009 they exceeded US$ 8.4 million.3 The improved NIR is based on the positive trade balance and the nationalization of hydrocarbons and of the economy, as well as from remittances from Bolivians abroad.

Between 2005 and 2008, public spending in Bolivia grew 9% annually, while revenue increased 18% per year. Fiscal policy in Bolivia, including an increase in public investment to increase domestic demand and increased spending on social protection programs.GDP growth, understood as the statistical indicator that measures the total value of final goods and services produced within the geographical boundaries of an economy in a period of time, shows a positive development, compared to previous years.

2.3.1 Analysis of the Economy

The trade balance showed a surplus 38.5% higher than observed in 2007, supported by favorable external conditions. The export sector had a positive performance in all areas. Emphasize the export of mineral products at 43.7%, 53.3% oil, so that the extractive industry in the last two sectors covering 72.4% of total export value. You can see a concentration of exports in products such as natural gas, zinc and soybeans, which account for over 60% of total exports. Despite significant declines in international prices of commodities in the second half of 2008 were obtained due to higher revenues than the average raw material prices was higher in 2008 than 2007. It is applicable to oil and gas. For these reasons the terms of trade had again a positive change for the country in 2008, growing by 5.7% from 3.6% in 2007.

In the following subsections, we analyze the critical sectors from a strictly climate change perspective:

Energy sector

Hydrocarbons were nationalized in 2006 bringing in significant revenues for the state sector. Overall, natural gas production grew by 6.0% since then. The Bolivian electricity system is mostly self-sufficient and sensitivity to external shocks is almost nonexistent. The government's goal is to turn Bolivia into an energy powerhouse in the region. The combination of hydroelectric generation and the use of natural gas are very positive from a climate change perspective.

The mining sector

Has been an important traditional sector for GDP growth. Annual production of minerals such as tin, lead, zinc, antimony, silver and wolfram continue to be significant. In 2008 growth was 56.3%, compared to 2007 and its contribution to GDP growth was 6.15%.

In agriculture

The area under cultivation was increased by 19%, especially rice, wheat and corn. Unfortunately, "el Nino" and "la Nina" came into play in the productive periods from 2006 – 2008 and had serious negative impact on agricultural production in the country, resulting in an estimated loss of $72 million. The production most affected included potato, quinoa and coffee bean in the provinces of La Paz, Oruro, Potosí and Cochabamba.

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3 After the International Monetary Fund (IMF) has assigned the country 192 million Special Drawing Rights (SDRs).

Livestock

In Bolivia is estimated at 6.5 million head of cattle, with a growth rate of 2.5% to 3% annually. The population density is distributed in 312 thousand units of production throughout the country. Livestock (including cattle, sheep, camels, pigs, poultry, etc..) contributes to 4% of GDP, of which 50% is cattle.

Industrial sector

Bolivia has begun a process of industrialization in large, small and micro scale. The manufacturing industry recorded a growth rate in the third quarter of 2008 of 4.5%. Industrial activities with the highest growth rates were food processing, manufacture of non-metallic mineral products and manufacture of soaps and cleaning products and toiletries, with growth rates of 30.9%, 29.0% and 25.5% respectively.

Construction

The importance of construction in GDP is small but cement production is growing significantly in 2008 compared with 2007, with a growth rate of 14.2%. Cement consumption is concentrated in Santa Cruz, with a 31% share of the total in 2008.

The transport and storage sector

Had a positive growth rate of 4.6%. The Bolivian fleet in 2008 grew 20% compared to the year 2007. In 2008, gasoline was the fuel most used by the fleet (79%) while diesel followed (19%). Natural gas is emerging slowly powering 1.44% of the fleet followed by alcohol with only a 0.01% stake.

2.4. Biogeographic scenarios

Bolivia is in the neo-tropical ecozone or in the bio-geographic empire stretching from North America to southern South America. It is characterized by really different regions such as Amazon, Andean and sub-Brazilian (Drude and Diels, 1902). The convergence of these regions is associated with high altitudinal gradients. Bolivia is a complex mosaic of ecosystems, where the influence of the Eastern Cordillera of the Andes creates transition zones that host significant diversity of regions with high endemism.

For these reasons, it is among the 15 mega-diverse countries on the planet. Bolivia has approximately 30 to 40% of global biodiversity represented. Its physiographic setting has 4 types of biomes, 32 eco-regions and 199 ecosystems. The flora and fauna is typical of the bio-geographic empire in which Bolivia is situated. Nevertheless the diversity in flora and fauna has a high percentage of endemic species. The greatest concentrations of endemic plants are found in the Andes, more specifically in the Yungas (transition to tropical valleys and lowlands) and in the dry inter-Andean valleys. Bolivia is one of the relatively small countries that has significant portions of its territory that are virtually undisturbed by human action.

The Bolivian Amazon region covers about half of Bolivia's territory (475,278 km $^{2)}$ and consists of a variety of ecosystems including tropical rainforests, savannah, semi-moist forests, transition into the "Cerrado" and Chaco, and sub-Andean tropical forests characterized by high biodiversity. About 24% of the Bolivian Amazon is under protection: 16% are under national protection and 8% are under provincial protection. 25% are communal lands, in some cases with overlapping protected areas, which correspond to the territories of over 25 Indigenous Peoples.

The sub Brazilian bio-geographic region covers a dry region of Chiquitanía in Bolivia and the Chaco region in the south. These regions are characterized by xerophytic species and by rainfall deficits. Depending on weather conditions and soil, the flora of Bolivia can be grouped into eight provinces: Amazon Basin, Grasslands Beni, Yungas, Savannas East, Park Chaco, Estepa Valluno, Front Subandean and Altiplano.

2.5. Bolivia's position on the Convention and on International Climate Change negotiations

The State's position in international climate change negotiations is based on the letter submitted by President Evo Morales to the General Assembly of the United Nations on 28 November 2008.This letter postulates that the development models and

economic policies adopted and promoted by developed countries since the industrial revolution, are the structural causes of climate change and of its harmful effects nature and humanity. The development patterns are characterized by accumulation and excessive consumption, energy wastage and a vision of exploitation of nature by man.

From these general ideas, flows a series of proposals which were developed based on a collective process of the government with social organizations and civil society. In particular the views and proposals of indigenous peoples are integrated part of the proposals. Indigenous groups should also be a part of the global negotiation process.

An underlying principle of these proposals is that human beings have not recognized that they are part of a larger system with which they must live in harmony and balance. For this reason Bolivia has raised the need for a declaration of the Rights of Mother Earth, which goes beyond climate change negotiations, and would have to be further elaborated at the United Nations.

Some specific elements of Bolivia's position include:

2.5.1 Past industrial models have created a Climate Debt

Industrial models of the developed countries inhabited by 20% of the world's population are responsible for nearly three quarters of historic emissions of these gases. This translates into an "emissions debt" or "climate debt" This concept was introduced by Bolivia and has been supported by many countries including the Group of Least Developed Countries. The climate debt should be paid by a combination of reducing emissions and through funding of effective technology transfer and capacity building.

2.5.2 Agro-fuels are not the answer

Bolivia is clear that agro-fuels are not an alternative for food production and that priority should be given to production of grain for human consumption as opposed to transportation needs. Agricultural production for fuel purposes contributes to mono-cultures, depletion of soils, and promotes the concentration of land ownership.

2.5.3 Reduction of emissions

Bolivia supports strict compliance to 2012 commitments of developed countries to reduce emissions of greenhouse gases, according to the provisions of the Kyoto Protocol, i.e. at least 5% below levels 1990. Bolivia also calls for the establishment of commitments to minimum emissions for the second period (2013 and 2017). In this scenario, Bolivia's emissions are reduced by 49% compared to 1990, as partial payment of the climate debt. However, these reductions must take place in the developed countries and not through the carbon market that allows the purchase of emission reductions that are actually made in other countries while developed countries continue to pollute in their own country. Bolivia believes in the establishment of mechanisms for monitoring, reporting and verification that are transparent and accessible to the public, to ensure compliance with these commitments.

2.5.4 A comprehensive financial mechanism

Should be created with public sector financial resources from developed countries, reaching the levels needed to cover the climate debt they have with the planet. This fund will support developing countries in implementing their programs for adaptation and mitigation including innovation, development and technology transfer. Funding should be on top of Official Development Assistance (ODA), bilateral aid and it should be channeled through agencies other than the United Nations.

2.5.5 Intellectual property rights

The transfer and development of environmentally friendly technologies from developed countries to developing countries is essential for establishing adaptation measures and to enable mitigation actions. However, intellectual property rights constitute a barrier to technology transfer. For these reasons, Bolivia supports the G77 in that property protection should be excluded from future patents for this type of technology. Even existing patent protection should be reconsidered for

relevant technologies. Furthermore, since climate change is an emergency for humanity as a whole and especially the people living in developing countries, Bolivia proposes that the option must be enabled to use all the flexibilities developed in the "Aspects of Intellectual Property Rights Trade-related, "including compulsory licensing.

2.5.6 Participation of Indigenous Peoples

All action in the framework of the UNFCCC should be taken with the active participation indigenous peoples, with full respect and implementation of the United Nations Declaration on the Rights of the Indigenous Peoples. Bolivia postulates that Indigenous People have been the best caretakers of Mother Earth even while they are the most vulnerable to the impacts of climate change.

2.5.7 Carbon Market

Bolivia does not support the carbon market concept or the possibility of developing new flexibility in this area. Addressing climate change requires dealing with the root problem, i.e. developed countries must reduce their emissions through domestic action or within their territories and not through the carbon market. The carbon market allows developed countries to continue to pollute at home while developing countries face unfair restrictions.

2.5.8 The REDD mechanism

Should support adaptation activities related to forests and comprehensive management of forests, to ensure sustainable protection of these ecosystems and the effective reduction of deforestation to mitigate climate change. Reducing emissions from deforestation and forest degradation REDD should be based on a mechanism of direct compensation from developed to developing countries. The objective should be to ensure wide and effective participation of indigenous peoples and local communities through an open and transparent process.

3. INVENTORY OF GREENHOUSE GASES

In this National Communication and through implementation of decisions 17/CP.8 and 13/CP.9 of the UNFCCC, Bolivia presents inventories of GHG emissions for 2002 and 2004. This Communication has also recalculated the inventories for 1990, 1994, 1998 and 2000, in order to provide a clear idea of the base level of emissions in the country. GHG inventories were developed following the methodology proposed by the IPCC in order to ensure the accuracy, comparability and completeness of the inventory.

The GHG inventory includes estimates of net emissions of greenhouse gases such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6). .The inventory also considers indirect greenhouse gases: carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2) and volatile organic compounds other than methane (NMVOC). Also considered in the GHG inventory: Energy, Industrial Processes, Agriculture, Land Use, :Land Use and Forestry and Waste sector.

Representatives of the technical units of various government institutions provided information that was assessed and then agreed for use in the GHG inventory. To achieve results, an institutional exchange was conducted through workshops both at the beginning and the end of the process.

3.1. 2002 and 2004 Total emissions

The overall results of national emissions of greenhouse gases for 2002 and 2004 can be seen in Tables 3.1 and 3.2 respectively. These tables look at the national GHG emissions, direct (CO 2, CH 4, N 2 O, HFC and SF6) and indirect (NO X, CO, NMVOC) and SO2 as a precursor of sulfate. Emissions were calculated by emission category emission for each of the sectors proposed by the IPCC methodology, which are Energy, Industrial Processes, Solvent use and other products, Agriculture, LULUCF and Waste. They also expressed the corresponding memo items.

TABLE 3.1
Bolivias's Total Greenhouse gas emissions for 2002 in Gg

GHG Emissions by Sources and Sinks	Emissions CO2	Sinks CO2	CH4	N2O	NOx	CO	COVNM	SO2	HCFs	PFCs	SF6
Total Emissions by sources and sinks	59.539,70	18.378,67	676,07	2,52	86,16	1656,18	62,76	11,63	8,18		0,00
1. Energy	8.603,30		46,66	0,23	53,52	368,36	55,63	11,58			
A. Combustion Activities	8.482,40		10,86	0,23	53,43	368,22	48,21	10,16			
Reference Method	9.286,93										
Method by sector	8.482,40		10,86	0,23	53,43	368,22	48,21	10,16			
B. Fugitive Emissions	120,90		35,80	0,01	0,09	0,14	7,42	1,42			
2. Industrial Processes	607,30		NO	NO	0,01	0,014475	7,13	0,06	8,18	NO	0,00085
4. Agriculture			546,47	1,57	8,24	428,99					
5. Land Use. Land Use Change and Foresty	50.329,09	18.378,67	12,06	0,26	24,39	858,81					
6. Waste			70,88	0,47							
Partidas informativas											
International Bunkers	216,45		0,00	0,01	0,00	0,00	0,00	NA			
Aviatión	216,45		0,00	0,01	0,00	0,00	0,00	NA			
CO2 emissions from biomass	3.260,00										

TABLA 3.2
Bolivias'sTotal Greenhouse gas emissions for 2004 in Gg

GHG Emissions by Sources and Sinks	Emisiones de CO2	Remociones de CO2	CH4	N2O	NOx	CO	COVNM	SO2	HCFs	PFCs	SF6
Total Emissions by sources and sinks	64.383,74	18.265,25	763,76	3,74	95,73	1.983,18	69,93	12,48	17,99		0,00
1. Energy	9.146,54		42,73	0,25	57,91	396,17	58,51	12,41			
A. Combustion Activities	9.038,72		11,73	0,24	57,82	396,03	51,09	10,99			
Reference Method	9.774,49										
Method by sector	9.038,72		11,73	0,24	57,82	396,03	51,09	10,99			
B. Fugitive Emissions	107,81		31,00	0,0066	0,09	0,14	7,42	1,42			
2. Industrial Processes	768,60		NO	NO	0,01	0,02	11,42	0,07	17,99	NO	0,00
4. Agriculture			587,68	1,84	13,43	728,18					
5. Land Use. Land Use Change and Foresty	54.468,61	18.265,25	54,95	1,17	24,39	858,81					
6. Waste			78,40	0,49							
Memo Items											
International Bunkers	80,45		0,00	0,00	0,00	0,00	0,00	NA			
Aviatión	80,45		0,00	0,00	0,00	0,00	0,00	NA			
CO2 emissions from biomass	1.346,34										

Source: Own

3.1.1 Carbon dioxide emissions

The results of emission estimates show that the largest greenhouse gas emission in Bolivia come mainly from exchange activities in land use and forestry (net emissions - accounting for removals) and which brought the total to 77.6% and 78.45% for 2002 and 2004 respectively. Subsequently, the energy sector is one of the most importants, which accounted for 20.90% and 19.90% respectively and then the industrial processes sector with 2.0% in 2002 and 2004.

3.1.2 Methane emissions

The CH 4 emissions in all years examined are primarily from the agricultural sector, mainly emissions from enteric fermentation, this sector contributes 78% in 2002 and 77% in 2004.Then the waste sector contributed to total methane emissions with 11% in 2002 and 10% in 2004, followed by the energy sector, with 9% in 2002 and 6% in 2004.

3.1.3 Nitrous oxide emissions

Similarly, emissions of N2O mainly come from the agricultural sector which contributed to the total nitrous oxide with 61% in 2002 and 50% in 2004. The waste sector follows with 19% and 13% for 2002 and 2004 correspondingly. The sector LULUCF has occupied the third place with 11% and 31% in 2002 and 2004, respectively.

3.1.4 National emissions in terms of CO2 equivalent

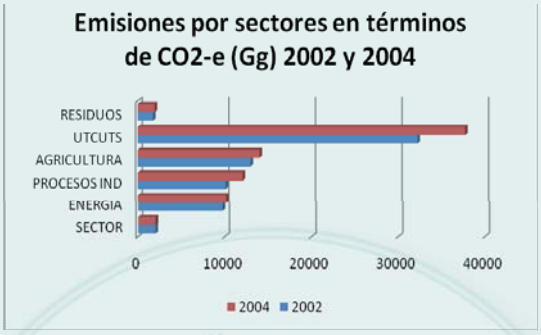
The results obtained in these calculations at the national level can be seen in Table 3.3 which shows the emissions of different gases in terms of CO2-eq for 2002 and 2004.These results show in terms of CO2-eq that the main greenhouse gas, CO2 has contributed with 61.63% in 2002 and 53,99% in 2004 compared to total emissions. Then CH4, with 23.21% in 2002 and 20.61% in 2004, ranking third in this year. The joint contributions of HFCs reached third place in 2002 with 14.72% and second place with 23.9 3% in 2004.The N2O, has contributed 1.11% in 2002 and 1.30% in 2004, ranking fourth and finally, the SF6 is the gas that has contributed to a lesser extent in both years to the total of emissions equivalent: 0.03% in 2002 and 0.02% in 2004.

TABLE 3.3
Bolivia's Total Greenhouse gas emissions for 2002 y 2004 in CO2-eq

Sector	GHG	Potential calentamiento Global	2002	2004
Energy	CO2	1	8.603,30	9.146,54
	CH4	23	1.073,15	982,70
	N2O	296	68,61	72,67
Industrial Processes	CO2	1	607,30	768,60
	SF6	22200	18,98	19,16
	HFC-125	3400	0,00	3.610,80
	HFC-134[a]	1300	9.521,44	11.334,72
	HFC-143[a]	4300	0	5.573,57
Agriculture	CH4	23	12.568,76	13.516,64
	N2O	296	464,54	546,12
LULUCF	CO2	1	31.950,43	36.203,36
	CH4	23	277,44	1.263,94
	N2O	296	75,74	345,04
Waste	CH4	23	1.630,20	1.803,10
	N2O	296	137,90	144,20
			66.997,78	85.331,17

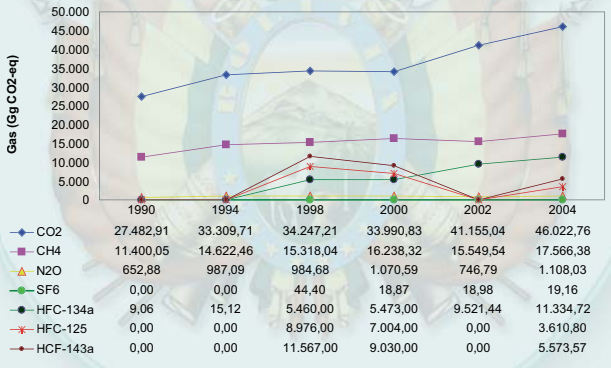
3.1.5 Contribution by sectors of national emissions in terms of CO 2 eq.

The GHG emissions for Bolivia in terms of CO2-e by sector show for the year 2002 a prominence of the sector of Land Use, Land Use Change and Forestry (LULUCF) with 48%, followed by the agriculture sector with 19%, the industrial processes sector with 15%, the energy sector with 15% and the waste sector with 3%.(See Figure).In 2004 this contribution did not vary in terms of order of importance of sectors, but if they increase the incidence of the LULUCF sector to 50% of emissions in terms of CO2-e, the agricultural sector reached 18%, industry industrial 16%, the energy sector decreased to 13% and the waste sector remained unchanged with 3%.



3.1.6 Comparison of emissions in terms of CO2eq for the decade 1990 to 2000

The behavior of the main greenhouse shows an increasing trend since 1990 (see Figure 3.1).



	1990	1994	1998	2000	2002	2004
CO2	27.482,91	33.309,71	34.247,21	33.990,83	41.155,04	46.022,76
CH4	11.400,05	14.622,46	15.318,04	16.238,32	15.549,54	17.566,38
N2O	652,88	987,09	984,68	1.070,59	746,79	1.108,03
SF6	0,00	0,00	44,40	18,87	18,98	19,16
HFC-134a	9,06	15,12	5.460,00	5.473,00	9.521,44	11.334,72
HFC-125	0,00	0,00	8.976,00	7.004,00	0,00	3.610,80
HCF-143a	0,00	0,00	11.567,00	9.030,00	0,00	5.573,57

Figure 3.1 – Comparison of emissions in terms of CO2eq for the decade 1990 to 2000.

3.1.7 Analysis of key sources

Bolivia has made an extra effort to include in their inventories, the key source analysis for the years 2002 and 2004 following Tier 1 and Trend Assessment.

Level Assessment

According to Tier 1the three major categories in 2002 were: 1) Land Use Change in the inventory year (42%), 2) enteric fermentation (17%), and 3) HFCs from refrigeration and air conditioning (14%). During 2004, the three most important were: 1) Land Use Change during the inventory year (39%), 2) HFCs from refrigeration and air conditioning (24%), and 3) enteric fermentation (14 %).

Evaluation of the trend

The trend assessment in 2002, shows majors contribution to the trend (42%) from Land Use Change during the inventory year, followed by Land Use (21%).

In 2004, there has been a major contribution to the trend (44%) from Land Use Change during the inventory year, and the second contributor was Land Use (20%)

3.1.8 Quality Control and Quality Assurance

Bolivia has made efforts to ensure quality control of information for its GHG inventories, for both activity data and at the level of emission factors, while respecting the primary and secondary information published by various institutions and particularly information generated during both years by the National Climate Change Program.

Sectoral meetings for the attainment of information have been developed and regularly discussion on the activity data and emission factors were carried out. Similarly, the results were socialized level with the various institutions involved in the process.

An information file system for all data developed during the inventory process in the country is under the control of the PNCC, which will allow a constant comparative assessment.

4. PROGRAMS TO FACILITATE ADEQUATE ADAPTATION TO CLIMATE CHANGE

4.1. Climate and Climate Scenarios in Bolivia

Bolivia has virtually all climates from tropical in the plains to polar, as one ascends the high mountain ranges. The climatic conditions of the country mainly depends on latitude, altitude, location within the tropics, the existence of high mountains, the presence of flat areas and the movement of trade winds. Weather has five units, dry forest, tropical moist, semi-desert-arid, and subtropical moist and dry.

Michel (2006) SENAMHI suggests changes from in average temperature from -0.4 º C to 0.8 º C in the eastern plains. Precipitation presents no significant changes (-0.17% and 0.98%). In the Northern region of the country the average temperature shows an increase between 0.2 º C and 1 º C, with no change in precipitation (0.16 to 0.22%). In the lowlands increase on average temperature is between 0.1 and 0.3 º C, with no expected changes in rainfall (0.07% and -0.29%).

In the valley region the changes in average temperature are oscillating between -2.3 ° C to 2ºC and precipitation between -0.48% and 0.21% considered constants. While the high plateau shows an increment in temperatures with values between 1.1 º C and 1.7 º C and change on precipitation levels that are not statistically significant (-0.4% 0.94%).

These observations are consistent with the configuration of ecosystems and taking into account the elevation gradients in the country, where the ranges in climate behavior are broad over the past years. The record cover periods from the 1940s to 2004 in 23 hydrometeorological stations.

Moreover, Garcia M. et al (2006) in "Evaluación de Tendencias del Balance Hídrico como indicador del Cambio climático". The analysis of 28 weather stations (excluding Beni and Pando provinces) shows trends in the variation of weather patterns for 30 years of observed series. The arid and semiarid areas of the country show increasing trends in temperature, which translates into increased demand for water vapor in the atmosphere, reflected as evapo-transpiration. It was observed that in most of the stations considered, during the period following 1983 the rainfall has decreased in than the historical average. Nevertheless, these studies conclude that the water deficit is rising primarily due to increased evapotranspiration, rather than the decrease in precipitation.

4.1.1 Generation of Climate Scenarios

The Regional Model B2-AIM4 generated by the Asian Pacific Integrated Model, suggests an increase in average surface temperature to 2050 by about 1.5 º C. There was little difference between the baseline scenario and the scenarios with the best policy assumptions. This would suggest that Bolivia would retain its average temperature at this level over the next 30 years.

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4 This makes the family of IPCC emission scenarios, B2 generated by the model Japanese Asian Pacific Integrated Model (AIM)

Regarding regional precipitation there is a 80 % probability of an increase in the rainfall occurrence in all the grids generated for Bolivia. However, the temporal distribution is a critical aspect for productivity activities because of its role in the recharge of aquifers.

Santa Cruz has the strongest record of precipitation but with lower odds of an increase in precipitation.

The Earth Simulator generated precipitation and temperature scenarios for Bolivia for the year 2100 and for the month of October as indicated by the figures 4.1, 4.2 and 4.3.

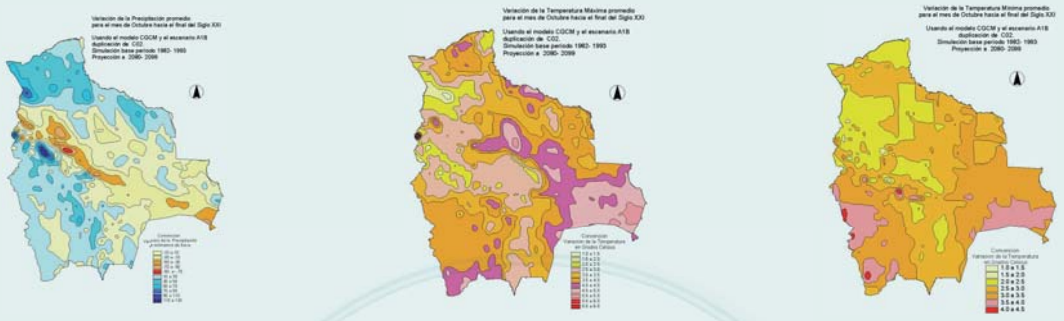

Figure 4.1 – Figure 4.2 – Figure 4.3 – Changes in patterns for Precipitation and Temperature under the Scenario A1B for the end of the XXI Century. (Source Arana I).

An approach with all the information from the Earth Simulator is presented in Table 4.1 below.

TABLE 4.1
Temperature and Precipitation –Future Scenarios

Region	Average Increase to 2030*			Average Increase to 2080		
	T máx	Tmín	pp	T máx	Tmín	pp
Highplains	1,5	0,556	0 a -15	4 a 4,5	2 a 2,5	- 20 a -45
Valleys	1,35	0,49	0 a -45	1,5 a 2	2 a 2,5	- 35 a -70
Tropics	1,35	1,2	0 a - 60	2 a 3	2,5 a 3	-60a -90

Source: Earth Simulator. (Arana I)

The National Service of Meteorology and Hydrology (SENAMHI) of Bolivia has begun to generate climate scenarios in the country in order to assess future variations. The SENAMHI analysis was done in coordination with the team that manages the Earth Simulator in Japan. However SENAMHI is still working to develop outcomes at a much smaller scale.

A study by the Fundación Amigos de la Naturaleza (FAN) called "Implementation and validation of a regional climate model for Bolivia using PRECIS" found that the observed data and models show a seasonal cycle and spatial correlation. With respect to the temperature, the model estimates correct values in the Lowlands, but underestimates the temperature in the eastern slope and the valley and the highlands. As for precipitation, the model estimates significantly different values in the Lowlands and overestimates precipitation in the eastern slope and in the highlands.

Climate change scenarios A2 and B2 for the years 2001-2030 and 2071 to 2100 based on ECHAM4 model with a resolution of 25km x 25 km produced the following results: the temperature increases in all of Bolivia the highest increase will be in the Highlands and the Amazon. The temperature increase could be in the range of 1-2 ° C until 2030 and 5-6 ° C up to 2100, compared with average values from 1961-1990.

The study worked the climate change scenarios A2 and B2 for the years 2001-2030 and 2071 to 2100 based on ECHAM4 model with a resolution of 25km x 25 km and obtained the following values: the future temperature increases in all of Bolivia with the most extreme in the Altiplano and the Amazon, an increase of 1-2 ° C until 2030 and 5-6 ° C up to 2100, compared with average values from 1961-1990.

Changes in precipitation are more complex. The Lowlands show a cycle of more intense rainfall, with more precipitation during the rainy season and less precipitation during the dry season (JJA DJF, respectively). The maximum relative changes include and increase of 53% and -36% until 2100. This cycle is also enhanced on the eastern slope where extreme reductions occur in August. The pattern is reversed in the Highlands for 2100 with more extreme increases or decreases in the dry and rainy seasons respectively.

4.1.2 Climate Change Impacts on Water Resources

Bolivia is regularly subjected to drought or floods of magnitude due to poor temporal and spatial distribution of the water resource. Thus, there are areas with very different rainfall regimes despite the fact that they belong to the same weather system. Coexisting within walking distance are areas with rainfall above 3000 mm per year with others that have precipitation below 300 mm.

Extreme hydro-meteorological events are frequent and tend to increase in magnitude and intensity as a result of climate change. At the country level the occurrence of tropical storms has increased in recent years, with winds in excess of 28 m / s according to the Beaufort scale, with significant damage, not observed in historical records over long periods of time for Santa Cruz, Yungas of La Paz, and Tarija. It has also being detected convective motions in the atmosphere causing violent hail storms such as those recorded in the city of La Paz in February 2002 and 2003.

Changes in climate are expressed not only in the intensity of extreme weather events, but also in exacerbated periodic and chronic shortages of water during periods of drought in the lowlands and valleys of the arid and semiarid parts of the country and generally by reducing the availability of water. Moreover, there are indicators of increased frequency of flooding in downstream areas, increasing the need to adapt not only to droughts and chronic water shortages but also to heavy rainfall to prevent flood damage to infrastructure.

It is reasonable to predict that arid regions will retain this contradictory pattern of chronic water shortage and significant flood damage from more intense rains even while many of the wetlands will see increased precipitation. Table 4.2 shows some examples of impacts that might occur using the experience of years of extreme events in Bolivia.

TABLE 4.2
Expected impacts by region due to climate change

REGION	STAGES OF CHANGE	EXPECTED IMPACTS
High Plateau	Increased concentration of precipitation Increased frequency of storms with less number of rainy days Increased frequency of hail Reductions in river flows	Increased presence of frost Increased water needs for irrigation by long periods without rain Problems with power generation Retreating glaciers Destruction of crops Floods in the rainy season Low water availability for human and animal consumption Little recharge into aquifers, bogs and similar Competition for water use
Valleys	Increased concentration of precipitation Increased frequency of storms with less number of rainy days Increased frequency of hail	Competition for water use Loss of biodiversity Increased water needs for irrigation by long periods without rain Increased risks of landslides, porridges and related Problems with power generation Soil Erosion and Desertification
Chaco	Reducing the number of days with rain Increased periods without rain during the growing season Recurrent droughts and intense Low flows in rivers	Competition for water use Loss of biodiversity Events heatwaves during the summer Soil Erosion and Desertification Increased pollution of water sources
Llanos and Amazonian	Increased rainfall received by event Higher rate of cloudiness High humidity in summer and severe drought in winter	Frequent Flooding Loss of road infrastructure Loss of winter crops and livestock died from lack of water Major pests and diseases due to high humidity. Reduction in biodiversity Outbreaks of infectious diseases related to water.

Source: Impact of climate change in Bolivia (PNCC, 2006)

Extreme events intensified by climate change

An event that shows the influence of climate change in Bolivia is the impact of El Niño and La Niña. The results of studies, meetings and workshops at national and global level, showed that there is consensus in identifying the water sector as one of the most vulnerable to climate change.

As noted, one of the direct impacts related to climate change is the increased intensity and frequency of extreme weather events5 [5]. In Bolivia such events have serious consequences, for example: 2002 (February black), 70 people died and about 40 were reported missing, 1997-98 had outbreaks of malaria, dengue and cholera. In 2008, it is estimated that the cost of floods exceeded $ 500 million, about 5% of GDP.

However, classic climate variability can no longer be considered as natural cyclical events, entirely responsible for emergencies or disasters. Changes in the normal behavior of the climate and changes in precipitation do not fully explain the magnitude of impacts.

The shrinkage of glaciers the most significant impact of climate change

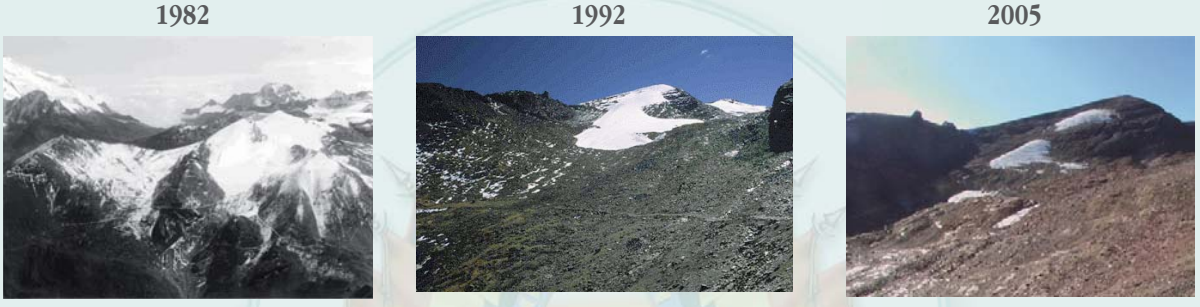

Figure 4.4 – Chacaltaya Glacier retreat 1982-2005 (Source Ramirez E)

Bolivia's glaciers are definitely receding as a result of climate change. These tropical glaciers are crucial sources of water for uses such as energy, agriculture, consumption and the natural recharge of aquifers and bogs. For example, studies show that the Chacaltaya glacier (former ski resort) is nearly extinct. The PNCC, with the IRD and the HHI have done a study on the shrinkage of the Condoriri Tuni glacier located in the Cordillera Real. The study concludes that this glacier has retreated about 35% in the last 50 years with serious future implications for water supply for the cities of El Alto and La Paz and for irrigation and power generation. These glaciers would be exhausted in 2045 and 2025 (Condoriri & the Tuni, respectively; Ramirez et al 2006). In addition to these studies of specific glaciers, surveys show that 80% of glaciers in Bolivia are in the process of receding.

Glacier shrinkage has a direct impact on river basins as well. The river basins of La Paz, Rio Grande Basin, Lower Pilcomayo River Basin, Rio Mamore River Basin Caine are vulnerable to serious impact from disappearing glaciers.

A water balance of watersheds for the dry season considering a climate change scenario of low rainfall and elevated temperature influences evapotranspiration water deficits are important in different watersheds of the country. (See Table 4.3.).

TABLE 4.3
Fall Water balance by basins under a scenario of climate change

Basin	Área (Km2)	Precipitatión (106m3)	ETR (106m3)	Water Usage (106m3)	Deficit (106m3)
Amazonas	818.810	170.811	169.810	1.655	654
Río de la Plata	234.648	17.033	16.550	1.164	681
Endoreic	191.293	6.845	6.845	692,5	692,5

5 *La Niña and Niño mild or moderate but have caused major damage*

At the present this deficit is covered with water intakes from rivers with a permanent channel of ice thaw. Clearly, climate change and glacier shrinkage would substantially reduce the river water wealth, and river basins might even disappear.

Moreover, although precipitation patterns in rainy periods show no significant rainfall deficit, the concentration of rainfall events, could cause people to face a periodic lack of water due to the poor distribution of the rainfall.

Scenarios of climate change impacts on water and sanitation services in Bolivia.

In some areas the water supply might decrease leading to over-exploitation of underground water with incremental costs for the provision of water (for any use) as a result of the need to extract water from far deeper sources. Additionally, over-exploitation of the water table, in some cases could lead to deteriorating water quality.

Increasing water scarcity, combined with increasing demand for food, and / or use of water for irrigation, as a result of high temperatures, will increase opportunities for the re-use of water. Areas with low water supply could practice reuse water, contaminated water and even sewage, but control of health risks is crucial. The deterioration of water quality as a result of the varying flow could lead to increased concentrations of pollutants by decreasing the dilution capacity of water bodies. At the same time, the increased flow of water, will cause erosion due to water/

Also, increased morbidity and mortality from water borne disease is expected in relation to an insufficient supply of potable water and increased pathogens combined with high water flows during rainfall extreme. Access to potable water is very poor for rural populations in Bolivia, which would increase under conditions of climate change.

4.1.3 Climate Change Impacts on Health

The health effects of climate change in Bolivia disproportionately affect vulnerable populations, by virtue of their poverty, education, population density, economic development, food availability, income, local environmental conditions, health status, quality and availability of health services and availability of early warning systems. Therefore, the health effects of climate change in the country and have an important contextual and geographic variation.

Human health is affected by the changing climate. Malaria, Chagas, dengue and other vector-borne diseases, show a growing trend and can become a substantial threat to the population in the next 5 to 10 years.

From December to February 2007/2008, the entire country was affected by floods exacerbated by the effects of climate variability, on the basis of climate change. The Provinces severely hit were Beni and Santa Cruz. Santa Cruz had 400 patients with classic dengue. Eventually, there were more than 1,300 suspected cases across the country, including 18 cases of dengue hemorrhagic.

El Niño 2007, flooded a third of Beni Province, producing 1,000 cases of malaria, 90% caused by Plasmodium vivax, with 212 affected patients. Other provinces such as Pando, Tarija presented 253 cases, and there were also isolated cases in the tropics of Cochabamba. On February of 2008 the same province was affected by floods affecting 11,239 families and 3,697 families were evacuated to shelters. As a result of the floods some cases of Acute respiratory diseases, Diarrhea, skin diseases and musculoskeletal were treated.(PAHO/WHO DANA)

The flooding has been rated as the worst in 25 years, affecting 116,000 families - over half a million people and killing 54 people. 75,000 families were displaced and 200,000 hectares of food crops and main crops have been damaged.

Climate Change, Malaria and Dengue

Studies in Bolivia showed that malaria is sensitive to variations and changes in climate trends, showing marked differences between the period of the baseline and the current period. Malaria caused by Plasmodium falciparum, is seasonally bimodal, with two incremental periods ranging from March to June and October to November, with periods of remission in the remaining months. However, cases occur over a larger number of months.

Climate change may increase new cases of malaria caused by Plasmodium vivax in 11.3% and 43.6% increase of malaria cases caused by Plasmodium falciparum,. (Aparicio M, Ortiz P.2000)

Projections for 2010 showed a 20% increase in endemic cases of Malaria in the study areas and transmission is being transformed from bimodal into multimodal.

The epidemiological profile has been characterized by tropical diseases such as malaria, leishmaniasis, dengue that occur in the low, hot and humid regions of Bolivia, mainly in the eastern region, but global environmental changes, particularly climate change, is creating habitats suitable for vector development in western areas.

In this context, one of the first signs of change, was presented in 1998, 50 km east of Lake Titicaca in the area belonging to Amban Carabuco Municipalities and Mocomoco Department of La Paz, with heights ranging between the 2615 - 3590 meters, where there was an outbreak of malaria from January to May in 9 communities . The entomological evaluation confirmed the presence of the vector Anopheles pseudopuntipenni in the area, both larvae and adults. In addition, active epidemiological monitoring of the area since November of last year detected 10 confirmed cases of Plasmodium vivax in 2006.

Dengue, which was not present in the country, has sprung up again and expanded from Santa Cruz de la Sierra, Cobija, Yacuiba, La Paz, Chapare and elsewhere. Leishmaniasis cases associated with deforestation is increasing. Chagas and endemic disease in Bolivia shows an increase in area, its vector Triatoma infestans, now is present in 7 of the 9 provinces of the country (84% of national territory), and it is expected to expand affecting the rest of the country, as the rainforest is replaced by dry forests, creating a suitable habitat for the vector.

4.1.4 Impacts of Climate Change on Agriculture and Food Security

The agro-ecosystems in the country have different characteristics in terms of their vulnerability. Some regions are witnessing significant vegetation changes; production has been affected by the emergence of new pests and diseases.

There is an imminent loss of agro-biodiversity in long-cycle crops or reducing their acreage and becoming marginal crops reducing the possibility of in situ conservation, this is due to reduced and changes in the precipitation cycles.

Reduction of rains cycles will affect the possibility of regeneration of soil fertility and lthe subsequent loss in vegetation cover leading to increases in erosion by wind and water agents, aggravating the situation.

Under climate scenarios there is a change in the temporal trends of frosts and delays in the rainy season, and a greater likelihood of losses by *late* season *frost* on late *crops. The frost reduction will cause difficulties for processing of potato tubers.*

The circulation models show a shortening of the rain periods and a reduction in probability exposes crops to rainfall deficit during their final cycle and thus causing reduction in yields and quality particularly for wheat.

The production deficit will affect not only the income of producers but will also the quality of the crops causing a decrease in prices and affecting significantly the ability to purchase other foods increase and increasing the food gap and malnourishment.

There is also the risk of shrinkage of cultivated areas due to loss of water sources during the dry season, given that only 10% of the area has access to irrigation.

Finally, climate change is affecting Bolivia gradually reducing the economically active population in food-producing regions, affecting the livelihood in already marginal areas.

4.1.5 Climate Change Impacts on Ecosystems

The strong interrelation and dependency of ecosystems to environmental conditions, (including the prevailing climatic conditions), make them susceptible to climate change impacts. A study by the PNCC (2007)6 shows that the subtropical rain forests in the country are showing greater vulnerability to climate change, and climate scenarios show a tendency to become a subtropical dry forest in 2100.

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6 *Impacts of Climate Change in Bolivia*

The changes observed in different ecosystems under climate change scenarios, according to Holdridge model output show that the impact of climate change can be variable according to the ecosystem. For example highlights that the cold temperate desert ecosystem will present no change for the climate change scenarios in 2010, 2030, 2050 and 2100. However, the zone of tropical rainforest could see an increase of 100% by 2100 possibly because many streams of moisture-laden air can not penetrate the slope of the Andes, increasing the amount of precipitation in these areas and increasing the extent of this ecosystem.

TABLE 4.4
Presents the reduction rate of each ecosystem areas scheduled for 2050.In the second column reports the percentage reduction in descending order and in the third column shows the percentage of area corresponding life zone for the base year.

LIFE ZONES CATEGORIES	REDUCTION (%)	PROPORCIÓN DE LA ZONA DE VIDA RESPECTO AL TERRITORIO NACIONAL PARA EL AÑO BASE (%)
Life Zone with the highest change		
Temperate rainforest (4)	100	1.4
Life Zones with moderate magnitude of reduction		
Cool Temperate Steppe (16)	94.1	2.3
Subtropical rainforest (1)	78.3	28.9
Cool temperate forest (10)	50.4	0.4
Temperate dry forest (5)	40.8	3.9
Subtropical very humid forest (6)	40.1	1.5
Subtropical dry forest (7)	33.0	12.9
Subtropical rainforest (8)	31.0	0.4
Very humid tropical rainforest (9)	27.9	0.4
Life Zones with no reduction:		
Tropical dry forest (2)	0	25.8
Tropical rainforest (3)	0	1.6
Tropical very dry forest (12)	0	4.0
Cold desert (15)	0	1.4
Others	0	16.5

Climate Change impacts on Wetlands

Wetlands are the most vulnerable members of endoreic environments, lakes, lagoons, rivers and mountain streams and dependent environments from groundwater for recharge as is the case of Bolivia. The effect will occur due to expected seasonal increase in precipitation causing the decrease of flooded surfaces and the subsequent reduction in groundwater recharge, currently under severe pressure.

A study of variation of wetlands, based on the Vegetation Index, conducted in the Bolivian highlands, showed significant variations due to change weather patterns. Of the four bogs under study three of them showed changes in vegetation (Ucha Ucha, San Calixto - Suriquiña and Chojñapata), this was evident became after the spatial analysis of the different bogs.

4.1.6 Summary of economic impacts of recent extreme events in Bolivia

Tables 4.5 and 4.6 give the level of economic impacts resulting from extreme events caused by El Niño and La Niña.

TABLE 4.5
Economic impacts caused by El Niño in Bolivia

YEAR	EVENTS	Economic Impacts
2006-2007	El Niño	Moderate El Niño causing monetary losses amounting US$ 443 millones.
1997/98	El Niño 97-98	Strong El Niño causing monetary losses amounting US$ 530 millions equal to 7% of the national GDP.
1982/83	El Niño 82-83	El Niño 82-83 causing monetary losses amounting US$ 837 millions (Strong El Niño).

Source: CEPAL (2007).

TABLE 4.6
Economic impacts caused by La Niña in Bolivia

YEAR	EVENTS	Economic Impacts
2007-2008	La Niña	Moderate La Niña, with high social and economic impacts in the country 26 deaths, loss of infrastructure and housing. Estimate damage US$. 540 millions.
2001-02	La Niña	Strong La Niña with no significant Economic Impact.
1988-89	La Niña	Strong La Niña with no significant Economic Impact. Floods around the region of Lake Titicaca. No estimation of the losses.
1973/74	Fenómeno de La Niña	La Niña fuerte sin impactos económicos significativos.
1982/83	Fenómeno de La Niña	La Niña fuerte sin impactos económicos significativos.

Fuente: Elaboración propia (2007).

4.2. Process of adaptation to climate change

Bolivia has given substantive priority to the fight against poverty and as this is being jeopardized by the impacts of climate change, national priorities have been linked to the actions for adaptation to climate change.

4.2.1 Self adapt efforts

Access to water is "a human right, legitimate, essential for all living beings" in order to ensure this Bolivia has affirmed a State Policy 'Water for All". The Ministry of Environment and Water has aggressively promoted action on adaptation of water resources to climate change by implementing projects in cities like El Alto, La Paz, Cochabamba and Tarija.

Global warming has had a major impact on Bolivian glacier's that clearly show a receding process that is affecting two cities, La Paz and El Alto. In order to prevent water shortages some measures have been approved such as drilling of water wells an expansion of the water treatment plant, on the highlands and also the plant's wastewater treatment Puchukollo. It has also approved a project to build a second dam of large capacity that will provide services to the city of La Paz,

Another important measure of adaptation to climate change is the construction of a Dam that can provide water to a city like Cochabamba, located in the central of Bolivia. Misicuni works include, besides the dam a water treatment plant.

The impacts of El Niño and La Niña, exacerbated by climate change, have forced Bolivia to develop a rehabilitation and reconstruction plan led by the Ministry of Development and Planning in coordination with the Ministries of Health, Education, Rural Development , Agriculture, Public Works and Water Ministry. The objective of the plan is to rehabilitate and rebuild the infrastructure and productive systems affected by natural disasters caused by El Niño and La Niña and also to strengthen the institutional and social capacities and thus reducing the vulnerability to climate change.

4.2.2 Pilot Adaptation Projects -Institutional and social learning

Bolivia since 2004 and as part of the process of mainstreaming adaptation to climate change at all levels and sectors has supported initiatives focused on plans and projects to address impacts of climate change, this initiative was re-launched in 2006 with a more participatory approach, such as : The Climate Change Research Project, the Five-Year Plan of National Climate Change Program, the Andean Regional Project for Adaptation to Climate Change in areas of retraction of glaciers (PRAA) and the Project Implementing National Adaptation Mechanism, and also the "Community Based Adaptation project " under the UNDP Small Grants Programme.

4.3. Public policy and climate change adaptation at national level

Bolivia on its 2006 National Development Plan (NDP), which has a 10-year strategic outreach, clearly established actions related to climate change. To meet these guidelines of the NDP, and in the framework of the New Constitution of the Bolivia,

assigned the Ministry of Environment and Water with the leading role in implementing climate change policies and ultimately the National Mechanism for Adaptation to Climate Change (MNACC). This National Adaptation Mechanism has prioritized the following sectors: water resources, agriculture, ecosystems, health, human settlements and infrastructure and climate risks. It has also raises /cross-sectoral actions relating to research, education and recovery of ancestral knowledge.

The strategic objectives of the National Mechanism for Adaptation to Climate Change are:

- To reduce vulnerability to climate change;
- To promote planned adaptation under various sectoral programs and
- To reduce the risks to climate change impacts in different sectors identified as vulnerable.

NMACC Management Objectives

- To respond to the National Development plan policies with adaptation measures to climate change in a comprehensive and cross-sectorial approach, to achieve a high degree of sustainability
- To strengthen mechanisms allowing the participation of different social and institutional actors.
- To coordinate cross-adaptation actions to climate change.
- To support the efforts of the PNCC encouraging climate change adaptation actions.
- To support the achievement of financial mechanisms that prompts national development and integrates adaptation actions (e.g. Investment funds, programmatic support, sectoral, etc).
- To articulate adaptation actions with other operational measures which are reflected either in development programs (Programs Watershed Management, Irrigation Projects and Programs, Health Programs, etc.), or on specific projects so that they integrate and devise the need to include actions to reduce national vulnerability to climate change.
- To promote the integration of adaptation actions at community, municipal and departmental level.
- To support the country's response to climate change transforming the responses into opportunities for discussion and strategic planning at all levels: local, municipal, departmental and national. Including the climate change issue in processes such as the National Dialogue, community and municipal forums, research networks, think tanks, etc.

5. CLIMATE CHANGE MITIGATION IN BOLIVIA

A study by the PNCC (2001) established a potential for emissions reduction in the country for the period 2001 to 2012 as a result of the implementation of mitigation measures. The reduction could reach 903 million tons of CO2, Land Use, Land Use Change and Forestry accounted for the 97.67% of the emissions reduction and the reduction on the energy sector could reach 2.33%.

The Plurinational State of Bolivia has begun implementing some of the measures proposed, particularly in the energy sector and a set of other measures are put into development plans, especially those with negative incremental costs. Therefore the Ministry of Hydrocarbons and Energy is promoted various programs for the implementation of this strategy:

PROGRAMS

1) Program to promote the use of *natural gas vehicles* aimed at changing the country's energy matrix, fin order to achieve this Bolivia has established two relief funds, the first for gas vehicle conversion and the second for the upgrade and replacement of gas cylinders. Nearly ten million dollars were used from these funds, allowing the conversion of 15.000 vehicles during 2008 and 18 thousand reclassified. However, no information is available on the reduction of total emissions achieved through the implementation of this program.

2) The Light Bulbs Program driven to improve the efficiency of energy use in the country, with the free distribution of 7.9 million light bulbs, which could save up to 30% in electricity consumption.

3) The hydropower program, which encourages greater use of renewable resources has begun implementing six large hydro plants in the next 10 years years and will generate 3290 MW the investment will cost around US$ 5,600 million.

The PNCC through the Five Year Plan has also developed various initiatives in small communities to develop mitigation measures to reduce the use of diesel and biomass in power generation through support to the construction of several small hydroelectric plants.

5.1. REDD in Bolivia

Beyond that Reducing Emissions from Deforestation and Forest Degradation (REDD) is a global alternative to mitigate climate change. Bolivia argues that these activities must necessarily respect and promote the rights and interests of Indigenous and local communities that includes their active participation and the right to consent in designing and implementing them in full compliance with international human rights conventions and other relevant and applicable national and international laws.

Bolivia also highlights other important aspect regarding the funding mechanism which should operate under the REDD mechanism, stating that REDD should establish an alternative source of resources, such as those from multilateral funds or special funds and not through carbon market.

5.1.1 REDD Community Experiences in Bolivia

The Indigenous Program Reducing Emissions from Deforestation and Forest Degradation in the Bolivian Amazon (REDD - Amazon) is being executed as a pilot experience in Bolivia and is is characterized by full participation of indigenous groups.

It has been estimated that this programme with participation of the local stakeholders, could reduce the current area of deforestation from 15 to 20 thousand hectares per year to a little over 7 thousand. This action will be possible through the sustainable use of forest products such as cocoa and wild chestnuts. The programme also plans other policies that will help reduce deforestation such as patrolling, monitoring and control of their own indigenous territories.

5.1.2 Noel Kempff Mercado Climate Action Project

The project Noel Kempff Climate Action (PAC-NK) covers and area of 634.000 hectares and is located at the Noel Kempff Mercado National Park,. This project is the largest forestry project for carbon mitigation in the world. By protecting forests and reducing emissions from deforestation and degradation (REDD), the Noel Kempff project simultaneously addresses climate change, conserves biodiversity and brings sustainable benefits to local communities.

5.2. Participation of Bolivia in the CDM

Bolivia has sought to participate in the Clean Development Mechanism (CDM) under Kyoto Protocol, confident that it would be handled in a framework of equity and would be a real investment flows to all developing countries. Unfortunately the initiative only served for some countries to benefit from it and Annex I countries seeking purchase only Certified Emission Reductions (CERs) and not investing in projects.

Bolivia has developed several projects at the Project Ideas and only five of them reached the level of National Approval for their contribution to sustainable development of the country, of which only one has profited from the CDM, having completed the project cycle CDM, all the rest were characterized as local initiatives and investments.

CDM PROJECTS IN BOLIVIA THAT RECEIVED THE NATIONAL APPROVAL LETTER
TAQUESI HYDROPOWER PROJECT GUARACACHI CO GENERATION PROJECT
NORMANDY LANDFILL PROJECT
COBEE ELECTRIC PROJECT
CETEFOR REFORESTATION PROJECT

6. INFORMATION RELEVANT TO THE ACHIEVEMENT OF THE ACHIEVEMENT OF THE OBJECTIVES OF THE CONVENTION

Bolivia has initiated a series of internal actions to tackle the impacts of climate change which include among others the development of greenhouse gas, climate change vulnerability and adaptation assessments, project implementation, capacity building and generation of scientific knowledge on the issue of climate change.

The President of Bolivia, the first indigenous president in the world, has giving priority to the subject of climate change by urging to save the planet Earth. Bolivia has initiated actions at all levels using ancestral knowledge and coping mechanisms.

Bolivia has initiated discussion in all fields to tackle climate change, with full participation of social sectors, main actors and victims of climate change, with whom he has generated and discussed the national positions in the framework of the Convention. The Ministry of Environment, Biodiversity and Climate Change has begun the task of forming a Plurinational Council on Climate Change.

The Ministry of Foreign Affairs, in order to play a greater role in the negotiations processes of the United Nations Framework Convention on Climate Change (UNFCCC) and in coordination with the Ministry of Environment and Water, has initiated aggressive action to form teams that will be involved in the negotiations processes. To achieve this has seek supports of countries like Denmark, Kingdom of the Netherlands and the Kingdom of Great Britain, which have enabled the country to develop a series of workshops and seminars with the participation local and international negotiators, allowing an open discussion of different topics covered by the UNFCCC.

At the same time is carrying out a project entitled "Negotiating Strategy and Institutional Capacity Building on Climate Change", under the leadership of the PNCC and UNDP management, the project aims to strengthening and enhancing the capacity of the e Bolivian delegates to the Climate Change Convention.

6.1. National Education Strategy

One of the objectives of the activities supported under the preparation of the Second National Communication was to strengthen the process for the development of educational strategies on climate change. In this context the SNC has worked across all levels in the country to analyze the needs and implications of introducing the theme of climate change on the national education system.

The Climate Change Strategy on Education seeks to develop and promote awareness campaigns with adaptation and mitigation activities that will encourage the participation of all sectors.

THE NATIONAL STRATEGY FOR EDUCATION AND COMMUNICATION ACTION LINES

1) To generated in the Bolivian population an awareness process on the impacts of climate change on their environment in order to be able to face adaptation and mitigation actions.

- *i)* Assessing levels of knowledge on the issue of climate change.
- *ii)* Mass Communication and Awareness Campaigns on the negative impacts of climate change and other issues such as vulnerability, adaptation and mitigation.

2) To Develop within the Bolivian educational system, awareness process and training that enable a planned and agreed capacity building process to introduce the topic in education at all levels.

- *i)* To disseminate, increase awareness and to build the capacities of teachers and Education Authorities on the issue of climate change.
- *ii)* To develop educational and communications tools for teach the issue of Climate Change
- *iii)* Introduction of the Climate Change theme on the Bolivian education programs

6.2. Comprehensive Plan for Climate Change Research

The National Climate Change Program of Bolivia, in coordination with the Vice Minister of Science and Technology has initiated actions for Climate Change Research in all areas, in order to build national capacity and to be able to fully interpret the impacts of climate change and other national alternatives for adaptation. In order to achieve this the PNCC has developed the Comprehensive Plan for Climate Change Research.

National development strategies have been incorporated into national policies in the section on environmental resources of the National Development Plan, being the National Mechanism for Adaptation to Climate Change the operative arm.

This plan has as a priority vulnerability, impacts and adaptation assessments. However, it should not lose sight of the need for baseline scenarios for greenhouse gas mitigation.

Articulating science to development is a big challenge. However, Bolivia considers necessary to build a research network on climate change by integrating a learning process in major research centers in the country in response to national policies and could create a sustainable process. This network is based on a structure that covers all areas of climate change research.

6.2.1 Strengthening national capacity for systematization

Since 2008 Bolivia pursues a complementary initiative driven by UNDP "Strengthening National Capacity of systematization of knowledge, information and dissemination of climate change", aimed to strengthen national capacities for systematization, information and dissemination of the issue of climate change. The initiative is being implemented with the assistance of a Technical Committee who provides general guidelines and approves documents relevant to the implementation of the project. This Committee consists of the Government Focal Point for Climate Change, donors and UNDP.

6.3. Technology Transfer

Technology transfer is understood as a broad set process covering knowledge flows, practices, experiences, equipment, technologies and methodologies that are widespread among various actors with all the elements for its practical application. Unfortunately this activity has not been carried out by any UNFCCC country listed in Annex I.

Bolivia in 2003 published a document on technology needs assessment for the following sectors: energy, industrial and LUCF. The paper evaluates preliminarily existing technology needs at the country level, to enable capacity building for zdaptation and mitigation of climate change.

6.4. Public Awareness and Dissemination of Climate Change

Bolivia has been making and developing a series of awareness and dissemination activities related to climate change, its causes, its consequences and ways to tackle it. Precisely in the context of the PNCC five Year Plan has developed a series awareness and education campaigns.

The main activities were

- Training for decision makers (policy makers, prefectures, municipalities, communities, etc.) within the institutional framework that will allow them to incorporate knowledge on climate change vulnerability, adaptation, mitigation, etc. within their action policies · Promotion of regular spaces for dialogue between civil society organizations, conservationists, farmers, grassroots organizations, industry, NGOs, etc.., Placing an optical widespread climate change and its implications, so that training also occurs within these areas.
- Promoting the introduction of the theme of climate change into national educational curricula.
- Creating social awareness and social sensitivity towards the issue of climate change.

The PNCC has produced a series of publications to guide society in climate change issues and has also produced a quarterly newsletter to report on the progress of state activities on climate change and further to update on the current

international discussions on the topic. It has also strengthened children's spaces for understanding climate change, through interactive and participatory projects.

7. CONSTRAINTS, GAPS AND FUNDING NEEDS, TECHNOLOGY AND CAPACITY BUILDING

Bolivia requires strengthening the human and institutional capacities to address climate change, primarily to understand the impacts of climate change on all sectors of its economy; given the size of its territory and the existence of different ecological systems this process will require additional efforts and resources.

7.1. Institutional needs

Bolivia over the past few years has worked hard on improving institutional capacities; as a result several sectors have begun to assess the implications of climate change. Some social sectors have initiated an open discussion on what climate change meant for their development. Non-governmental organization has also begun incorporating the variable of climate change into the projects supported by them.

However, there is a long way to go on what is called the process of incorporation of the variable climate in the planning – action activities in the country.

7.2. Capacity needs and research

Bolivia will require developing national strategies for adaptation and education to climate change, to accomplish this it will need to create multidisciplinary research centers in different regions. At the same time it will need to create centers for technology analysis for mitigation and adaptation.

In this context knowledge transfer to the universities is vital, and in particular the generation of scientific and critical capacities to address the causes and consequences of climate change. Strengthening research and education will only be plausible to the extent that the centers have the tools, means and capacities.

7.3. Technology transfer needs for climate change mitigation

The technology requirements in the residential sector can be classified into three groups: technology for the construction of residential buildings, technology to equip residential buildings and for the use of renewable energy.

In the area of cooking there is a pressing need for actual transfer of technology for enhancing systems in rural and peri-urban areas, an at the same time will improve health conditions in rural areas.

In the lighting sector, Bolivia has taken a bold step in introducing the use of energy efficient light bulbs in urban and rural areas; nevertheless there is still a strong need to expand coverage throughout the country and primarily to incorporate these lighting systems in street public lighting.

The transport sector in the country has taken significant steps in using fuel alternatives Bolivia has initiated campaigns to encourage fuel switching, particularly from diesel to compressed natural gas (CNG) or gasoline-CNG dual systems. However, it requires improvement in cost and technologies to achieve better results.

In forestry sector some new technologies could be introduced for a more effective monitoring of the protected areas, especially where there is illegal logging and the resources of the loggers exceeds the control capacity of the state.

Some other technologies could be introduced to reduce methane emissions from cattle.

7.4. Technology transfer needs for adaptation to potential climate change

In the field of agriculture, improved irrigation systems are required. The area under irrigation in the country is very low, new technologies will allow the expansion of croplands, making optimum use of irrigation water in different regions.

There is also the potential to improve the quality of the crops through biotechnology. To determine the adaptation potential is relevant to establish plant genebanks in networks with clear objectives for the use of biodiversity.

There is a wealth of local knowledge in the country to predict the weather, so it is important to make efforts to rescue indigenous knowledge to solve some of the problems caused by climate change.

In terms of water and sanitation, is important to invest on alternative water sources, given the evidence of glacier mass loss, there is an increase of the runoff and the consequent losses. Dam construction is a high cost alternative. It is urgent to develop technology for construction of small water reservoirs that will store high mountain ground water.

The country's demands technologies for bio-remediation of water sources, for creating efficient systems for water consumption and treatment plants, and also for wastewater treatment.

7.5. Technology transfer needs to improve the systematic observation

The SENAMHI has received important support to improve their monitoring systems; however given the size of the country Bolivia needs more and better technology for strengthening the network of weather observation systems. A technology required in the country is radar, to allow the estimation of storms and hailstorms with greater precision.

It is also imperative to transfer technology for the development of regionalized climate scenarios with high resolution. There is also the need for capacity building for re-analysis of climate data in areas of high vulnerability to climate change.

A related issue is the rain gauge network of hydrological observation network flows with flood warning stations in major river basins that threatens human settlements. In this context, Bolivia lacks of equipment to detect real-time floods.

7.6. Funding Needs

The Plurinational State of Bolivia has decided to face the implementation of the National Mechanism for Adaptation to Climate Change as a strategic measure that will support development efforts being carried forward. This has raised the need for a National Adaptation Fund that would cover the costs of extreme weather events that are increasing in time and space, and the subsequent loss of glaciers, crops, infrastructure, and other difficulties that will arise from new weather conditions.

The Fund will require multilateral and bilateral contributions from developed countries generated to cover the climate debt owed to developing countries and thus meet its commitments to the UN Framework Convention on Climate Change.

So far Bolivia has only received funds from the Global Environment Facility for the preparation of national communications and some of the Special Fund for Climate Change, and calls for a less bureaucratic and more transparent and equitable transfer of resources.

Bolivia recognizes, however, the bilateral support and cooperation through various countries especially the European Union.