Climate Change
Relevant Aspects at World and National Levels+

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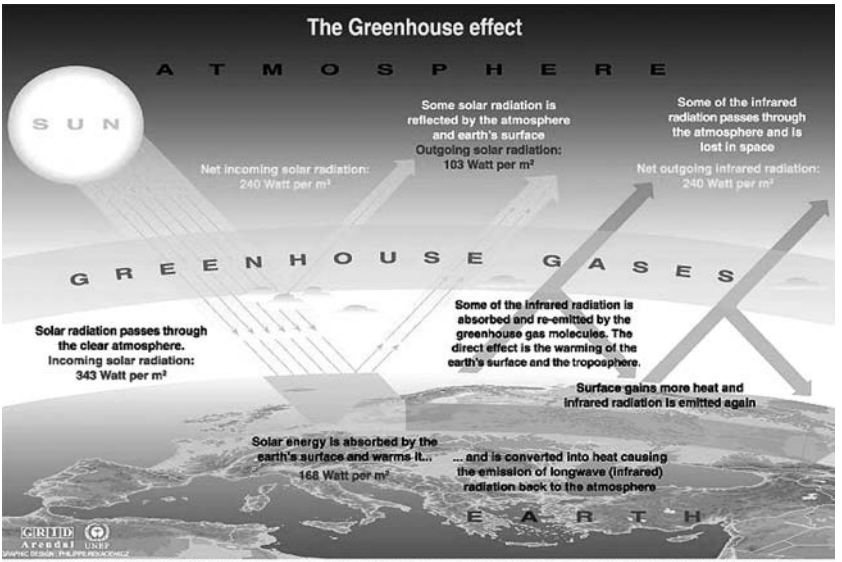
1 The Problem

The chemical composition of the atmosphere includes what is called Greenhouse Gases (GHG) that allow the sun's short wave radiation to pass through, trapping the portion of long wave radiation emitted by the Earth's surface.

Life on Earth has been possible thanks to the naturally occurring greenhouse effect, which makes possible an average global temperature of approximately 15 °C. Without this effect, the temperature would hover around -18°C.



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

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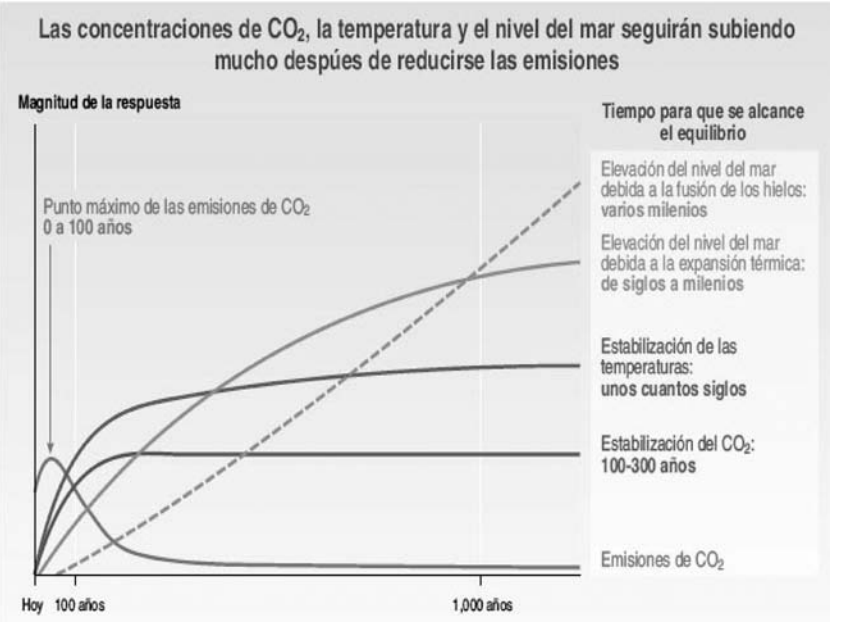
Since the pre-industrial era, man's "energy-related" (supply and use of fossil fuels for energy generation) and "forest" (land use, change of land use and forestry) activities, among others, have increased the naturally occurring greenhouse effect due to the increase of Greenhouse Gases (GHG)[1] in the atmosphere. This increase generates a greater potential of absorption of long wave (caloric) energy generated by the Earth, and obviously additional warm up.

The rapid increase of anthropogenic emissions of GHG and their impacts are cause for increased world concern, since there are no antecedents of significant variations in such short periods of time, especially when these are the result of human activity. Even if GHG emissions decreased and their atmospheric levels tended to stabilize, climate will continue to change during the coming centuries and even possibly during the next millenniums.

This problem implies that "historic generators" of GHG (the developed world), as well as "future generators" (developed and developing countries) must respect and comply



1 According to the UN Framework Convention on Climate Change, GHG means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and reemit infrared radiation. The main GHG are carbon dioxide, water vapor, carbon monoxide, methane, nitrous oxide, etc.

with their common but differentiated responsibilities, as set forth in the United Nations Framework Convention on Climate Change.

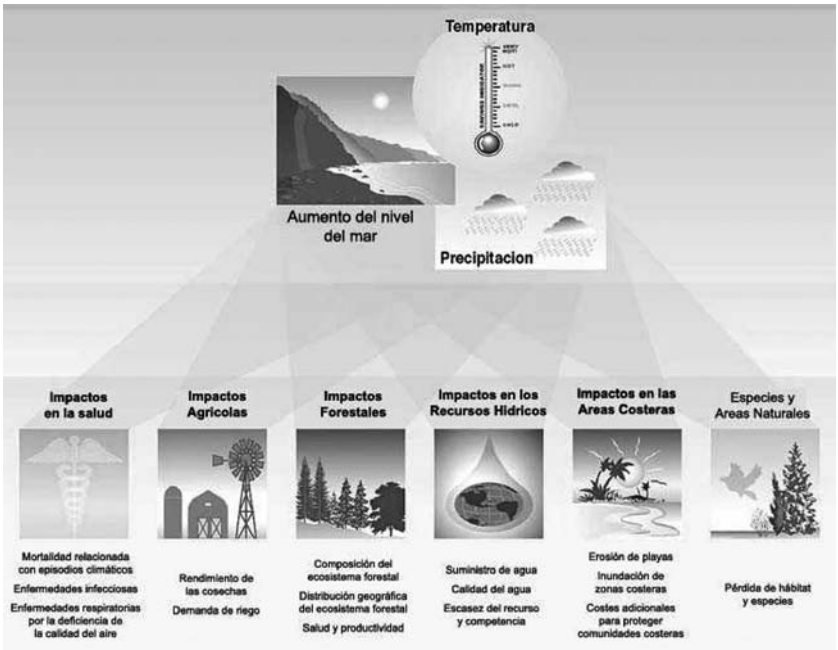
2 Climate Change: Conceptualization and Components

According to the United Nations Framework Convention on Climate Change (UNFCCC), climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

This explanation means that climate, both present and future, has two components, one natural and another anthropogenic (climate change). Beyond attributing global or particular changes in the climate system to natural or anthropogenic origins, climate variations and the impacts they generate are a reality that needs to be addressed.

Climate change can be divided in two main components: causes (mitigation) and impacts (vulnerability and adaptation).

On a global scale, approximately two thirds of GHG emissions



are generated by the energy sector, and one third by changes in plant cover, where the developed world is responsible for two thirds of said emissions. All the measures intended to reduce the net concentration of GHG are framed within the mitigation component.

The carbon market is included as an important element within the mitigation context, as a result of quantified commitments to emission reduction assumed by developed countries under the Kyoto Protocol.

The second component of climate change (vulnerability and adaptation) is related to climate system variations and their impacts on social, economic and environmental sectors. Changes in the climate system (for instance, rainfall, temperature, average sea level, glacier retreat) generate impacts on a series of ecosystems, social sectors, geographic regions, etc.

Additionally, several significant cross-cutting components should be considered among these components: public awareness, information and monitoring, capacity building, technology transfer, etc.

This means that climate change goes way beyond climate itself, because it involves several emission generating sectors and human groups, ecosystems, and zones potentially affected by these changes.

3 International Response

For several decades, the scientific community knew and had evidence regarding the global warming issue, but the world political community would not pay attention. The First World Climate Conference in 1979, the dire consequences of the Sahel drought, several world conferences held in the 1980's and other significant milestones laid the foundations for political decision.

The first official political reactions came from United Nations agencies:

- The United Nations Environment Program and the World Meteorological Organization, through the creation in 1988 of the Intergovernmental Panel on Climate Change (IPCC) and the publishing of its first Assessment Report that mentioned the possibility of climate change as a result of anthropogenic activity.
- The United Nations General Assembly for the establishment of an Intergovernmental Negotiation Committee.

The Earth Summit of 1992 adopted the United Nations Framework Convention on Climate Change (UNFCCC), as the world's

first big political response to climate change. The Convention entered into effect in 1994.

A solution to climate change is currently being led by the UN through the United Nations Framework Convention on Climate Change and the Kyoto Protocol (in effect since 2005).

In addition to these two international legal instruments, several regional forums have initiated actions to support countries in their efforts to address climate change, including the Ibero-American Forum of Environmental Authorities, the Andean Community of Nations, the Amazon Cooperation Treaty Organization, etc.

3.1 Current World and Regional Situation

At present, the issue has gained notoriety at national and world level, mostly as a result of at least three processes/documents disseminated over the last few months: the Documentary "An Inconvenient Truth" (Al Gore, mid 2006); the Stern Report: Economics of Climate Change (J. Stern, October 2006), and the Reports of the IPCC Working Teams (February, April and May 2007)

The findings of these documents have ratified and clarified the results generated by the international community over the course of the last decades: With a certainty of 90%, CC is attributable to human activity; the "damage has already been done". The impact will be felt for centuries and possibly millenniums, and CC is not only an environmental problem but also an essential element of sustainable development.

According to the Stern Report, if the world does not take drastic measures, the cost of inaction could range between 5% and 20% of the world's GDP every year; should measures be taken, it could be reduced to 1%. Within this context, poorer countries/societies/communities will be the most vulnerable.

According to the Reports of Groups I and II of the IPCC, changes expected this century may be summarized in:

- An increase in temperature by the end of the century:
  - Best estimation: 3° C
  - Probably between 2-4.5° C
  - Very unlikely: < 1.5° C
- Temperature in the next two decades:
  - Increase of 0.2° C each decade
- Increase of average sea level: 18 – 59 cm.
- High probability that changes in the 21st century will be more intense than in the 20th century.

- High chance of changes at regional scale:
  - Greater frequency of extreme events: heavy rainfalls, heat waves, extreme temperatures.
- Rainfall:
  - Very likely increase in high latitudes
  - Probable decrease in subtropical continental regions
- Warming:
  - Higher on high latitude continents and regions
  - Lower on southern oceans, and in parts of the North Atlantic sea
- Contraction of ice cover

4 National Response

The Climate Change Process began after the adoption of the Convention in 1992, mostly with the assistance of international cooperation that funded several projects to support advances in political, institutional and scientific fields.

The ratification of the Convention in 1993, and of the Kyoto Protocol in 1999, as well as the presentation to the UNFCCC in 2000 of the first National Communication, are the major advances in the international political arena.

The National Communication to the Convention, prepared between 1999 and 2000 under the GEF-UNDP ECU/99/G31 Climate Change Project, presents an abstract of the political, institutional and scientific advances achieved; it proposes 39 adaptation and mitigation projects within the energy, forestry and agriculture sectors; it defines national requirements in terms of capacity building, vulnerability and adaptation, impact of response measures, mitigation, GHG inventory, CC assessment system, national communication preparedness process and public awareness, and it insists on adaptation as a top priority.

In the beginning, climate change coordination in Ecuador evolved following national and institutional conditions in effect at times when international cooperation has been available. First it began with the establishment of the National Meteorology and Hydrology Institute (INAMHI); later on, the Environmental Advisory Commission of the Presidency of the Republic was included, then the Ministry of Environment (1996), and finally the National Climate Committee, as the responsible entity for addressing the CC issue in Ecuador.

At present, the National Climate Committee exercises coordination and is responsible for the matter. It was initially created by Executive Order in 1999, and it is currently included in the Unified Text of Secondary Environmental Legislation, Title VII, Book VI, Environmental Quality.

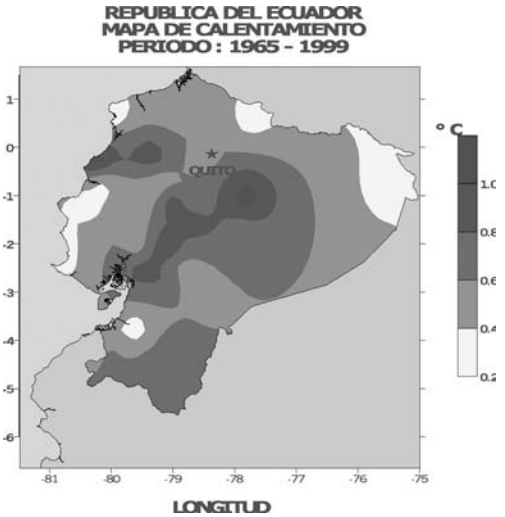
The structure of the National Climate Committee has two levels: a political level and an operational level. The political level is headed by the Ministry of the Environment and includes the Minister of Energy and Mines, the Minister of Foreign Affairs and delegates from CEDENMA, CONESUP and the Coastal and Highland Chambers of Production. INAMHI acts as Permanent Secretary. The operating level is made of 11 work groups, several of which are already in the process of being implemented.

Over 50 studies and research papers have been prepared by several public and private entities, universities, NGOs, etc. Study issues are related to mitigation (energy, forestry, agriculture), as well as adaptation (agriculture, water resources, forestry, fishing, coastal marine sector, etc.), and cross-cutting basic issues like CC evidence in Ecuador, development and technology transfer, and the GHG inventory.

4.1 Evidences of Climate Change

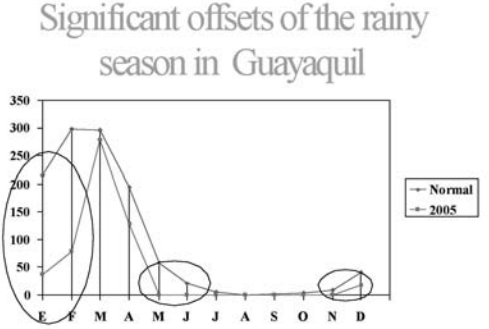
As a result of climate variability (El Niño, flooding not related to El Niño, droughts, frost, heavy rainfalls, etc.), Ecuador has endured serious social, environmental, and economic consequences. As an example, it is worth recalling that the impact of the 1997-1998 El Niño cost around 3 billion dollars, excluding the loss of human lives, ecosystems and in general the damages caused to the environment.

Climate change in the country is evidenced though studies undertaken by several national and international organizations and consultants, which



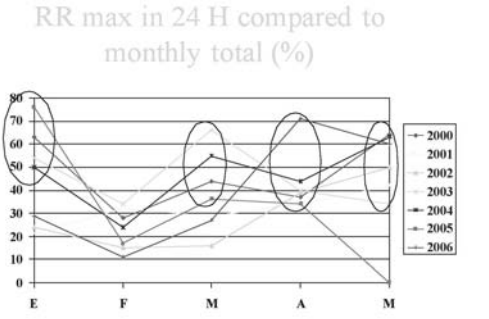
show sustained increases in temperature, changes in frequency and intensity of extreme events (droughts, floods), changes in the hydrological regime, and glacier retreat.

These changes have worsened over the last years. Several emergency decrees were issued in 2006 to tackle the lack of rainfall; several regions in the country have suffered unusual heat and cold waves, significant discrepancies of rainy seasons and very intense rainfalls in short periods of time, followed by days with no rain, as illustrated in the following graphs.



Fuente: INAMHI

Elaboraci ón: L. C áceres



Fuente: INAMHI

Elaboraci ón: L. C áceres

An analysis of the last 7 years reveals considerable displacements in the beginning of the rainy season. As an example, the graph on the left illustrates year 2005, in Guayaquil, when the rainy season started very late and ended rather early. The graph on the right shows the increase of rainfall intensity, for instance, in 4 of the last 7 years, in just one single day it rained between 50% and 80% of the amounts expected for the whole month.

Ecuador does not yet have studies evidencing or refuting potential changes in temperature and in average sea levels.

The National Government decreed a state of emergency in the agricultural sector at the end of July, in an effort to address the lack of rains.

4.2 Potential Impacts of Climate Change

The methodological assessment is based on the identification of potential changes that may be present in a given sector (for instance, agriculture) or in a geographical area (the Lower Guayas River Basin) under different climate change scenarios.

Studies carried out in the country demonstrate the vulnerability and potential impacts under four climate[2] change scenarios identified by INAMHI. Currently, updated global, regional and national information is available, but the scenarios require updating. Some of the results of the studies carried out in Ecuador are summarized below. They are included in the First National Communication mentioned before.

Agriculture Sector: In the study undertaken by the Ministry of Agriculture and Livestock, food security[3] was taken into consideration for years 2010 and 2030, in normal climate conditions, and under two climate change scenarios.

The supply of rice, hard corn, soybean and potatoes, under the ECC2, would exceed in different levels the requirements of the population in 2010. Should the ECC3 take place, the supply of rice and potatoes would exceed the demand, but the opposite would occur for soybean and hard corn.

For the year 2030 and under scenarios ECC2 and ECC3, the demand would exceed the supply of rice, potatoes and soybean in differing levels, while in the case of hard corn it would be the opposite.

Forestry Sector: The Holdridge methodology was used to make the assessment under current conditions

2 ECC1: Temperature:+ 1,0°C, Rainfall:- 15%. ECC2: Temperature:+ 1,0°C, Rainfall:+ 20%. ECC3: Temperature:+ 2,0 °C, Rainfall:- 15%. ECC4: Temperature: + 2,0°C, Rainfall:+ 20%.

3 In the study, food security results from comparing offer against demand of product under analysis.

and under the four CC scenarios mentioned in this document. The work was prepared by CLIRSEN. Findings show that the number of humid zones would decrease, while dry zones would increase. For instance, with an increase in temperature of 1°C and a 20% increase in rainfall, dry zones would augment in 14%, aggravating current existing problems in the provinces of El Oro, Guayas, Manabí, Chimborazo, Bolívar and Loja.

Coastal Marine Sector: The Lower Guayas River Basin. The study took the Lower Guayas River Basin as a pilot area. Two scenarios for the assessment of average sea level (30 and 100 cm) were considered. With an increase of 30 cm, the basin would suffer, among other impacts, a loss of 231 km2 of shrimp farms, 347 km2 of mangrove, 38 km2 of urban areas, 167,000 people would have to be evacuated and another 132,000 would be in danger.

Water Resources Sector: The study was developed by INAMHI and compares resource supply and demand in 10 of the country's main river basins. When comparing resource supply and demand (under the 4 climate change scenarios), the following findings were identified:

Under scenario ECC1: Deficit increase and worsening of runoff periods, rather critical in the Esmeraldas, Pastaza and Napo river basins.

Under scenario ECC2: Conditions under this scenario are less worrisome compared to the previous, with respect to the possibility of lower supply versus demand, because dry periods would be shorter.

Under scenario ECC3: This is the most critical scenario; deficit values are the highest for the basins mentioned under ECC1.

Under scenario ECC4: The possibility of rainfall increases generates an increase in supply, reducing deficits in time and quantity versus demand.

INAMHI has also made a preliminary assessment of the potential impacts that would take place in Paute and Agoyan. Thus, considering scenarios ECC1 and ECC2, which imply rainfall reduction, the Agoyan Hydro-electrical Project would be affected by a reduction of 23% in water inflow, principally during the dry season, and the Paute Project would barely cover between 43 and 45% of average generated power, or a deficit of about 27% compared to the production of energy under normal conditions.

On the other side, a higher frequency in the outbreak of tropical diseases has been registered in relation with temperature and humidity increases, this is related with the appearance of appropriate environ-

ments for vectors of these diseases to grow and develop.

It must be pointed out that these works are pilot studies; they do not have a national coverage nor do they include all sectors, ecosystems, geographical spaces, or human groups most vulnerable to climate changes. These groups include the following:

- Sectors: food security, biodiversity, forestry, health, infrastructure, hydro-energy, fishing, tourism, water resources, etc.
- Ecosystems: high altitude prairies, mountain/glacier systems, wetlands, mangrove, forests, etc.
- Geographical spaces: coasts, Amazon region, mountainous systems, national parks, the Galapagos Islands, protected areas.

The shortage of economic and environmental assessments on climate change impacts is worth noting. Even studies on the impacts of El Niño do not include environmental assessments.

4.3 Greenhouse Gas Emissions

Greenhouse gas emissions in Ecuador are mainly generated by the energy sector and by changes in land use. Due to its magnitude, carbon dioxide is the country's major source of GHG, followed by carbon monoxide and methane. Nevertheless, it is necessary to underline that Ecuador is a marginal emission source of GHG, as its emissions represent less than 1% of the world total.

Some 69.5% of CO2 is produced by changes in land use (conversion of forests and prairies, and changes in forest composition), and 28.8% by the energy sector (transport, small scale combustion and industry).

Methane emissions are basically the result of activities related to rice crops, flooding, and enteric fermentation of animals.

4.4 Planning - Institutionalization - Policies

In spite of the significant socio-environmental and economic impacts registered as a result of abnormal climate events like floods, droughts, frost, El Niño, etc., Ecuador has a very limited response capacity, because in previous extreme events like these it has had a reactive response instead of a preventive one.

The relationship between sustainable development and climate change is a reality confirmed at national and world level, moreover when the impacts of climate variation will be more significant in already high vulnerable countries, regions, human groups and ecosystems.

National, regional and local planning do not include climate system variations in their policies, programs and projects. This barrier translates into the fact that state institutions do not have sector policies, and they lack responsible units and budget.

Several national initiatives and strategies in process, related to fighting poverty and to food security, Millennium Development Goals, etc., barely contain slight references to this issue, while climate change and the occurrence of extreme events may generate significant impacts on the success of these initiatives.

Under these climate change conditions, the country's vulnerability to risks originated by climate is even higher.