Latin America and the Irreversible Effects of a Warmer Planet

First Regional Report on Climate Change

TERRAMÉRICA

Environment and Development

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Tierramérica is an environmental and sustainable development news service published weekly by 20 newspapers in 13 countries of Latin America. It is produced by the news agency IPS and sponsored by the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank.

INTRODUCTION

A Journalistic View

For many years one side has been warning and denouncing, while the other underestimated and denied. But at long last, reality has prevailed. Nobody in their right mind now doubts the severity of the threat that climate change poses to life on the planet as we have known it.

Every expert agrees that even if we did everything possible now, even if we acted with the greatest of determinations, we are no longer able to prevent the huge impacts that climate change has in store for the planet, and so we should therefore be preparing ourselves to live with these changes and mitigate their worst consequences.

But even with the evidence of imminent disaster before us, those who have the power to act -the national governments and the international community- still fail to react with the forcefulness required.

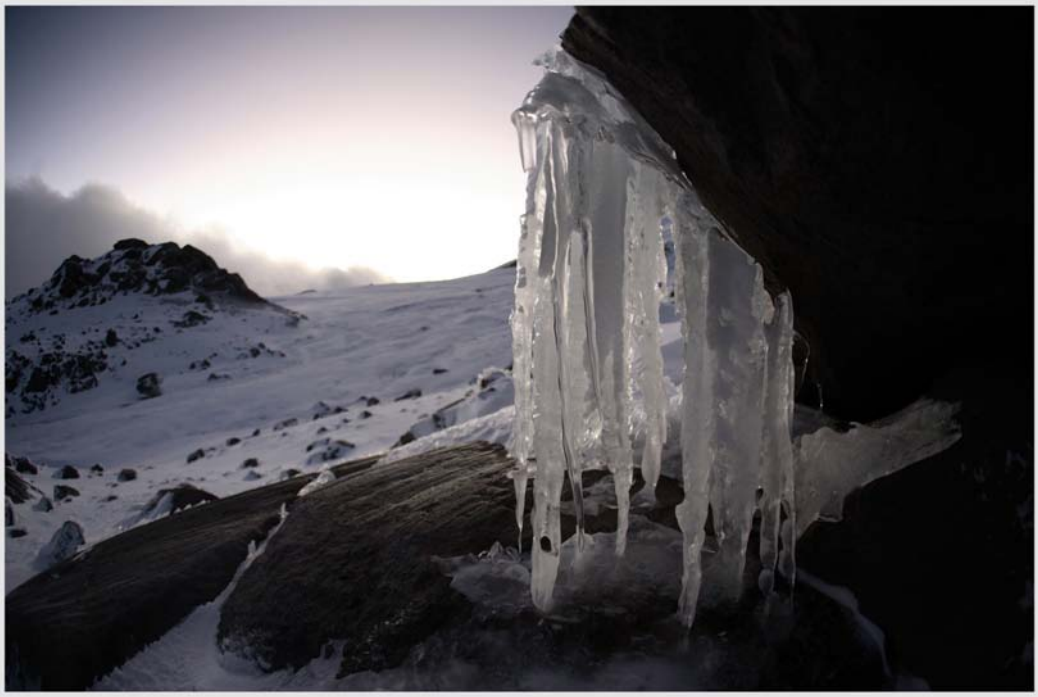
With only days to go before the Fifteenth Conference of the Parties to the United Nations Framework Convention on Climate Change is held in Copenhagen, the forecasts are not very encouraging.

This first report on climate change in Latin America is prompted by the conviction that the issue has been firmly placed on the global agenda, and therefore on the agenda of the media, and will demand ongoing, alert and close attention.

It is part of a larger effort by Tierramérica to periodically consult with experts, scientists and authorities, and representatives of civil society and international bodies to analyse the state of climate change in the region, assessing the gains and setbacks that have occurred either through action or omission.

Its aim is to provide a journalistic and rigorous look at the issue, free of preconceptions, but committed to the greater cause of preserving our planet.

Joaquín Costanzo
General Coordinator
Tierramérica



Melting ice on Pico de Orizaba mountain, Mexico. Mauricio Ramos/IPS

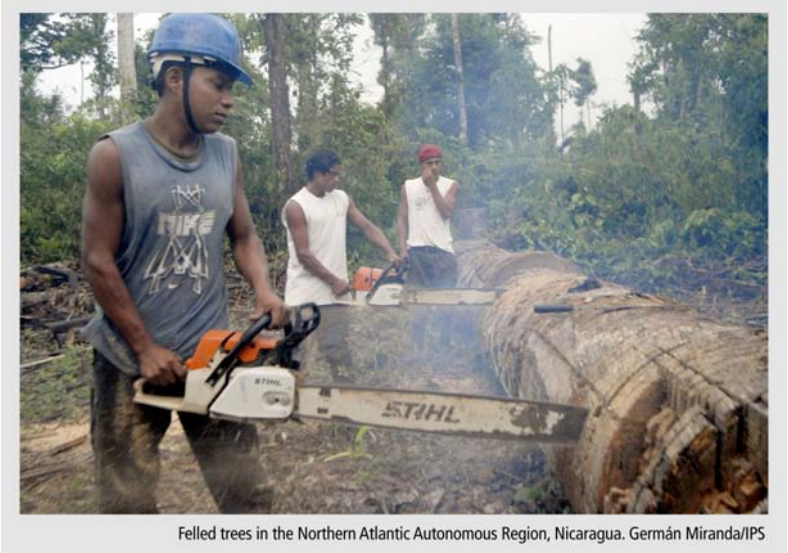
Doubts, scepticism and mixed expectations are what 23 Latin American experts consulted by Tierramérica expressed ahead of the Fifteenth Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 15)

Nearly 600 million people in Latin America and the Caribbean are already suffering the dramatic effects of climate change, ranging from droughts and floods to glacier retreat, temperature rises, and new agricultural pests and diseases, among other ills.

Concern over global warming began to arise several decades ago, and numerous scientific and political meetings have been held on the subject since. But as the world prepares to discuss the issue at the Fifteenth Conference of the Parties to the United Nations Framework Convention on Climate Change (COP15) scheduled for December 7-18 in Copenhagen, 23 experts consulted by Tierramérica are sceptical about the success of this meeting and, therefore, about the future of the planet.

Meanwhile, through deforestation and extreme climate variations, the eastern region of the Amazon rainforest - the largest tropical jungle in the world- is rapidly turning into an extensive savannah; its luscious vegetation and its soil are being substituted with pastures, characteristic of drier lands.

Deforestation causes more than 75



Felled trees in the Northern Atlantic Autonomous Region, Nicaragua. Germán Miranda/IPS

percent of Brazil's greenhouse gas emissions.

The glaciers of the Andean mountain range are melting, and in only 15 years the smallest glaciers will have disappeared completely, putting at risk the water supply of the surrounding cities.

The South Atlantic Ocean, a region previously not affected by hurricanes, is now being hit by increasingly frequent and more devastating hurricanes.

The torrential rains and floods caused by these hurricanes, and the steady rise in sea level are displacing whole communities, populations who lose their homes overnight and are forced to migrate with no livelihood and without food.

In this situation, local and national governments are faced with the challenge of having to allocate special budgets to relocate thousands of people in new habitats, with the ensuing economic and cultural impacts.

Extreme meteorological variations affect agriculture and the productivity of certain crops, thus exposing an increasing number of people in the affected areas to hunger.

Agricultural pests and new human diseases plague the continent, which looks on with perplexity as an unprecedented and chaotic scenario is mounted.

Based on this data, many scientists warn that climate change is no longer just an environmental problem.

The very fate of civilisation is at risk, they say, and if urgent measures are not taken to address it, it will become a major challenge for humanity, eventually endangering all life on the planet, as occurred with the great extinctions that led to the disappearance of more than 90 percent of all living species over the course of millions of years.

The torrential rains and floods, and the steady rise in sea level are displacing whole communities which lose their homes over-night, are left with no livelihood and forced to migrate without

Birds on the coast of Sonora, Pacific Ocean. Mauricio Ramos/IPS

Those extinctions were brought on by great cataclysms, wiping out dinosaurs, reptiles, fish and amphibians. Today, it is human beings themselves who are threatening their own survival.

Human activities contributed to accelerate the planet's normal climate cycles, and the global warming caused by harmful gases emitted into the atmosphere is the indication of how humankind has reached an unparalleled capacity to alter the environment. The very existence of humanity and the ecosystems that support human life are at risk.

The consequences of climate change are only now beginning to be seen. A reduction in greenhouse gas emissions (responsible for global warming and climate change) will not solve the problem immediately.

Even if forceful action is taken now, effectively lowering the planet's temperature is a process that could take hundreds of years. For this reason, scientists recommend taking urgent action to prevent future disasters.

The socio-economic models of development adopted more than 200 years ago, based on the use of non-renewable and contaminating energy sources, are challenging politicians today to devise new paradigms of development, the region's experts interviewed by Tierramérica say.

However, these scientists have mixed expectations about the results and commitments that will emerge from the international negotiations at Copenhagen.

Most hope that enough pressure will be exerted to bring about significant progress in global commitments.

But at the same time they are sceptical because of the industrial powers' reluctance to assume clear obligations, and because they feel that large emitters like India and China must also commit to reduction targets.

India surprised the world in September, during the United Nations Summit on Climate Change, when it announced ambitious targets to curb its carbon emissions. But the final commitment

must come at the Copenhagen meeting in December.

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The Greenhouse Effect, the Leading Culprit

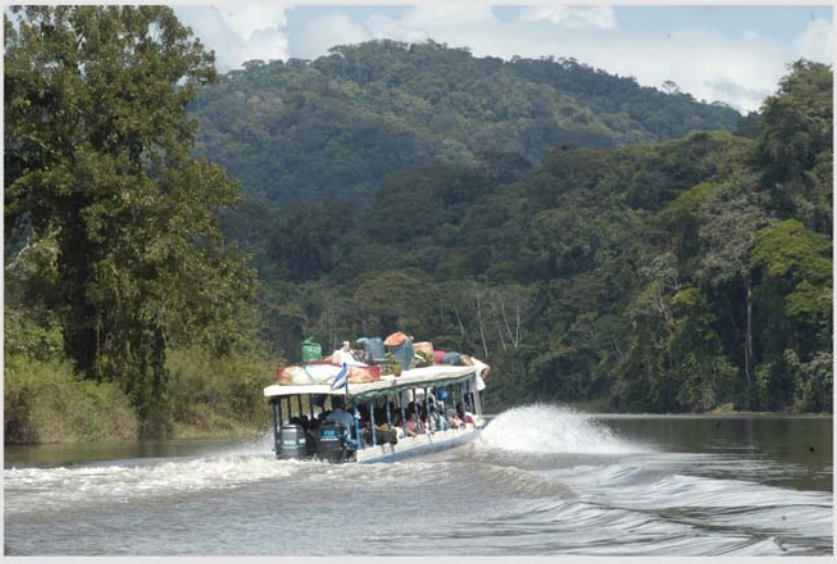
The greenhouse effect is a natural phenomenon whereby the atmosphere regulates the planet's temperature by allowing solar radiation to come through and prevent the heat accumulated over the earth from escape into space.

Certain gases present in the atmosphere prevent heat from escaping, which is why they are called greenhouse gases (GHG).

The main GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapour, ozone (O_3) and halocarbons or groups of gases known as chlorofluorocarbons (CFCs) because they contain carbon, fluorine, chlorine and bromine.

When solar radiation reaches the earth, part of it is transformed into heat. GHGs (in particular, carbon dioxide) absorb the heat and retain radiation. The amount of heat that is retained determines the world's temperature and this mechanism prevents days from being too hot and nights from being too cold.

In addition, human activities also emit four long-lasting GHGs, that is, gases that remain active in the atmosphere for a long time: carbon dioxide, methane, nitrous oxide and CFC. Since 1750, the concentrations of the first three of these gases has increased as a result of production activities, and, in particular, due to the use of fossil fuels and the changes in soil use, for example, in agriculture and deforestation. The



River navigation in Costa Rica. Germán Miranda/IPS

increase registered in methane concentration is primarily a consequence of agricultural activities, as is the high concentration of nitrous oxide.

According to FAO data, 40 percent of global methane gas emissions produced by human action are caused by agricultural activities, and 22 to 27 percent are generated directly by cattle. As the amount of these gases rises disproportionately, they heat up the atmosphere, and this has produced major changes in the world's climate over time.

In its Fourth Assessment Report (AR4), published in 2007, the Intergovernmental Panel on Climate Change (IPCC) notes that global GHG emissions generated by human activities since pre-industrial times increased by 70 percent from 1970 to 2004. Over this period, the greatest contribution came from the energy sector, transportation and industry, while contributions from housing, commerce, forestry (including deforestation) and agriculture increased at a slower pace.

The IPCC, formed by some 2,500 scientists from 190 countries, studies, validates and gathers works on climate issues published by thousands of researchers from around the world. Its reports, which include recommendations, are the result of discussions and agreements between the delegations of the different member countries, and they provide important knowledge and guidelines for decision-making by governments.

It was created in 1988 by the World Meteorological Organisation(WMO) and the United Nations Environmental Programme (UNDP). The first IPCC report was completed in the year 1990. The next two came out in 1995 and 2001, respectively, and the last one was released in 2007.

The reports are prepared by teams of specialists from the different scientific fields that study climate change, although the IPCC invites member States to contribute their comments during the government reviews.

The IPCC is formed by three working groups. The first assesses the scientific aspects of climate change. The second is in charge of analysing environmental aspects of the vulnerability (sensitivity and adaptability) of socio-economic sectors and human health to climate change, as well as the negative and positive consequences (impacts) on ecological systems. Lastly, the third group assesses scientific, technical, environmental, economic and social issues involved in mitigating climate change.

In its leading conclusions, disclosed in the Fourth Report in February 2007, the

IPCC predicted a rise of 1.1 to 6.4 degrees Celsius in global average temperature before the year 2100, as a result of human activity, with a 90 percent degree of certainty.

For its part, the Economic Commission for Latin America and the Caribbean (ECLAC), in a report entitled "Climate Change and Development in Latin America and the Caribbean: A Review," prepared under the coordination of Chilean researcher and scientist Joseluis Samaniego and released in early 2009, concludes that "halting the increase in the concentration of these gases in the atmosphere, so that by the end of the century they are stabilised at a range of 500 to 550 parts per million (ppm), would entail a rise in global temperature of 2.5 to 3.5 degrees Celsius. If that level is exceeded, every system in the world will have reached its limit of change, with very scarce chances of adapting."

The volume of greenhouse gases in the atmosphere increases at an annual rate of approximately 2.5 ppm a year and the current concentration stands at about 370 ppm, according to the study. "If this growth rate continues, in 48 years concentration will have reached 500 ppm, but emissions will not have stopped. This means that we are quickly running out of time to attain the goal of stabilising the concentration of GHGs at safe levels," it concludes.

According to the ECLAC report, in the year 2000, the greenhouse gas emissions of Latin America and the Caribbean accounted for 11.78 percent of the world's total.

"What distinguishes the region is the huge contribution of emissions from the loss of forest cover as a result of the expansion of the agricultural frontier," the report states.

> "Global warming and climate change are clearly evidencing that our biological species has reached an unparalleled capacity of altering the environment in an inadvertent and unprecedented way." (Carlos

The fourth IPCC report warns that some of the impacts that global warming will produce will most likely be irreversible. These impacts include the extinction of 20 to 30 percent of the animal and plant species that have been assessed by hundreds of studies (which are only a fraction of the known species) if the world's temperature increases 1.5-2.5 degrees as compared to 1980-1999 levels.

But, it the world's average temperature increases more than 3.5 degrees, the models projected indicate massive

worldwide extinctions (40 to 70 percent of the species assessed).

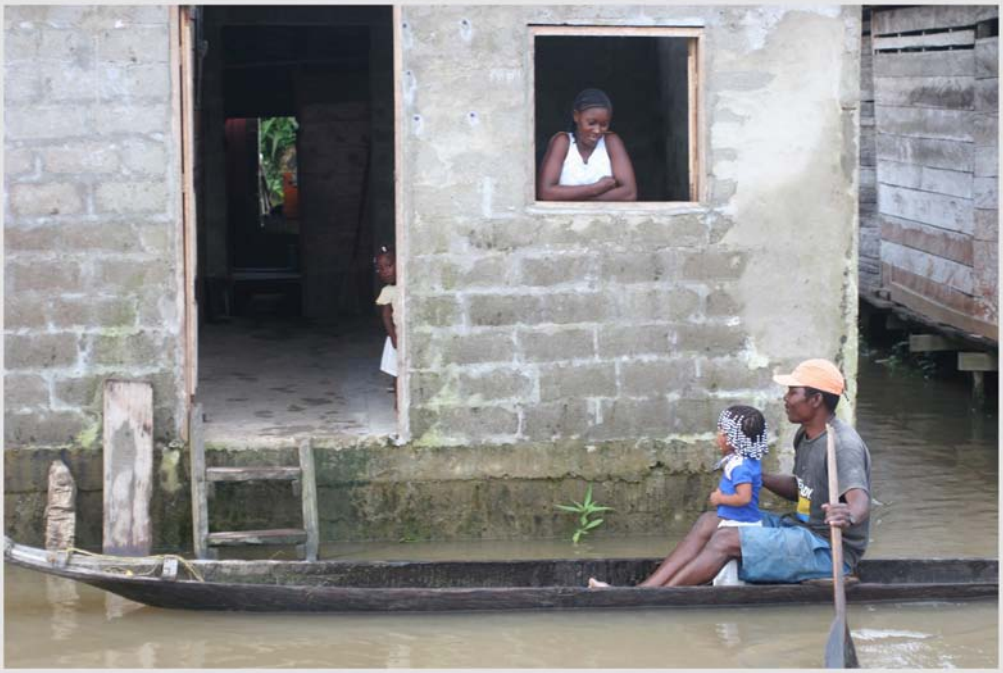
Some researchers and activists warn that the effects of even a two-degree Celsius increase will be more severe than anticipated, and therefore the maximum threshold of GHG concentration in the atmosphere should be no more than 350 ppm for the next four decades.

Bleak Outlook for the Region

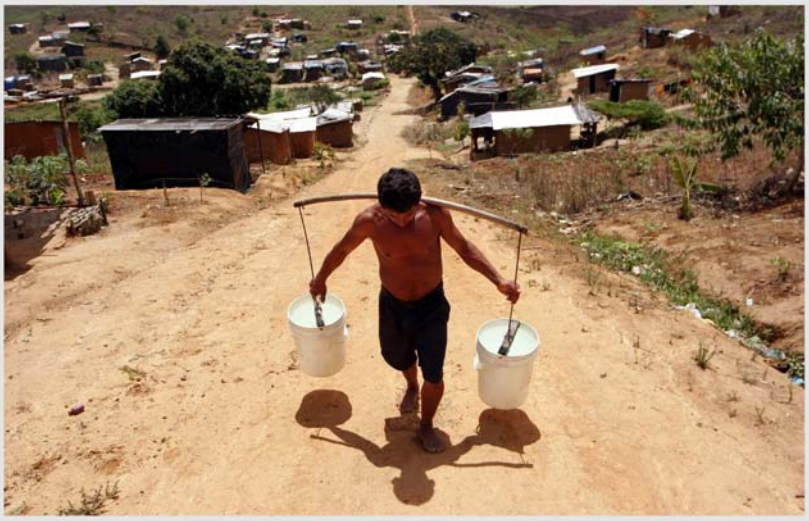
As the situation stands today, Latin America and the Caribbean -which by 2010 will have a population of almost 600 million inhabitants- is, in fact, one of the most vulnerable regions in the world, and the phenomena projected for it by computerised climate models exceed the most conservative forecasts.

The region contributes little to the generation of emissions but it still suffers its effects. "It is among the most vulnerable regions for several reasons: because it is located below the hurricane belt and has numerous islands States and low coastal areas; because it depends on the Andean snowmelt for urban and agricultural water supply; and because it is exposed to floods and forest fires," ECLAC diagnosed.

Tierramérica's survey -which included several IPCC collaborators and ECLAC study authors- concluded that the most evident and negative effects in the region are the increase in climate variability and the greater occurrence of extreme events.



Villages on the banks of the Atrato river in the Colombian Chocó rainforest are repeatedly flooded. Jesús Abad Colorado/IPS



Carrying water in the Chico Mendes landless peasant settlement, Pernambuco, Brazil. Alejandro Arigón/IPS

Eleven of the 12 years in the 1995-2006 period are the warmest years on record since 1850.
In almost every country of Latin America, the temperature has gone up considerably in the last 40 to 50 years and there has been a marked variation in annual rainfall and in the time of year the rainy or dry seasons start.
The annual mean temperature of Mexico City "increased by more than four degrees since the beginning of the twentieth century," Fernando Tudela, Mexico's Under Secretary of Environmental Planning and Policies, told Tierramérica.
Already in the first decade of the twenty-first century, temperatures in the northern Andes increased at a rate of more than 0.6 degrees per decade.
South America's glaciers are retreating, severely affecting the ecosystem and the water supply of Andean cities.
The extreme droughts experienced in 2005 in the southwest Amazon Basin are an indication of what could happen if, as many models forecast, the lack of rainfall starts to affect part of the Andean region and endangers its plant and animal life.
Corals will lose their characteristic colour, bleached by the abnormal warming of the sea surface. But the effects of high sea temperatures will be felt even at depths of more than 3,000 metres.

"In only 15 years, certain coastal areas, primarily in the Caribbean and the Continent's lowest coasts, will have lost part of their surface, and this loss will affect coastal tourism and artisanal activities." (Alicia Villamizar, Vene-

As for animal life, the region will experience a reduction in the distribution, abundance and existence of amphibian species.
Hurricanes will be intensified, even in areas where such phenomena are unusual, like the South Atlantic.
A clear example of this is Cyclone Catarina, which

impacted southern Brazil in 2004. In 1998, Hurricane Mitch, for instance, affected several countries of Central America, killing between 10,000 and 19,000 people and causing damages estimated at two-thirds the gross domestic product (GDP) in Honduras alone. By 2025, hurricanes will be causing three times more damage than they did in the 1979-2006 period.

In agriculture, unsustainable exploitation and the expansion of croplands is wiping out natural forests. This further contributes to increase carbon dioxide emissions. Forests are sources of absorption of carbon dioxide and deforestation eliminates these natural sinks.

An estimated 300,000 hectares are deforested every year in Bolivia -75 percent of them in Santa Cruz- to make room for industrial crops, such as soybean.

The rising temperatures are shortening crop cycles, cutting the time from sowing to harvesting. This phenomenon affects yield and productivity, because less time to grow means less biomass accumulation.

Crops are also being displaced to higher lands. This is happening, for example, in Bolivia with potatoes, which are being planted at very high altitudes.

The immediate evidence of climate change can be observed in the

Corncobs in Chiapas, Mexico. Mauricio Ramos/IPS

increasing temperatures in several regions, particularly in South America. For example, studies conducted in Bolivia's highlands, valleys and plains reveal that in some areas both minimum and maximum temperatures are rising. In other areas, very close to the Andes mountain range, maximum temperatures are increasing while minimum temperatures are dropping.
Extreme droughts (most recently in 2008-2009) affected summer crops, like soybean, corn, sunflower, sorghum and pastures, which are used as feed for beef and dairy cattle. Excess water has also affected winter crops, such as wheat and barley.
In addition to extreme events that affect production, there are other alarming consequences. The frequency of adverse meteorological phenomena, such as floods, hurricanes or droughts, is being altered.
Agricultural systems are thus gradually losing their resilience and the sectors that depend on agriculture are becoming increasingly impoverished.
But the more intense rains have not always had an adverse impact on agriculture. In recent years temperate regions -which include areas of Argentina, Uruguay and southern Brazil- have seen an increase in yields, particularly in summer crops.
In Argentina, Colombia and Bolivia, frost periods have been shortened, and there has been a more significant presence of hail, with larger hailstones, as compared to previous decades.

Disappearing Glaciers

In 2004, the disappearance of the snow peak of Chacaltaya, a 5,300-metre high mountain near La Paz, eliminated one of the world's highest ski runs, and while scientific climate models and projections had announced that the glacier would be completely melted by 2013, there is already almost no ice left on the peak.
The disappearance of this glacier is also significant because of the loss in meltwater and its impact on power generation, as most Andean countries are highly dependent on hydroelectric energy (more than 50 percent of electric power supply in Ecuador, 70 percent in Bolivia, and 68 percent in Peru), John Nash, World Bank lead economist for Latin America and the Caribbean, pointed out to Tierramérica.
Some of the hydroelectric power plants depend on glacial meltwater for their supply, particularly during the dry season.
At the same time, glacial meltdown increases water currents thus multiplying the threat of floods.

But this is a temporary phenomenon. Although it will continue for decades, with time the volume of glacial meltwater from the ice melt will be reduced. This will in turn cause adaptation problems, as populations are generally dependant on seasonal water flows. In the longer term, while the disappearance of glaciers may not affect all water supply, it is likely that it will change seasonal water flow patterns.

> "Regional contingency plans or alert systems to face extreme events, if available at all, are too incipient. In most cases, there are no such plans yet; they are not being given the priority they demand." (Edith Fernández-Baca

Glacier retreat may not only affect the quality and quantity of water, but also the seasonal variation. That is, high seasons will come earlier than expected. As the melting ice consists of freshwater, this phenomenon also contributes to the desalination of seawater, causing changes in marine ecosystems.

Any reduction in the regulation of water flows in the dry season, caused by increases in the variability of rainfall or the reduction of water stored in natural deposits (glaciers, high cold plateaus, mountain lakes), will require new investments in dam reservoirs to maintain electric power generation capacity.

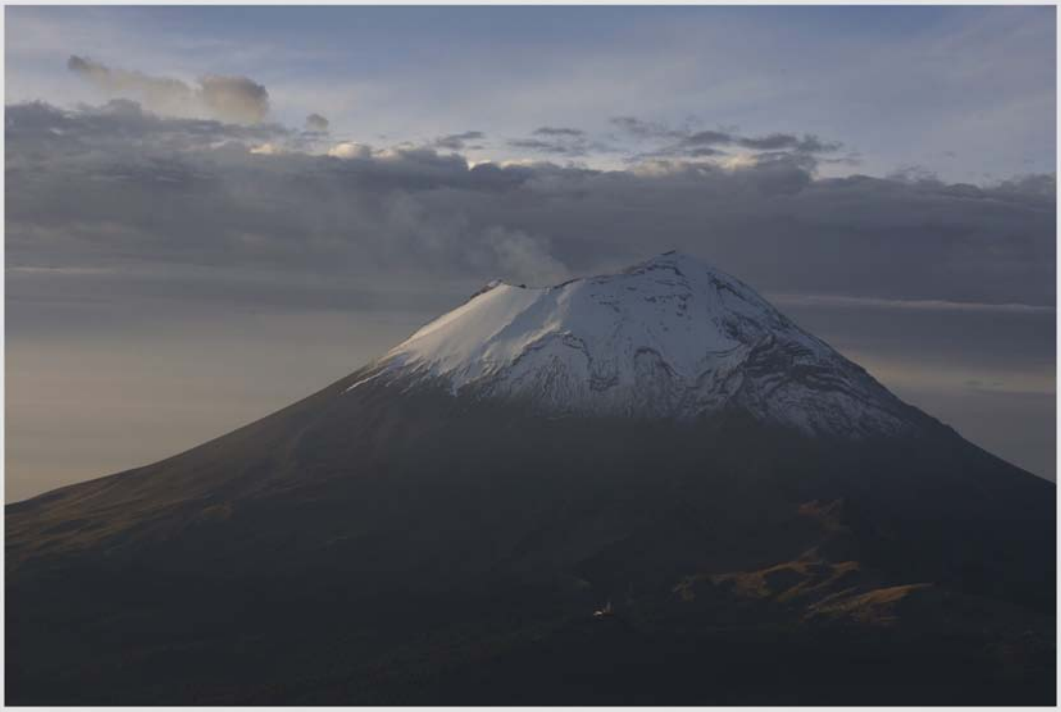
Glacial meltdown will also have severe consequences for the water supply of Andean cities.

José Marengo, a meteorologist and one of the authors of the IPCC reports, considers that the possible alternatives for meltwater as a source of water supply -seawater desalination, well drilling, or basin integration through engineering works- are too costly.

In Peru, the so-called *Cordillera Blanca*, the Pastoruri Glacier -which has great symbolic value and is visited by students from across the country in their graduation trips-, has receded enormously and today little remains of it.

In Mexico, the glaciers of the highlands of Iztaccíhuatl, Popocatépetl and Pico de Orizaba are also being affected by climate change. According to available data, the Iztaccíhuatl glaciers are retreating both in terms of their surface area (in up to 40 percent in a period of 20 years) and their depth (in 1999, the depth was 70 metres and by 2004 it had dropped to 40 metres).

There is a similar trend in Pico de Orizaba and Popocatépetl, the country's tallest volcanoes, but in the latter the



The ice on the Popocatépetl Volcano is also melting. Mauricio Ramos/IPS

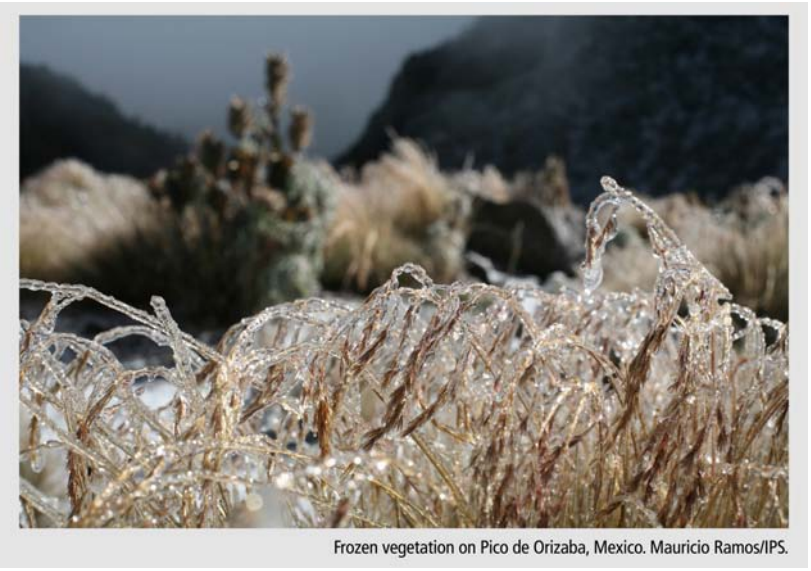
retreat has been accelerated even more by the volcanic activity of recent years. Experts estimate that, if the current rate of retreat of the Iztaccíhuatl and Pico de Orizaba glaciers continues, they could disappear completely within the next 10 and 35 years, respectively, Mexico's Tudela said. The freshwater supply of the cities located in the centre of Mexico depends on these glaciers.

Equatorial icecaps, such as Colombia's, are considered sensitive indicators of climate change. Colombia's six snow peaks or glaciers lose three to five percent of their surface area each year, so that if the current rising temperature trend continues, it is estimated that over the next three to four decades the 47 square kilometres of glacier mass that exists today will be considerably reduced.

None of Colombia's municipal capitals, however, depend solely on glacial meltwater for their freshwater resources.

Rather these come primarily from the high Andean forest and *páramo* (or high cold plateau) ecosystems.

Colombia's Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), which operates under the Ministry of Environment, Housing, and Territorial Development, calls for a detailed protocol to be implemented to identify, select, gather, handle, analyse and register biophysical, geographical and socio-economic information of water and carbon cycles in the high mountain ecosystems. This protocol is



Frozen vegetation on Pico de Orizaba, Mexico. Mauricio Ramos/IPS.

proposed as a scientific base for monitoring activities aimed at detecting possible alterations caused by climate change.

The Most Alarming Predictions

In addition to the rapid retreat of glaciers, the savannisation of the Amazon region, the deterioration of mangroves in tropical or subtropical areas, and the rise in average sea level with the ensuing loss of coastal line are all physical phenomena that enable a diagnosis of the impact of climate change.

In the Andean region, this impact has been evident for more than three decades. While global temperatures have risen at a rate of 0.2 degrees per decade since 1990, temperatures in the central Andean region increased by 0.34 degrees from 1974 to 1998, that is, 70 percent more than the global average.

Another evidence of extreme climate variations is the propagation of vectors, such as the *Anopheles* mosquito, which transmits malaria. This insect has its natural habitat in the tropics, less than 1,000 metres above sea level, where temperatures are normally higher than 20 degrees.

Today, the *Anopheles* is adapting to much higher regions -more than 2,000 metres above sea level-, and can be found, for example, in the valleys of Santa Cruz, Bolivia, and in high areas near the Andean highlands, at 3,000 metres above sea level, where rises in temperature can be observed.

A report released in mid September 2009 by the United Nations Environmental Programme (UNEP) confirms that the

> "Climate change will affect human health through heat waves that will particularly impact the elderly, and combined with air pollution problems in the large cities will lead to an increase in respiratory diseases." (Rosa Moreno,

pace and scale of climate change could outstrip the predictions of the last IPCC study.

The report, entitled "Climate Change Science Compendium 2009," is a review of some 400 major scientific contributions on the subject produced over the last three years.

"We need the world to realize, once and for all, that the time to act is now and we must work together to address this monumental challenge. This is the moral challenge of our generation," United Nations Secretary General Ban Ki-moon writes in a foreword to the document.

The compendium's diagnosis backs the concern expressed by the Secretary General, in particular, in respect to Latin America.

An increase of three to four degrees Celsius over the next 50 years will be the main cause of the potential destruction of the Amazon rainforest.

Even in scenarios with relatively low greenhouse gas emissions, regions like Central America and the Andes will experience a more than 90 percent rotation of species. Thus, these areas' plant and animal life will be radically different from what they are today.

Among recent significant climate anomalies, the compendium cites the intense rainfall that affected northern and eastern Brazil in April 2009, causing floods and landslides that forced over 186,000 people to abandon their homes.

In 2008, certain areas of Argentina, Paraguay, Uruguay and Chile suffered their worst drought in more than 50 years. Ecuador, for its part, experienced extreme floods.

> "The most evident and negative effects of climate change in Uruguay and in the region (the Argentine Pampas and southern Brazil) are the increase in climate variability and the more frequent occurrence of extreme weather events". (Agustín Giménez,

In Brazil, the heavy rainfalls that affected southern states, like Santa Catarina, in November 2008, disrupted the life of 1.5 million people.

Bolivian climate change expert David Cruz Choque, one of the lead authors of the IPCC Fourth Assessment Report, gave Tierramérica some examples of natural disasters that are a result of the variation in frequency and intensity of weather events.

In 1997-1998, the El Niño / Southern Oscillation (ENSO) phenomenon revealed Bolivia's vulnerability to climate risks.

According to a study by the Andean Development Corporation (CAF), the losses suffered as a result of the ENSO phenomenon in that period amounted to approximately 530 million dollars, an equivalent of seven percent of the national GDP. Fifty-three percent of the damages were caused by droughts in the Andean highlands, and the remaining 47 percent by floods, primarily in Bolivia's northern and eastern regions.

In the first months of the year 2000, floods affected 180 families in the locality of Viacha, near La Paz, largely ruining or damaging their potato crops, which are the area's main agricultural activity.

The hailstorm that hit La Paz on February 19, 2002, killed 73 people and caused 10 million dollars worth of material damages.

The June 2002 snowstorm devastated the production of many farmers of Potosí, a department located in the farthest southwest region of Bolivia.

In 2003, the Cordillera province in the eastern department of Santa Cruz was affected by a drought that killed 13 children under the age of five and destroyed almost all of the agricultural production.

Another consequence of frequent droughts are severe forest fires.

Agriculture: Adapt or Perish

The experts consulted concur that the sector worst hit by climate change in all the countries of Latin America and the Caribbean is agriculture.

In the long term, the average loss of revenue in all of Latin America (based on climate change simulations for the year 2100) is estimated at around 12 percent in a mild climate change scenario, and 50 percent in the worst-case scenario.

A similar study conducted in Mexico projects that, depending on the severity of global warming, the country will experience a 30 to 85 percent drop in productivity in all crops and livestock production.

"Naturally, these studies cannot take into account the possibilities of adaptation that may be provided by technological advances in the future. So they should not be considered as predictions of what will inevitably occur, but rather as

> "Climate patterns are altered and that is a fact acknowledged by the vast majority of Andean farmers, who follow the weather very closely because their crops and livelihoods depend on it." (Jorge Recharte,

indications of the need to step up research efforts to develop production technologies aimed at reducing damages," the World Bank's John Nash said.

For Under Secretary Tudela, vulnerability varies depending on the region, the crop and the technologies used. It also depends on the shifts in rain and wind systems, on the incidence of more intense cyclone phenomena, and on the rise in night temperatures.

The new climate conditions herald variations in the degradation rates of agricultural soils, increased salinity of irrigation lands, greater losses caused by disasters (soils that are burned or affected by droughts or floods) and changes in production patterns as a result of water availability and temperature.

Tudela also said that major changes are expected in the distribution and dynamics of pests, diseases and predatory species, as well as a decline in pollination species, which are vital for agricultural production.

According to Tudela, in order to address the decrease in yields and agricultural product quality caused by extreme events, it will be necessary to promote more resistant plant varieties and to design systems that will produce food and generate revenue without negatively impacting the environment.

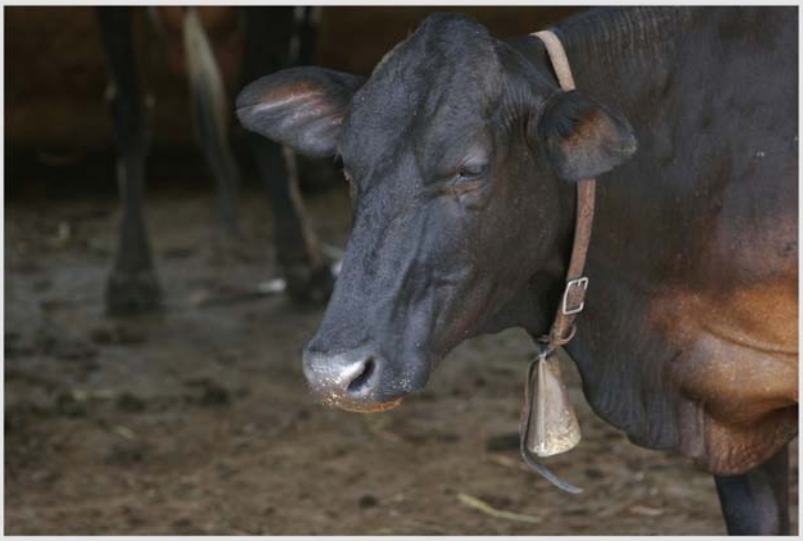
International research centres are in fact devoting efforts to the development of climate-change resistant varieties. They have already successfully developed a water-resistant rice variety that survives floods.

"Reliable weather and agricultural production databases covering extensive periods - 80 to 100 years- are needed to determine the impact of climate change on agriculture. There are very few countries in the region with that kind of records." (Walter Baeth-

In order to counter damages, Tudela says, it is necessary to incorporate adaptation measures that reduce the vulnerability of the agricultural sector and protect its biodiversity.

Also necessary are improvements in water storage infrastructure, technical enhancement of agricultural lands in coordination with local authorities and farmers, and greater studies on the impacts on the sector and its vulnerability to climate change and variability.

With respect to global warming mitigating actions, Tudela said that efforts should be directed to reconverting degraded agricultural lands with low productive potential into



Cattle in Brazil. Livestock is one of the greatest sources of methane emissions in the region. Alejandro Arigón/IPS.

sustainable systems, promoting green harvesting of sugarcane, reducing nitrous oxide emissions (N_2O) from fertilisers, and encouraging the adoption of sustainable agricultural practices, such as conservation tillage to maintain carbon reserves in the soil and increase its carbon sequestration capacity.

Uruguayan expert Walter Baethgen, Latin American and Caribbean Programme Director at Columbia University's International Research Institute for Climate and Society, said to Tierramérica that reliable weather and agricultural production databases covering extensive periods - 80 to 100 years - are necessary to determine the impact of climate change on agriculture. Baethgen noted that there are very few countries in the region with that kind of records.

"The most suitable measures are those that improve the capacity to adapt to the current weather variability, that is, those that enable better management of current climate risks," he said.

He informed that in Brazil, Uruguay and Costa Rica, efforts are being made to adapt the forestry sector, but said that in his opinion the problem of cattle methane emissions must be addressed.

According to data from the Panama-based Water Centre for the Humid Tropics of Latin America and the Caribbean, the most common impacts of climate change on agriculture are crop losses caused by extreme events. Some measures suggested to address negative effects are the generation of weather data for agricultural sector planning, the introduction of technological improvements in irrigation and sowing processes (including the elimination of pesticides), the optimisation of soil use and crop practices, and the implementation of strategies or action plans that take vulnerability studies into account and prioritise measures that contemplate all the stakeholders involved.

Many of the scientists consulted admitted that the data available is provided by the agricultural producers themselves, who are very observant of the climate and perceive the variations. They indicate that there is a greater concentration of rainfall and extreme events are occurring with greater frequency.

Similarly, in some countries they identify new areas in high regions that have been opened up for cultivation, as well as shifts to more commercial and sophisticated production systems, changes that are associated with the rise in temperature.

The failure of natural weather indicators, which farmers use to guide their production activities, aggravates the situation. This is compounded with a loss of biological diversity, the desertification of soils, the exposure of water sources -at the risk of drying up completely- and the appearance and growth of new pests and diseases.

These changes also mean that crops require more irrigation, and thus new water sources are tapped.

Some of the adaptation measures suggested by researchers include developing indicators for climate change vulnerability, establishing early warning systems, supporting conservation systems for agricultural biodiversity, and designing programmes to consolidate new agricultural calendars for the various regions.

As a mitigation measure, some countries are working on increasing what are known as carbon dioxide (CO_2) "sinks." Sinks are any process, activity or mechanism that captures and stores excess greenhouse gases from the atmosphere.

Afforestation and reforestation, certain land uses and forestry activities are considered sinks by the Kyoto Protocol (see table).

Reducing deforestation and forest degradation -largely caused by the expansion of croplands- is the region's top priority. Both activities account for 46 percent of all harmful emissions, compared to energy-related activities (including power generation, transportation and industrial emissions), which account for 26 percent, and other sources, such as agriculture and waste management, which account for 28 percent.

> "In Latin America there are no coordinated efforts to exchange or share weather and hydrological information, and there are no organised, common actions undertaken by the various countries to address climate change." (José Marengo, Peru and

"Mitigation policies and sustainable development practices aimed at preventing climate change from reaching catastrophic levels are not enough. We need actions." (Niro Higuchi,

National legal frameworks must be adapted in order to ensure the success of these measures. This includes improving landholding systems, as well as introducing mechanisms for payment of environmental services (PES), a tool for financing investments in sustainable land or resource managment.

Some Latin American countries, such as Costa Rica and Mexico, have spearheaded PES systems. Costa Rica, which had a relatively high deforestation rate, currently has a positive net rate of reforestation.

Among other mitigation measures, the experts consulted cited the reduction of emissions through better management of carbon dioxide, methane, nitrogen dioxide and other greenhouse gas flows, using suitable crop techniques and improved cattle management.

They also pointed to the elimination of emissions by increasing carbon sequestration in plants and soil through, for example, conservation tilling and restoration of degraded land, direct sowing of pastures and, lastly, displacement of polluting emissions, giving priority to bioenergy sources.

For Uruguayan expert Daniel Martino, lead author and coordinator of the Agriculture Chapter of the Working Group III Report, a component of the IPCC Fourth Assessment Report on Climate Change, afforestation and forest conservation are among the most effective ways of combating global warming through the sequestration of carbon dioxide present in the atmosphere.

But he also said that the use of wood as an alternative construction material, substituting it for bricks, cement, metals or plastics, has a double benefit in terms

Coffee crops in Costa Rica. Germán Miranda/IPS

of mitigating the effects of climate change.

“On the one hand, wood is an excellent heat insulator, and thus it contributes to reduce the power consumption necessary for the heating and air conditioning of buildings. On the other, the energy per unit mass consumed by wood is less than that of any other material,” he underlined.

According to Virginia Sena, a chemical engineer with the United Nations Development Programme (UNDP), policy decisions in economic models must be aimed at achieving the responsible use of natural resources.

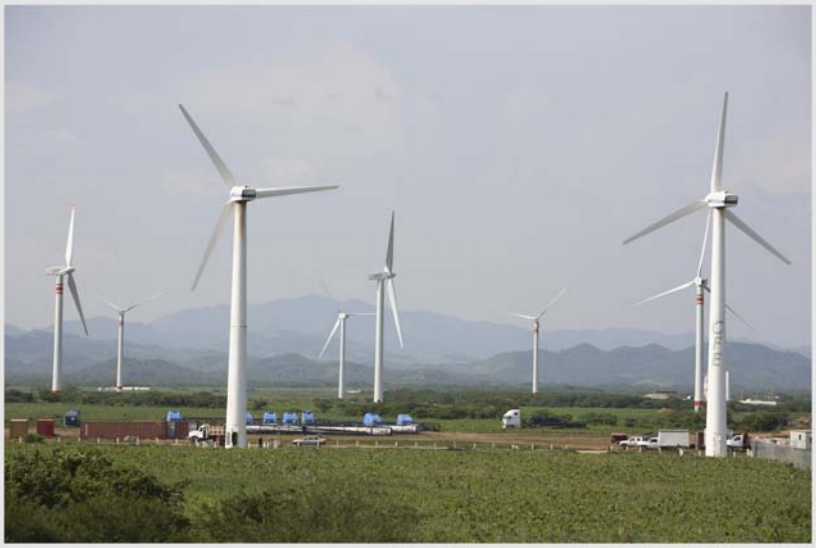
“These changes require a process, and that process entails raising awareness, learning lessons, taking risks and accepting the loss of short-term benefits in order to ensure benefits in the future," she said.

"But this process of change may not succeed if governmental decisions are not accompanied by behaviour changes at the community level. Moreover, communities can and must influence public policies, through the generation of experiences and lessons learned by carrying out environmental management actions at the local level,” she explained to Tierramérica.

> “We need to promote the implementation of mechanisms that will enable the full development of alternative energy sources, and include such mechanisms in the framework of national and regional development.” (Joel Pérez

Uruguay currently has a UNDP-supported project in the field of climate change aimed at using cattle manure to generate biogas and biofertiliser, which has attracted the interest of numerous artisanal cheese producers.

In Sena’s opinion, the expansion of this technique will achieve a considerable reduction of methane emissions, while at the same time generating an economic benefit for small-scale producers, due to the



Windmills in Oaxaca, Mexico. Mauricio Ramos/IPS

savings in fossil fuel consumption and chemical fertiliser use.

"In order to address climate change, humankind must pursue sustainable development, and this can be attained by increasing actions led by actors with political and economic power (public and private agents) and by the organised efforts of civil society," she concluded.

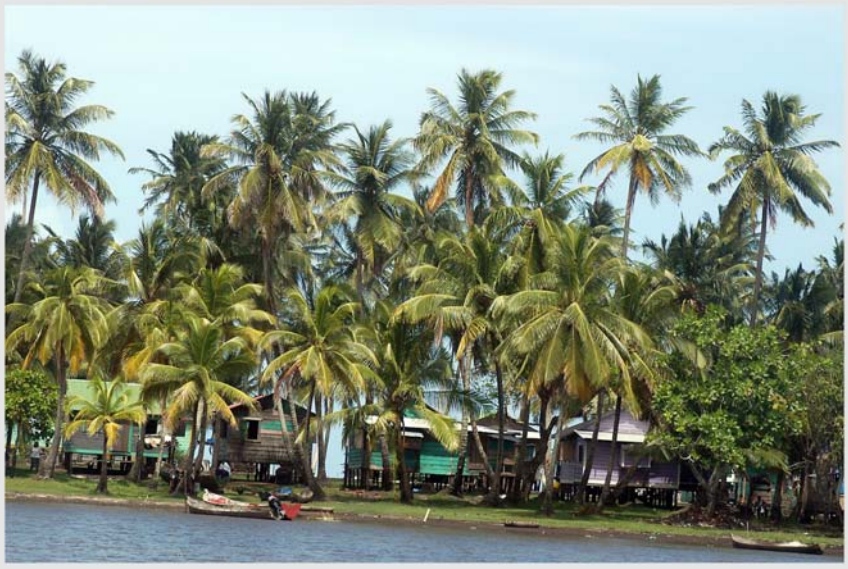
Ismael Antonio Sánchez, an engineer with the Department of Energy Sciences of the "José Simeón Cañas" Central American University, in El Salvador, has a radical position with respect to the adoption of measures for mitigating climate change.

"Most Latin American countries should not be wasting time anymore with mitigation; it's clear already that Kyoto, unfortunately, will not achieve its goals. Neither the Clean Development Mechanisms (CDM) nor the reductions pledged by some of the signatory countries have been effective," he said to Tierramérica.

"Most Latin American countries should not be wasting time anymore with mitigation; it's clear already that Kyoto, unfortunately, will not achieve its goals. Neither the Clean Development Mechanisms nor the reductions pledged by some of the signatory countries have been effective." (Ismael Antonio Sánchez, El

(Fotografía: aldea costera Nicaragua). (Leyenda): A village on the Caribbean Coast of Nicaragua. Germán Miranda/IPS

Sánchez defends the idea that, in addition to making an inventory of GHGs, developing countries must make an inventory of the adverse climate events that occur in their territories and assess the damages and consequences to agriculture, health and infrastructure, measuring how these impact their economy and development.



A village on the Caribbean Coast of Nicaragua. Germán Miranda/IPS

These countries, he added, should focus on looking for adaptation and vulnerability reduction measures that are best suited to their realities, and on obtaining the sources of financing that are necessary. “Climate change is an irreversible phenomenon,” he stated categorically.

Kyoto: A Beginning or a Resounding Failure

There is abundant evidence today that natural resources are not infinite and that nature is not in itself capable of eliminating the by-products of development. There is also proof that the commitments undertaken to reduce emissions are often too fragile.

An example of this is the Kyoto Protocol, an international agreement that, when it was signed in Japan in 1997, established a consensus to reduce the emissions of the leading gases responsible for global warming.

The Protocol, adopted under the United Nations Convention on Climate Changed, which was signed in 1992 at the Rio de Janeiro World Summit, commits the industrial countries who ratified it to cut their combined greenhouse emissions by an average of 5.2 percent as compared to 1990 levels by 2008-2012, date on which the first commitment period is set to expire.

The Protocol was based on a principle established in the Convention, namely that countries have common but differentiated responsibilities with respect to climate change.

As a huge proportion of the gases that have accumulated in the atmosphere over more than two centuries were emitted by the industrial powers, industrialised nations have a greater responsibility in the reduction of contamination and in assisting and cooperating with poor countries, whose right to development cannot be conditioned by obligations to curb greenhouse gases.

Consequently, the industrial countries that are party to the Convention were listed in Annex I and took on binding obligations to mitigate climate change.

To fulfil these obligations, emission reduction commitments were specified for each party as a percentage of its GHG emissions in the base year -for example, six percent for Japan, and 8 percent for the European Union as a whole.

But the Protocol also adopted flexibility mechanisms to offset the contamination caused by the countries listed under Annex I, which are governed by the rules of the market. These mechanisms include emission trading (the possibility of

purchasing assigned amounts of CO_2 emissions from countries that have reduced their emissions above their required target), Joint Implementation (JI, between developed countries), and the Clean Development Mechanism (CDM).

JI allows industrialised countries (their governments, companies or private organizations) to invest in other, also industrialised, countries, to put into place projects aimed at reducing greenhouse gas emissions or increasing the removal of GHGs through sinks.

The country that invests obtains certificates for reducing emissions at a lower cost and the other receives the investment and technology.

The CDM is a procedure whereby governments and private companies in industrialised countries can transfer clean technologies to developing countries by way of investments in projects that reduce emissions. In exchange, the investing countries receive emissions certificates that are added to their internal reductions, and which are issued by independent bodies.

Latin America benefits from the implementation of CDM projects because it obtains money for activities aimed at promoting sustainable development. However, mounting a wind power park or a biogas generation plant involves installation costs that greatly exceed what the CDM can contribute.

The environmental organisation Greenpeace warns that the kind of projects that are being presented -such as carbon capture and sequestration, sinks, or large water infrastructures- could seriously compromise sustainable development and the possibility of moving towards additional emissions reductions once the Kyoto Protocol deadlines expire.

In the opinion of this organisation, “the only acceptable projects are those based on renewable energies and energy-efficient improvements.”

Developing countries that are party to the Protocol, while not bound by commitments to reduce their emissions, must demonstrate that they are adopting less contaminating technologies in their economic activities.

After years of negotiations, however, little progress has been made in the implementation of the Kyoto Protocol. Successive meetings adjusted the terms of the original agreement negotiated in December 1997, which only came into effect on February 16, 2005, following Russia’s ratification in late 2004. Only then did the Protocol meet the condition that ratifying countries had to represent at least 55 percent of the world’s total carbon dioxide emissions for 1990 in order for it to become international law.

Despite the entry into force of the Protocol, the concentration of carbon dioxide in the atmosphere continues to increase, according to new figures published on October 21, 2009 by the Climate Change Convention Secretariat.
The emissions of the 40 most industrialised countries grew by three percent between 2000 and 2007. Although the emissions of the 37 nations with binding obligations under the Kyoto Protocol have decreased by 16 percent since 1990, this reduction is due to the decline of the economies of the former socialist bloc, and not to the adoption of appropriate environmental and energy policies.

From Kyoto to Copenhagen

In December 2007, a new follow-up meeting to the Kyoto Protocol was held in Bali, Indonesia, along with the Thirteenth Conference of the Parties to the Convention on Climate Change (COP 13).
The nations that participated in the meeting adopted what became known as the "Bali Road Map," which includes the Bali Action Plan. These set the objective of reaching long-term cooperation agreements, following the expiration of the Kyoto commitments in 2012, with four areas proposed as basis for discussion: mitigation, adaptation, financing, and technology.
Although the United States signed the Kyoto Protocol, not only did it not ratify it, but in 2001, under the administration of George W. Bush (1993-2001), it withdrew from the treaty. Bush consistently rejected mandatory limits aimed at reducing emissions and defended instead the setting of voluntary limits adjusted by each nation. He also objected the fact that China and India, two other large contaminators, were not included in the group of countries with binding obligations to control greenhouse gas emissions.

> "There's no doubt that Kyoto has failed. And it failed because the bodies in charge of controlling the fulfilment of commitments or the countries that requested them did not meet their targets." (Graciela Magrin, Argentina)

The election of Democrat Barack Obama to the presidency in 2008 led many to believe that the United States would change its position. With less than five percent of the world's population, the United States accounts for about 25 percent of all fossil fuel consumption, and it is the second largest greenhouse gas emitter and

the first in terms of emissions per inhabitant.

During his campaign, Obama promised to reduce the country's annual emissions by 20 percent until 2020, to bring the country back to 1990 volumes, and to reach an 83 percent reduction by 2050. But it does not seem very likely that the U.S. Congress will back these commitments.

In April 2009, Obama, without mentioning Kyoto, convened the first preparatory meeting of the Major Economies Forum on Energy and Climate, which was held in Italy in the month of July.

The meeting was attended by representatives of 17 of the world's largest economies, which are willing to adopt a new joint agreement for the reduction of contaminant gases after 2012. Participants included delegations from Australia, Brazil, Canada, China, Denmark, France, Germany, Great Britain, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa and South Korea, plus the European Union. Denmark was also invited as COP15 host.

Asked whether Kyoto has failed as a joint attempt to address the issue of global warming, the answers given by the 23 scientists consulted by Tierramérica ranges from complete scepticism regarding the effectiveness of this mechanism and relativisation of its results.

For Mario Bidegain, Uruguayan professor and researcher of the Department of Atmospheric Sciences of the University of the Republic's School of Sciences, and for Graciela Magrin, Argentine expert and one of the IPCC coordinators for Latin America, the Kyoto Protocol has been a total setback. "There's no doubt that Kyoto has failed. And it failed because the bodies in charge of controlling the fulfilment of commitments or the countries that requested them did not meet their targets," Magrin said.

However, most of the Latin American researchers consulted see the Protocol as a step towards securing future agreements.

In the opinion of Uruguayan expert Daniel Martino, Kyoto cannot be seen as a failure. "In certain aspects it has been very successful; for example, in the development of a significant body of regulations to measure, report and verify emissions, and, especially, in the development of a market mechanism that is without a doubt the most effective instrument for the achievement of environmental goals." For Martino, the Protocol is merely an instrument with short-term targets. But he highlights the fact that the Protocol

Aerial view of crops in the Northern Atlantic Autonomous Region, Nicaragua. Germán Miranda/IPS

has been ratified by more than 180 countries.

"One of the failures has been the absence of the United States, which is the leading country responsible for climate change. When the Kyoto Protocol was signed there was still no conclusive evidence that climate change was caused by human actions. But this had achieved widespread consensus by the time the third IPCC report was released in 2001, the same year of the terrorist attacks against the United States," Martino added.

> The high-income countries should be the ones taking the lead in this agreement. But, because of the magnitude of the emissions reductions required, in order for a global agreement to be effective both industrialised and developing countries will necessarily have to participate. (John Nash, United States)

However, he pointed to certain flaws in the Kyoto Protocol, such as the exclusion of agricultural lands and forestry activities in developing countries, which are important for mitigating climate change. He also identifies as "another serious problem" the excessive influence of the European Union, "which, with the absence of the United States, has imposed its own interests to the detriment of the interests of other countries."

For World Bank economist John Nash, Kyoto was a first, but insufficient, step

to revert the world's movement towards an increasingly warmer future. Brazilian researcher Carlos Nobre, one of the authors of the IPCC Fourth Assessment Report, agrees that despite its serious flaws Kyoto has provided major lessons for reaching a global agreement.

In his opinion, the Protocol has also served to encourage developing countries to participate in the search for solutions through the CDM, and to place the issue of climate change on the public agenda of these nations.

"To use a soccer metaphor -as Brazilian politicians often do-, we could say that Kyoto was the 10-minute warm-up prior to the game, an exercise to test the playing field. The real game should start now, even if there are many players who would like to stay indefinitely in the warm-up stage."

In Nash's opinion the Kyoto Protocol must be continued with a much more ambitious agreement after 2012, including specific commitments to reduce emissions undertaken by all the leading developed countries, in particular the United States.

"To use a soccer metaphor -as Brazilian politicians often do-, we could say that Kyoto was the 10-minute warm-up prior to the game, an exercise to test the playing field. The real game should start now, even if there are many players who would like to stay indefinitely in the warm-up stage." (Carlos Nobre, Brazil)

"The new administration appears to be very receptive, so naturally that gives us reason to be optimistic," Nash said.

The high income countries must be the ones to take the lead in this agreement, he admitted. But, because of the magnitude of the emissions reductions required, in order for a global agreement to be effective in mitigating climate change, both industrialised and developing countries will necessarily have to participate.

On October 7, 2009, at the Third European Union-Brazil Summit, Brazilian President Luiz Inácio Lula Da Silva undertook to join the European bloc in the strategy taken to Copenhagen.

Lula spared no praise for the European Union's emissions reduction policy and took on the challenge of cutting deforestation in Brazil in 80 percent by 2020. According to estimates by the European Commission, Brazil is the fourth most polluting nation in the world, after China, the United States and Indonesia.

Denmark May Not Be the Last Stop

The experts interviewed by Tierramérica expressed scepticism and a range of expectations with respect to the outcome and commitments that will result from the Fifteenth Conference of the Parties to the United Nations Framework Convention on Climate Change (COP15) to be held in Copenhagen on December 7-18, 2009.

For most experts it is not yet clear how discussions will evolve, but they hope that international pressures will be strong enough to push the parties into making significant progress in terms of commitments.

They also expressed scepticism, as they believe that many large emitters from the developing world, such as China and India, should take immediate action.

Moreover, they said that the global economic crisis has served as a handy excuse for inaction.

Expectations include the creation of an assistance fund to help diminish the vulnerability of the most impoverished countries, and the planning of effective adaptation measures.

> "Copenhagen could be a turning point in the history of the planet, if the world's leaders understand the urgency of changing the unsustainable course we have set the Earth on." (Carlos Nobre, Brazil)

Some feel that the failure to undertake significant commitments will have a political cost that governments will not want to pay.

The more optimistic say that conditions are ripe for Copenhagen to result in some form of agreement that will lead to an effective mechanism for the reduction of greenhouse gases.

Hopes are set on countries like the United States and the countries of the BRIC group (Brazil, Russia, India and China) agreeing to reduce their emissions, based on differentiated values, instead of strict and joint targets.

The experts also believe that in 2010 it will be possible to reach agreements to reduce emissions by 25 to 40 percent, to be met by 2020.

Many also consider that Copenhagen must focus more on adaptation efforts and on strengthening the capacity to respond to climate change, than on trying to mitigate it or reduce GHG contamination.

This would diminish the vulnerability of sectors and regions that are at risk, and would foster sustainable development and equality, especially in the less developed countries.

"This adaptation can be achieved by strengthening the natural resilience of ecosystems and the natural capacity of impoverished populations to 'better' adjust to the state of perpetual emergency in which they live," Venezuelan expert Alicia Villamizar, of the Simón Bolívar University and lead author of the third and fourth IPCC reports, said.

Carlos Nobre was categorical: the world's leaders must understand the historical significance of what is at play in Copenhagen, which goes beyond just a meeting of the parties to the Convention with the purpose of negotiating the details of the post Kyoto commitments.

"Copenhagen could be a turning point in the history of the planet, if the world's leaders understand the urgency of changing the unsustainable course we have set the Earth on," he said.

Meanwhile, the confrontation between industrialised and emerging countries continues. Emerging countries blame the great industrial powers for creating favourable conditions for climate change with GHG emissions, and for the economic losses that poor nations suffer as a result of the adverse impacts of global warming.

They demand that the rich countries of the North pay the costs, or at least the bulk of the costs. But the rich countries hide behind the global economic crisis.

There are proposals on the table to reach an agreement based on new grounds, and there is also great pressure from the industrial North for emerging powers of the developing world, such as China, India and Brazil, to undertake commitments.

Bitter differences have emerged in the discussions prior to Copenhagen. At stake is the principle of common but differentiated responsibilities, one of the pillars of international environmental law.

ANNEX

Tierramérica prepared this report based on the responses to a survey put to 23 climate change experts in the region. The procedure consisted in an extensive questionnaire sent by email to the experts, which was supplemented by telephone contacts.

Walter Baethgen, Director of the Programme for Latin America and the Caribbean at the International Research Institute for Climate and Society (IRI), Columbia University, United States. From 1989 to 1990, he acted as a consultant for the United Nations Food and Agriculture Organisation (FAO), in Colonia, Uruguay.

Mario Bidegain, professor and researcher at the Department of Atmospheric Sciences of the School of Sciences, University of the Republic, Uruguay. He holds an MSc in Atmospheric Sciences from the University of São Paulo, Brazil, and is currently Director of Uruguay's National School of Meteorology. He is one of the reviewers of the Working Group I (Climate Change 2007: Physical Science Basis) and Climate Change and Water Resources (2008) reports of the Intergovernmental Panel on Climate Change (IPCC), which was honoured with the 2007 Nobel Peace Prize, shared with former Vice President of the United States Al Gore.

David Cruz Choque, climate change expert with a PhD in agronomy. Lead author of the IPCC Fourth Assessment Report. He is currently Director of Agronomy Studies at Universidad Mayor de San Andrés, La Paz, Bolivia.

Edith Fernández-Baca Pacheco, PhD in Veterinary Medicine, MSc in Veterinary Sciences from Massey University, New Zealand, and MSc in Rural Sociology from

Iowa State University, United States, with a specialisation on food, agriculture and environmental systems and community development. She is currently regional officer of the decentralised hub of the Mountain Partnership Secretariat, located at the Consortium for the Sustainable Development of the Andean Ecoregion. She is also a visiting professor at the Agrarian Innovation for Development MSc Programme at Universidad Nacional Agraria La Molina, Peru.

Niro Higuchi, forestry engineer with a degree from the Federal University of Paraná, Brazil, and post-graduate degrees in the same field from Michigan State University, United States, and the University of Oxford, Great Britain. He is currently a member of the National Institute for Amazon Research, Brazil, and of the editorial board of Acta Amazónica, a journal published by the Centre for Renewable Natural Resources Studies, connected with the Department of Forestry Sciences of the Federal University of Lavras, Brazil.

Agustín Giménez, National Coordinator of the Agro-Climate and Information System Research and Development Unit of the National Agricultural Research Institute, Uruguay. He is an expert in identification and assessment of the impacts of climate change on agriculture and livestock production and the development of information systems for climate risk management.

Graciela Magrin, agricultural engineer, with a degree from the University of Buenos Aires, Argentina, and a PhD from École Nationale Supérieure Agronomique de Montpellier, France. Her areas of expertise are climate change, plant eco-physiology and agro-meteorology. Since 1980, she is a researcher at Argentina's National Institute of Agricultural Technology, and has been a visiting professor at several national universities and international institutes. She coordinated studies on climate change and the agriculture sector for Argentina's first and second national communications to the Climate Change Convention, and

participated in the preparation of the IPCC's Third and Fourth Assessment Reports, as coordinating author for the Latin American region.

José Marengo, Peruvian expert, PhD in Meteorology and author of IPCC reports. He is currently a senior scientist at Brazil's National Institute for Space Research (INPE), where he is coordinator of the Climate Change Studies and Research Group.

Daniel Martino, MSc from the University of Manitoba, Canada, and Agricultural Engineer from the University of the Republic, Uruguay. He coordinated the work in the "Agriculture" and "Land Use and Forestry" sectors in the preparation of Uruguay's National Inventory of Greenhouse Gases. He is a member of the roster of experts of the United Nations Framework Convention on Climate Change, and lead author and coordinator of the Chapter on "Agriculture" of the Working Group III Report "Mitigation of Climate Change," a component of the IPCC Fourth Assessment Report.

Ana Rosa Moreno, biologist with a degree from the National Autonomous University of Mexico (UNAM), and an MSc in Human Ecology from the University of Texas School of Public Health, United States. She has been a member of the IPCC since 1995, and participated in its last three Assessment Reports.

Gustavo Nagy, assistant professor of environmental sciences (oceanography/ climate change) at the School of Sciences of the University of the Republic, Uruguay, vulnerability and adaptation specialist, and member of the IPCC Working Group II.

John Nash, lead economist for Latin America and the Caribbean at the World Bank, where he has worked in different areas since 1986. As of January 2007, he

has been lead economist in the Sustainable Development Department in the Latin American and Caribbean Region, working on rural development, environment, social development, energy, infrastructure, urban development and water supply.

Carlos Nobre, electronics engineer, senior researcher and head of the Terrestrial System Science Centre, at the Brazilian Institute for Space Research. He holds a PhD in Meteorology from the Massachusetts Institute of Technology, United States, and participated as author in the 1990, 2001 and 2007 IPCC assessment reports. Nobre was ranked among the top 100 most influential personalities of Brazil in 2007 by the magazine Época.

Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), of the Ministry of Environment, Housing, and Territorial Development of Colombia. Several members of IDEAM answered the survey, including researchers from the Ecosystems, Environmental Studies, and Meteorology areas, and members of the General Board and the Forecasts and Alerts Office.

Joel Pérez Fernández, member of the team of professionals with the Water Centre for the Humid Tropics of Latin America and the Caribbean. He works in the Climate Change and Adaptation area, Applied Research and Development Division. He is responsible for the Regional Visualisation and Monitoring System in the weather and climate area. He has also participated in regional processes for the development and planning of climate change and adaptation strategies to be submitted to the attention of the United Nations Framework Convention on Climate Change.

Roberto Quiroz, head of the Production Systems and Environmental Divisions of the International Potato Centre, Peru. He is lead researcher in the projects "Andean Agriculture of the Peruvian and Bolivian Highlands," 2005-2010, and

"Analysis of the Vulnerability of Mountain Agricultural Ecosystems," 2007-2008. He is a member of the Governing Board of the Common Good Institute and the Consultative Council of the Consortium for the Sustainable Development of the Andean Ecoregion. His main field of work is the design and implementation of conservation and sustainable development programmes for mountainous regions.

Jorge Recharte, anthropologist and Director of the Andean Programme of the Mountain Institute since 1997. He directs a multidisciplinary team that implements integrated conservation and development initiatives of Peru's mountainous regions. He is a member of the Governing Board of the Common Good Institute and the Consultative Council of the Consortium for the Sustainable Development of the Andean Ecoregion. His main field of work is the design and implementation of conservation and sustainable development programmes for mountainous regions.

Virginia Sena, chemical engineer, programme assistant in the Small Grants Programme of the Global Environment Facility in Uruguay since 2005. She was global environmental issues advisor for the National Department of the Environment from March 1998 to January 2001, and from March 1996 to January 2001, she worked as technical engineer for the Institutional Strengthening Project for the Implementation of the United Nations Framework Convention on Climate Change.

Félix Reinado Trujillo Ruiz, head of the Forecasts Unit at Bolivia's National Meteorology and Hydrology Office. He is a meteorologist with degrees from the National Meteorology Institute of Spain and Universidad Mayor de San Andrés, La Paz, Bolivia.

Fernando Tudela, Under Secretary of Environmental Planning and Policies of Mexico. He holds a PhD in architecture from the University of Sevilla, Spain. He has worked as consultant for the United Nations, and occupied the posts of Director of the Sustainable Development and Environmental Advanced Studies Programme, coordinator of advisors to the Secretary of the Environment, Natural Resources and Fishery, and president of Mexico's Inter-sectorial Committee on Climate Change.

Ismael Antonio Sánchez, mechanical engineering with an MSc in Energy Management from the University of Pittsburgh, United States. He is head of the Department of Energy Sciences of the "José Simeón Cañas" Central American University, in San Salvador, El Salvador.

Ernesto Viglizzo, MSc from the Catholic University of Leuven, Belgium, independent researcher of the National Scientific and Technical Research Council, Argentina. He is Coordinator of the National Environmental Management Programme of the National Agricultural Technology Institute, and one of the lead authors of the IPCC Fourth Assessment Report (2007).

Alicia Villamizar, member of the Environmental Studies Department and the Institute of Environmental Resources of the Simón Bolívar University, Venezuela. She is one of the lead authors of the IPCC Third (2001) and Fourth (2007) Assessment Reports.