Up in smoke? Latin America and the Caribbean

The threat from climate change to the environment and human development

The third report from the Working Group on Climate Change and Development

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Foreword

Never before in history has humankind achieved today's level of scientific understanding and development. Our civilisation has managed to reach outer space, communicate across the world in fractions of a second, eradicate many diseases, and extend peoples' life expectancies. We have also achieved important gains in political, economic, social, cultural, and environmental rights. And yet, never before have the life forms that share this extraordinary planet – humans among them – been as threatened as they are today.

The terrifying forecasts made in past years about the possible effects of climate change and its consequences have transformed themselves from hypotheses into realities. The most recent research and observations of climatic phenomena and their impacts on ecosystems and human populations evidence this. Even if humanity managed to reduce or stop greenhouse gas emissions into the atmosphere within the next few years, climate change and its impacts would continue through the next few centuries due to their own inertia.

This publication – the product of the commitment and effort of a group of concerned agencies – is an important contribution to greater awareness about climate change. It is a call to action not just for the governments and peoples of Latin America and the Caribbean but also for leaders in developed countries, the principal emitters responsible for the impacts and effects climate change is having on our nations, their economies and the natural world we depend upon.

Latin America and the Caribbean make up an extraordinarily complex region, not just in terms of the great variety and abundance of its ecosystems but also in terms of its cultural diversity. It is a region where 44 per cent of the population still lives in poverty and where inequities in the distribution of wealth are among the highest in global terms. These characteristics make the region one of the most vulnerable, where the adverse impacts of climate change could lead to surprising environmental changes and social and cultural responses. This will be all the more so if the IPCC predictions about poor people in developing countries being the most affected groups are correct, and could lead to deepening inequality.

Changes in temperature and in the frequency and intensity of rainfall have increased the number of floods and droughts, adversely affected food production, the provision of water and the viability of ecosystems and environmental services these provide. Glaciers have receded to levels without precedents in the last 10,000 years. Entire regions have been affected by climate change. Plants and animals have been displaced or perished for lack of adaptive capacity. The increasing intensity of storms and hurricanes and the surge in their destructive forces have affected hundreds of thousands of victims and led to multi-million dollar damages. Climate change has shifted vectors for diseases such as malaria or Chagas' disease to different regions where they previously did not exist.

No doubt, the damage is done. The only option we have, apart from demanding that developed countries take responsibility for the damages that climate change is causing and reduce their emissions to stabilise the atmosphere in the long term, is to define adaptation policies that anticipate and neutralise the adverse impacts that are upon us. It is the right time to re-think the development model for Latin America and the Caribbean and to establish a new social contract that leads down the path of poverty reduction and greater equality to sustainable development. It's also the right time to re-think the model of international aid. Without question, it's about an ethical commitment that can be put off no longer.

I hope this report contributes to this purpose.

Juan Mayr Maldonado
Former Minister of Environment, Colombia
President of the first Conference of the Parties to the UN Convention on Biological Diversity

Prologo

Nunca antes en la historia de la humanidad el hombre había logrado el nivel de desarrollo y conocimiento científico que tiene hoy en día. Nuestra civilización ha logrado conquistar el espacio, intercomunicar el mundo en fracciones de segundo, erradicar muchas enfermedades y ampliar las expectativas de vida de la población. También ha logrado significativas conquistas en los derechos políticos, económicos, sociales, culturales y del medio ambiente. Sin embargo nunca antes las formas de vida que conviven en este extraordinario planeta, entre ellas la especie humana, habían estado tan amenazadas como lo están hoy en día.

Las aterradoras predicciones que se venían haciendo sobre los posibles efectos del cambio climático y sus consecuencias han dejado de ser hipótesis para convertirse en realidades. Así lo evidencian las más recientes investigaciones y observaciones de los fenómenos climáticos y sus efectos sobre los ecosistemas y las poblaciones humanas. Aún si la humanidad lograra reducir o detener las emisiones de gases efecto invernadero a la atmósfera, la inercia del cambio climático y sus impactos se mantendrán a lo largo de los próximos siglos.

La presente publicación, producto del interés y esfuerzo de un importante grupo de ONG´s, es una valiosa contribución a la generación de conciencia sobre el cambio climático y una invitación a la acción, no solo para los gobiernos y pueblos de Latinoamericana y el Caribe, sino también para los dirigentes de los países desarrollados, principales emisores responsables de los impactos y afectaciones que el cambio de clima esta ocasionando a nuestros pueblos, sus economías y el mundo natural del cual dependemos.

Latinoamérica y el Caribe hacen parte de una región de extraordinaria complejidad, no solo por la gran variedad y riqueza de sus ecosistemas, sino también por su diversidad cultural. Igualmente es una región donde el 44% de la población vive en la pobreza y se presenta una de las mayores inequidades, a nivel mundial, en la distribución de la riqueza. Son estas características las que hacen de la región una de las más vulnerables y donde los impactos adversos del cambio climático podrían llegar a ocasionar cambios ambientales y fenómenos sociales y culturales insospechados. Mas aún, si las predicciones del Panel Intergubernamental sobre Cambio Climático resultan ser acertadas, en cuanto a como los principales afectados serán las personas pobres en los países en vías de desarrollo y como en esas naciones se profundizaran las desigualdades.

Los cambios en la temperatura y en la frecuencia e intensidad de las lluvias han incrementado las sequías e inundaciones, impactando negativamente la producción de alimentos, el abastecimiento de agua y la viabilidad de los ecosistemas y los servicios ambientales que estos prestan. Los glaciares han tenido un retroceso sin precedentes en los últimos 10.000 años. Regiones enteras han sido afectadas por el cambio climático. Animales y plantas han sido desplazados o han muerto ante su incapacidad de adaptación. La creciente intensidad de las tormentas y huracanes y el incremento de su poder destructor han acarreado cientos de miles de victimas y multimillonarios costos materiales. El cambio de clima ha desplazado vectores que transmiten enfermedades, como la malaria o el mal de Chagas, a otras regiones donde antes estas no se presentaban.

No cabe duda de que el daño ya esta hecho y que la única salida que nos queda, además de exigir a los países desarrollados responder de manera responsable por los daños que viene generando el cambio climático y cumplir con la reducción de emisiones para estabilizar la atmósfera en el largo plazo, es definir una urgente política de adaptación para contrarrestar y anticiparnos a los impactos adversos que se avecinan. Es el momento oportuno para repensar el modelo de desarrollo para Latinoamérica y el Caribe y establecer un nuevo acuerdo social que nos conduzca por la vía de la erradicación de la pobreza y la inequidad a un desarrollo sostenible. Es igualmente el momento de repensar el modelo de cooperación internacional. Sin lugar a dudas se trata de un compromiso ético inaplazable.

Espero que la presente publicación contribuya a este propósito.

Juan Mayr Maldonado

Introduction and overview

For years, the writing has been on the wall about the impact of climate change on the people, plants, animals, and habitats of Latin America and the Caribbean. Now, day-to-day experiences and eye-witness accounts from leading environmental and development groups are proving predictions to be correct.

In the late 1990s, the world's pre-eminent group of climate scientists gathered under the Intergovernmental Panel on Climate Change (IPCC) and predicted a devastating range of impacts, including an increase in the intensity and number of extreme weather events exacerbating natural disasters, forest die-off, melting glaciers, and the drying out of temperate grasslands. The region's huge geographical diversity means that patterns of vulnerability to climate change are extremely varied. It also makes modelling difficult, although this is constantly improving. To avoid misunderstanding, it is important to point out that with or without global warming, extreme weather is a problem for the people of the region. For many people, however, climate change is set to turn an already rough ride into an impossible one.

This report confirms that temperature and rainfall patterns, hitherto largely regular and predictable, are changing and becoming less predictable and often more extreme. Based upon the experiences of partner agencies and the people they work with across the region, this report catalogues impacts linked to both climate change and environmental degradation ranging from drought in the Amazon to floods in Haiti and elsewhere; from vanishing glaciers in Colombia to extreme cold in the Andes; and hurricanes, not only in Central America and the Caribbean, but also in southern Brazil.

It examines the impacts on agriculture and farming practices, fishing and coastal zones, towns and cities, and on the people of Latin America and the Caribbean: peasants, indigenous peoples, women, town dwellers, migrants. The direct and indirect impacts catalogued include the loss and degradation of water systems, protected areas, strategic ecosystems, and endangered species and a general decline in biodiversity, the web of life upon which all human systems ultimately depend. The net effect of all these damages is to reduce the capacity of natural ecosystems to operate properly or to act as buffers against extreme weather events and other shocks.

Climate change impacts

Climate change could bring positive results to some places, but this will only be in the short-term if temperatures continue to rise inexorably. What we are seeing currently are many more negative and cumulative impacts. The larger the changes and the rate of change, the more the adverse effects predominate.[1]

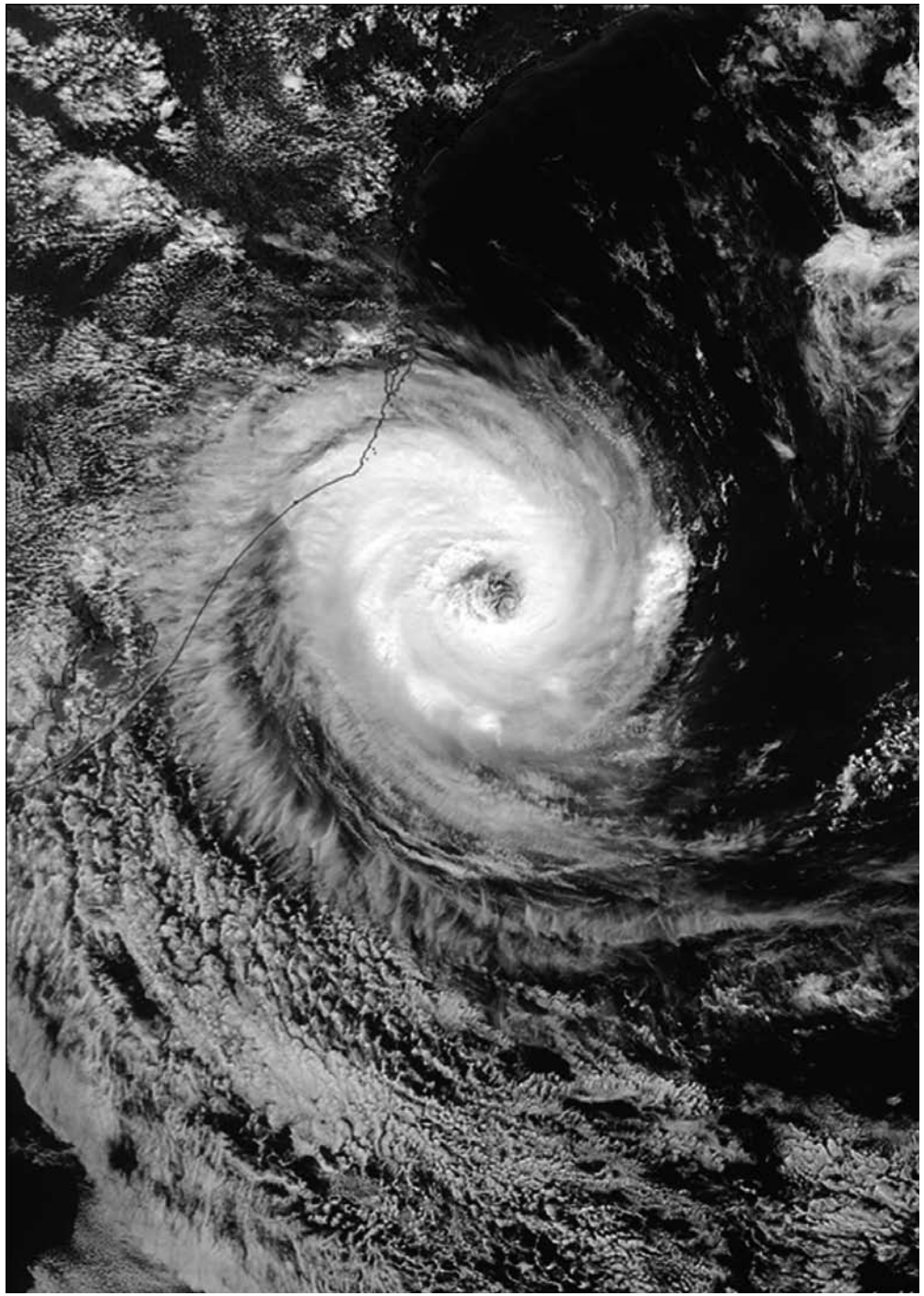
The *El Niño* Southern Oscillation (ENSO) phenomenon is crucial. Happening around Christmas, *El Niño* was named by Peruvian fishermen after the Christ child. Characterised by warmer water temperatures in the eastern Pacific Ocean it typically reverses weather patterns bringing more rainfall at the coast and bringing drought inland at higher altitudes. *El Niño* is often followed by *La Niña*, its cold counterpart, where climate patterns and worldwide effects are, for the most part, the opposite of those produced by *El Niño*. Both have major impacts in Latin America, but also in Africa and, indeed, globally.

> *"Certain regions of Latin America are more prone to extreme events than others. Central America and southern Mexico often experience the effect of tropical cyclones and associated heavy rain, flooding and landslides. The extremes that occur in north-western South America and north-eastern Brazil are closely related to El Niño."*[2]

> *"Some regions of Latin America will experience increased rainfall; there will be increased risk of floods and droughts associated with El Niño events in many different regions."*[3]

A recent comprehensive assessment of the likely impacts of climate change on the region, funded by the World Bank's Global Environment Facility (GEF), concludes that, "Increasing ocean temperatures are a common feature of all the models used to predict global warming and its effects. *El Niño* (ENSO) may be made both more frequent and severe by global warming."[4] [5] As a sign of things to come, the 1997–98 *El Niño* led to severe drought in Brazil, worsening major forest fires. The harvest of fish fell by 53 per cent.[6] This phenomenon also triggered severe bleaching and the subsequent death of a significant percentage of corals along the MesoAmerican reef (MAR) system.[7] It was also responsible for the collapse of a critical lagoon reef community in Belize.[8]

Hurricanes and tropical storms are likely to increase in intensity. With 26 tropical storms and 14 hurricanes, the 2005 hurricane season is rated one of the most active and destructive in history. In Central America, the most destructive hurricane was Stan, the eighteenth cyclone of the season.[9] Although it reached only Category 1,[10] it left a trail of death and destruction in its wake. The storm caused flooding and mudslides in Belize, Costa Rica, El Salvador, Guatemala, Haiti, Honduras, Mexico, and Nicaragua. The entire Central American isthmus suffered its effects.



Sea-level rise is likely to hit coastal areas, particularly in vulnerable parts of the Caribbean, Central America, Venezuela, and Uruguay, leading to loss of coastal land, infrastructure, and biodiversity, as well as the intrusion of soil-contaminating saltwater. Sixty of Latin America's seventy-seven largest cities are located on the coast.[11]

Snow and rainfall patterns are changing, creating extra stress on already limited freshwater availability in Peru, Bolivia, Colombia, Chile, and western Argentina. In subtropical South America, east of the Andes, rainfall has been increasing since about 1970 accompanied by more destructive, sudden deluges. More northern areas of South America are expected to experience greater warming than southern areas of the continent. Climate models predict more rainfall in eastern South America and less in central and southern Chile. Both the positive and the negative rainfall trends on either side of the Andes are predicted to continue for decades.[12] Yet, indicating the likelihood of greater and opposite extremes, the 2005 drought in the Amazon Basin was probably the worst since records began. At its height, river levels in parts of the Amazon were at their lowest for 35–60 years.[13]

Warming in high mountain regions melts glaciers, snow and ice, affecting farming and the availability of water to coastal cities and tourist activities. Glacial lake outbursts also pose a threat to lives and livelihoods. Glaciers are currently disappearing fastest in the Venezuelan, Colombian and Peruvian Andes.

Impacts on the poorest

The climate in Latin America and the Caribbean is changing and will continue to do so. What emerges most strongly from this report is that the impacts of climate change are hugely magnified by abuse of the natural environment – the destruction or inappropriate use and management of natural resources. This abuse is rarely due to the activities of poor communities, who have little say in, or are themselves victims of infamous 'mega projects' built in the name of development, illegal logging and deforestation, over-fishing, mining, and governmental neglect. But because of this environmental damage it is much more difficult for poor communities to cope with climate change. Women suffer most because they are the main providers of food, fuel and water for the household. The difficulties faced by communities in coping or adapting are greatly increased by the neglect of the needs and capacities of women.

As one recent regional survey concludes:

> *"Poorer people are more susceptible to the destruction caused by hurricanes and flooding for a variety of reasons. The poor typically live in substandard housing that is more susceptible to damage from winds, heavy rain and floodwaters. Substandard or non-existent sewage facilities and lack of potable water in poor neighborhoods can result in greater exposure to water-borne diseases after flooding. Areas that are historically prone to flooding or mudslides are often inhabited by the poor."*[14]

Water: Around 35 per cent of the world's freshwater is found in Latin America. Regardless of climate change, stress on water resources is set to increase because of rising human demand from growing populations and economic activity. Estimates of freshwater availability and the impacts of climate change in Mexico and South America over the next quarter of a century indicate that by 2025 about 70 per cent of the population will live in regions with low water supply.[15]

Farming: Farming employs around 30–40 per cent of the working population of Latin America. Studies in Brazil, Chile, Argentina, and Uruguay show yield decreases in a number of key crops – barley, grapes, maize, potatoes, soybeans, and wheat – potentially linked to global warming. Climate change could also lead to more damaging impacts from plant and animal diseases and pests. The IPCC has pointed out that, "Large alterations in Latin American ecosystems resulting from climate change impacts would have the potential to endanger the livelihoods of subsistence farmers and pastoral peoples, who make up a large portion of the rural populations of the Andean plateaus and tropical and subtropical forest areas." But urban populations that depend on food and other resources from rural areas are also at risk.

Poverty: Projected changes in climate could increase the impacts of already serious chronic malnutrition and diseases affecting a large sector of the Latin American population. Climate change will also have major economic impacts on agriculture, fisheries, coral reefs, tourism, and water availability.

Health: Vector-borne diseases like malaria, dengue and Chagas' disease, as well as infectious diseases like cholera, are set to spread.[16] Higher surface temperatures will worsen the effects of pollution and high concentrations of ground-level ozone, especially in urban areas. Wider impacts on access to food and to safe drinking water will interact with direct health impacts in a potentially lethal cocktail.[17]

Global feedback concerns

If more permanent *El Niño*-type conditions lead to a long-term drying out and die-off of the Amazon rainforest, the IPCC believes that the subsequent release of carbon to the atmosphere could potentially alter the global carbon balance.[18] This could then become one of the environmental feedback mechanisms that scientists fear may trigger irreversible and catastrophic global warming.

Latin American forests cover over one-fifth of the region and account for over one-quarter of global forests. They strongly influence local and regional climates. If the 2ºC temperature rise threshold is breached and if continued drying leads to large-scale die-back, the carbon released from forest decomposition will accelerate climate change and lead to the extinction of countless plant and animal species.[19]

Underlying causes of climate change

Greenhouse gas emissions have been rising since the industrial revolutions of the nineteenth century. Most of the observed enhanced global warming over at least the last 50 years is likely to be due to increases in greenhouse gas emissions resulting from human activities.[20] Ironically, the whole Latin American region has so far contributed only around 4 per cent of human-caused global emissions of greenhouse gases.[21]

The United Nations Framework Convention on Climate Change (UNFCCC), established at the 1992 UN Conference on Environment and Development held in Rio de Janeiro, has almost global membership. It recognises that countries have common but differentiated responsibilities in causing the problem and in their respective capacities to take action to address it. Developed countries therefore agreed to take the lead and reduce their emissions. They are also required to assist developing countries in their efforts to reduce greenhouse gas emissions and to adapt to the inescapable effects of climate change already built into the Earth's systems.

A message of hope

There is growing consensus about the current challenges facing the region and what is needed to tackle them.[22] Many of these are elaborated in this report. There is reason to hope. There is already enough knowledge and understanding to know what the main causes of climate change are, how to reduce future climate change, and how to begin to adapt.

This report looks at positive measures that are being taken – by governments, by civil society and by people themselves – to reduce the causes of climate change and to overcome its effects. It gives examples of emissions reduction; alternative water and energy supply systems; preservation of strategic ecosystems and protected areas; increasing capacity, awareness and skills for risk and disaster management; and the employment of effective regulatory and policy instruments. At the time of writing, the UK – as an example of a wealthy industrialised country – is conducting a flurry of reviews. Reports are being written simultaneously, and separately, on everything from energy policy to climate change and its economic impacts. This report emphasises that the desire for more research should not be used as an excuse for further delay. The challenge is clear and many of the solutions are known: the point is, to act.

Up in smoke? – the first report from the Working Group on Climate Change and Development – joined the environment and development communities in a united view on the minimum action necessary to deal with the threat of global warming to human development. The proposals it called for in October 2004 are much more urgent now. Three overarching challenges include:

1. How to stop and reverse further global warming.
2. How to live with the degree of global warming that cannot be stopped.

3. How to design a new model for human progress and development that is *climate proof* and *climate friendly* and gives everyone a fair share of the natural resources on which we all depend.

In that light, our urgent priorities include:

- A global risk assessment of the likely costs of adaptation to climate change in poor countries.
- Commensurate new funds and other resources made available by industrialised countries for poor country adaptation, bearing in mind that rich-country subsidies to their domestic, fossil-fuel industries stood at US$73 billion per year in the late 1990s.
- Effective and efficient arrangements to respond to the increasing burden of climate-related disaster relief.
- Development models based on risk reduction, incorporating community-driven coping strategies in adaptation and disaster preparedness.
- Disaster awareness campaigns with materials produced at community level and made available in local languages.
- Co-ordinated plans, from local to international levels, for relocating threatened communities with appropriate political, legal and financial resources.

In addition to these, as organisations striving to improve human well-being in the face of enormous challenges, we will:

- Work towards a collective understanding of the threat.
- Share the best of our knowledge about how to build human and ecosystem resilience and live with the degree of global warming that is now unstoppable.
- Do everything in our power to stop dangerous climate change and help bring about a global solution that is fair and rooted in human equality.

Mexico…

"We expect the impacts of a changing climate to increase, with a greater area of our country becoming desert, more woods and jungle being lost, torrential rains, hurricanes and greater seasonal instability."[23]

Recommendations for Latin America and the Caribbean

1. Cut greenhouse gas emissions

Rich countries need to meet and exceed their targets for reducing greenhouse gas emissions set under the Kyoto Protocol. They need to cut emissions to a level commensurate with halting global warming so that the temperature rise is kept well below 2°C above pre-industrial levels. Commitments to cut emissions should be progressively raised after 2012 – in subsequent commitment periods of the Kyoto Protocol – in a way that puts industrialised countries on track to reach cuts of up to 80 per cent by 2050. More sustainable lifestyles and energy efficiency are a priority.

Taking account of the internationally agreed principle that wealthy countries must act first and fastest to cut emissions, Latin American countries should implement sustainable development policies that prioritise both energy efficiency and renewable energy. And, to help mitigate climate change and to maintain valuable ecosystems, they should reduce, and eventually halt, deforestation. From a developing-country perspective, implementing these measures means strengthening the economy, enhancing energy security, promoting technology innovation, and creating new and better jobs. These measures will also lower pollution costs and significantly reduce the growth of greenhouse gas emissions. Developed countries should assist the region in climate-friendly development with actions ranging from technology transfer to financial support.

2. Map national vulnerabilities in detail and apply the 'climate test'

Developing countries are the most susceptible to climate change. Their economies are heavily dependent on sectors vulnerable to the climate, such as agriculture, forestry and hydropower, not to mention public sectors such as the health service and water utilities. But they are also the least able to cope with the impacts of extreme weather conditions. There is limited analysis, however, of climate vulnerability and its related economic, social and environmental risks. Equally, there is limited understanding of which approaches and tools will maximise resilience at regional, national and local level. Consequently, there is an urgent need to develop detailed maps of the complex impacts of global warming, integrating climate-change-related risks with other vulnerabilities.

Health is a clear example. Regional vector-borne, water-borne and respiratory diseases all have demonstrated links with climatic changes. Hurricanes, storms and heavy rainfall have direct life-threatening impacts. Access to safe drinking water is compromised by drought and other factors, such as glacial melt. Health is further threatened when nutrition is undermined by the impact of weather extremes on farming. Urban and coastal populations are at risk from storm surges, flooding and coastal erosion. The challenge to the international community is to help map the complex impacts of global warming, and to ensure that the resources are available to tackle them. But, more than that, it is important that the development policy

framework does not inadvertently make things worse – for example, by prioritising the market-based re-engineering of health systems and access to water above human need.

Water, too, will change the regional pattern of vulnerability. The impacts of glaciers melting in the Andes will change river flows and threaten water supplies for people, industry, agriculture, and nature. Disputes over access to water resources are certain to increase as a consequence of climate change. Changes in hydrology will also exacerbate the effects of pollution. All these factors point to the need to scale-up water conservation and river-basin-management strategies.

All policies and programmes should face the test of whether they will leave people in Latin America and the Caribbean more or less vulnerable to the effects of global warming. The test will be: is this climate friendly and climate proof?

3. Support community-based coping strategies and disaster risk reduction

Global warming presents a huge challenge to the coherence and co-ordination of aid. Many donors are focusing strongly on the role of technology. But our experience tells us that promoting disaster reduction at local level by supporting community-based coping strategies is far more effective and yields immediate benefits that stretch beyond just tackling climate-driven disasters. In our view, 'good adaptation' also makes 'good development'. Responsible knowledge-sharing between communities is required. This needs facilitation and resources. Early warning systems on drought can help avoid sudden migration into cities or rainforests. The integration of community-based disaster risk reduction in relief, reconstruction, development programming, and poverty-reduction plans should now be a priority, and implemented as agreed at the World Summit on Sustainable Development (WSSD). The climate change community needs to recognise that disaster risk reduction is a vital component of climate change adaptation. It must work with the disaster management community to advance both fields and avoid duplicating activities.

4. Increase support for small-scale agriculture

Dramatically increased support for small-scale agriculture is needed, along with an approach to farming based on maximum appropriate diversification. Highly diverse systems, as opposed to commercial monocultures, have repeatedly been shown to be more resilient – and more productive. Farming based on expensive and energy-intensive artificial inputs will be both vulnerable to fuel price rises and will further add to the problem of climate change and environmental vulnerability. Vitally, small-scale farmers need support by a favourable policy environment and research that addresses the problem that they, themselves, have identified. Boosting production is crucial, and doing so requires systems that combine new insights and technologies with the wisdom of tradition. Dangers associated with clearing forest land and planting biofuels as opposed to food crops should be avoided.

5. Increase support for conserving biodiversity and win commitment to stop deforestation and illegal logging

More stringent measures to protect Latin America's rainforests from unsustainable logging and environmentally destructive development, including agricultural expansion, are needed. Tropical deforestation has negative impacts on biodiversity, air quality, local communities, and indigenous peoples. Reducing tropical deforestation is key to reducing overall global greenhouse gas emissions and staying below the 2°C global warming threshold. Latin American countries must adopt clear targets and timetables for reducing deforestation: by increasing local governance and providing economic incentives for sustainable forest management while developing and effectively implementing protected areas. The international community must support Latin American countries in this effort with appropriate technology, resources and regulations.

Substantially more protection for biodiversity and the integrity of ecosystems in the mountain regions and the MAR system is also needed. This is the world's second-largest barrier reef system supporting several World Heritage sites and is already suffering from severe bleaching episodes. Conservation must allow for and enable the necessary movement of species that will occur as a result of climate change. Three key recommendations include the protection of adequate and appropriate environmental spaces; the limiting of all non-climate related stresses; and the management of adaptation. New measures also need to run alongside greater respect for the centuries of knowledge accumulated by indigenous people.

6. Develop and implement clean and efficient energy

Even though wealthy countries must act first and fastest to cut greenhouse gas emissions, emerging Latin American countries also need to contribute to climate change mitigation by implementing sustainable development policies that include halting deforestation and substantial development of both energy efficiency and renewable energy.

The exploitation of fossil fuels in Latin America and the Caribbean does little for the development or security of its people. But the potential for sustainable and renewable energy on the continent is enormous, and the market, especially in poor communities, is huge. To meet people's need for energy, to improve health at the household level, and to help Latin America avoid further 'dirty development', international donors, financial institutions, energy companies, and transnational corporations should switch investment from fossil fuels to promoting access to renewable and sustainable energy, removing obstacles to the transfer of clean technology, supporting the transition down low-carbon development pathways, and adopting targets and timetables to achieve those objectives. The successful development of biofuels in Latin America is both an opportunity and a threat. The benefit of increased energy independence is offset by greater pressure on biodiversity in tropical forests from agricultural land-use. Europe, for example, is one

of the largest buyers of soya grown on former Brazilian Amazon rainforest. Rigorous management is needed to ensure that the increase of crops like soya, and others grown for biofuels, does not come at an irreversible environmental cost. An urgent assessment is needed of the carbon benefits of different biofuel schemes, the risk of further deforestation, potential socially negative impacts, and whether or not there is an emerging risk of competition between land-for-fuel and land-for-food.

7. Promote sustainable urban development

With 75 per cent of Latin America's people living in urban areas, reducing greenhouse gas emissions in the cities is vital. Projects that promote low-carbon city development, protect water resources and green areas, and reduce greenhouse gas emissions should be instigated. Case studies from cities such as Curitiba and Porto Alegre in Brazil should be highlighted to provide Latin America with examples of how to integrate sustainable transport considerations into business development, road infrastructure development, and local community development. There are numerous possibilities for alternative energy technologies, such as solar heating and cooling systems, especially for low-income families and in tropical countries. Good water-management practice should also be supported.

8. Implement existing agreements on environment and development

The Johannesburg Plan of Implementation agreed at the WSSD contains many commitments to 'protecting and managing the natural resource base of economic and social development', relating to water, disaster management, agriculture, desertification and drought, mountain ecosystems, biodiversity, and forestry. The international community should implement these agreements, for example:

- Reduce the risks of flooding and drought in vulnerable countries by, among other things, promoting wetland and watershed protection and restoration; improving land-use planning; improving and applying more widely techniques and methodologies for assessing the potential adverse effects of climate change on wetlands; and, as appropriate, assisting countries that are particularly vulnerable to those effects.

- Encourage the dissemination and use of traditional and indigenous knowledge to mitigate the impact of disasters. Promote community-based disaster management planning by local authorities, including through training activities and raising public awareness.

- Make rapid progress in implementing the Hyogo Framework for Action agreed at the World Conference on Disaster Reduction.

9. Apply new standards for the private-sector

Corporate involvement in Latin America in such sectors as energy, logging, mining, water, and the construction of infrastructure, such as pipelines and transport links, must take on board that development in the region needs to meet sustainability criteria. As climate change puts stress on scarce water resources, a dogmatic approach to water privatisation could easily increase the vulnerability of millions of people in the region. Consultation with local communities is central to ensuring the effective distribution of benefits from economic activity.

Conclusion: achieving development resilient to climate change

Latin America and the Caribbean needs to be freed from a one-size-fits-all development approach. Effective responses to climate change will differ everywhere depending on local circumstances, so a new flexibility is needed. The greatest challenge is to build climate resilience and resistance, and to secure livelihoods at local level. Promoting recognition of local knowledge is key. Integrating gender analysis and gender-equality indicators into programmes and projects will help identify where specific vulnerabilities to climate change lie, and where most opportunities for mitigating and adapting to climate change can be found. The cancellation of outstanding, unpayable international debt, and trade justice that promotes a fair and sustainable trade system, rather than trade liberalisation as an end in itself, would help tackle deepening poverty and environmental degradation in the region.

As Juan Mayr, one of the world's leading environmentalists, writes in his foreword to this report: "It is the right time to re-think the development model for Latin America and the Caribbean and to establish a new social contract that leads down the path of poverty reduction and greater equality to sustainable development. It's also the right time to re-think the model of international aid. Without question, it's about an ethical commitment that can be put off no longer."

Disasters: why some are bigger news than others

The world watched and the US woke up to the fearsome potential of climate chaos driven by global warming when Hurricane Katrina hit New Orleans in August 2005. Yet, both before and after Katrina there were other major hurricanes that caused widespread devastation. The difference? These extreme weather events struck Latin America and the Caribbean with their full force, rather than the US.

One was almost indistinguishable in name. Hurricane Catarina struck the southern coast of Brazil in March 2004 and left 33,000 people homeless. Hurricane Ivan came after the disaster in New Orleans and terrified people across the Caribbean hitting Jamaica in December 2005. Previously in 1998, Hurricane Mitch hit Honduras, causing mudslides and flooding and leading to the loss of almost 10,000 lives. Its impact on agriculture, coral reefs, fisheries, and infrastructure was devastating.

Hurricane Wilma struck Cuba in October 2005 leading to the evacuation of 640,000 people, but with another interesting story to tell. When New Orleans was inundated during and after Hurricane Katrina around 1,500 lives are thought to have been lost. In six major hurricanes that ran over Cuba between 1996 and 2002, only 16 lives were lost. What is it that a wealthy super power is doing wrong, that a poor country, subject to a long-standing and tight economic embargo from the US, is doing right? The difference would appear to be efficient organisation and a commitment to social development. The alteration and destruction of many of the natural wetlands in Louisiana in the US, and the amount of land at or below sea level may have also increased vulnerability.

Disasters cost lives, destroy communities, wreak havoc on people's livelihoods, and leave a lasting impact not only on physical infrastructure but also on people's well-being. Although the number of deaths from disasters has dropped over the last ten years, more people are being affected. The economic consequences are becoming ever more severe. In development terms, disasters can have a devastating impact both at household and at community level: a trend, which is growing. During the 1990s, an estimated two billion people globally were affected by disasters, triple the number impacted in the 1970s, while economic losses increased by a factor of five during the same period from US$138 billion to US$629 billion.[24] If current trends continue, disasters could have a global cost of US$300 billion per year by 2050.[25] More lives are lost in poor countries than in rich countries; in poor countries, more poor people than rich people lose their lives. The underlying causes of disaster lie in vulnerability, inequality, discrimination, and exploitation.

Many governments ignore disaster risk reduction; the result is high costs in human and economic terms. Yet research shows that the cost of disaster reduction is much less than the cost of recovery from disasters. It is estimated that for every £1 spent on mitigation between £4 and £10 can be saved in the costs of recovery.

Table 1. Economic impact of natural disasters in Latin America and the Caribbean

Damaged region	*Economic impact (millions of US$)*	*Event*
The 2004 Hurricane Season		
Bahamas	551	Hurricanes Frances and Jeanne
Cayman Islands	3,432	Hurricane Ivan
Dominican Republic	296	Tropical Storm Jeanne
Grenada	889	Hurricane Ivan
Haiti	296	Hurricane Jeanne
Jamaica	595	Hurricane Ivan
Cuba	1,500	Hurricane Frances
Total for 2004	**7,559**	
The 2005 Hurricane Season		
Guyana	465	Flooding in Georgetown and Albion
Guatemala	988	Torrential rain and Tropical Storm Stan
El Salvador	356	Torrential rain, Tropical Storm Stan (losses from eruption of Llamatepec volcano also included in figures)
Mexico	2,200	Hurricanes Emily, Stan, Wilma and others
Cuba	1,400	Hurricane Dennis
Total for 2005	**5,409**	

Source: Economic Commission for Latin America and the Caribbean

Measures to help communities cope with climate risks[26]

- Better housing for poor people located out of hazardous zones, such as floodplains.
- Improved sanitation and greater access to clean water in poor neighbourhoods, and more efficient use of water in key areas.
- Early warning systems combined with public education about the hazard; preventive actions prior to a warning; and appropriate responses when a warning is issued.
- Better building codes and strict enforcement thereof.
- Better management of resources during emergencies.
- Public education programmes on preparedness for slow onset hazards, such as drought.
- Improved weather and climate forecasting from short to seasonal time horizons.
- Partnerships among forecasters, intermediary organisations and users to facilitate delivery, interpretation, and application of forecasts to manage climate risks.
- Better coastal zone planning guidelines, especially those that recognise the flood mitigation potential of mangroves and natural wetlands.

The one they did not expect: Hurricane Catarina[27]

"No one could sleep because of the pressure of the wind on the walls and roofs. In a lot of houses the water came in without mercy, making that the longest dawn of history. There was nothing to do, but wait for it to end. When the first lights of the day came, I went out in the street, and I had the exact feeling that the city looked like a battlefield."

Saulo Machado, Araranguá/SC.

Until recently, only two tropical cyclones had been recorded in the South Atlantic, and no hurricanes. But on 28 March 2004, the southern coast of Brazil was battered by its first ever hurricane, Hurricane Catarina. It happened over a year before the similarly named Hurricane Katrina flooded New Orleans but, unlike Katrina, Catarina passed virtually unnoticed by the world's media.

Hurricanes do not normally happen in the South Atlantic Ocean because sea-surface temperatures are usually too low to develop such intense weather systems. In addition, the atmosphere does not provide enough 'spin' near the sea surface to get them started and winds higher in the atmosphere tend to shear off any that do begin to grow.

The speed of Catarina was around 150 km per hour, affecting two states in the southern Brazil, Rio Grande do Sul and Santa Catarina. Twenty-three cities were severely struck, leaving 33,000 people homeless. Four people were killed and a further seven fishermen were lost at sea. Catarina caused an estimated US$350 million in economic losses. Cities remained without contact with the outside world for a week, some without water and light for three days. Eighty per cent of schools were damaged leaving 40,000 students without classes, some for fifteen days.

The hurricane immediately raised speculation about whether there might be a link to climate change. In spite of scientific uncertainty on individual cases, there is broad consensus that global warming is likely to increase the intensity of hurricanes. Many believe the frequency will also increase. Researchers from Brazil's National Institute for Space Research believe that Catarina can be related to climate change due to warmer sea temperatures. They warn that some areas rarely or never visited by hurricanes may become vulnerable to more frequent severe storms.

As a consequence, local organisations and 700 residents of the region held the 'First Meeting of the Southern Region on Natural Phenomenon, Adversities and Climate Change', to look at causes, effects and adaptation needs. It was the beginning of a growing community awareness of a global problem and a chance to discuss solutions. It has led residents from southern Brazil to call for climate justice. Those who faced Catarina say the worst consequence is the resulting insecurity regarding what is going to happen next and how to face new climate catastrophes.

Extreme weather in El Salvador[28]

In El Salvador, climate change appears to have passed from scientific discussion to harsh reality. In October 2005, Tropical Storm Stan luckily dipped below hurricane strength before it reached El Salvador. Previous weeks, though, saw Category 5 hurricanes in the Caribbean. Although absolute cause and effect cannot be shown between individual events and broad climate change trends, over the past 20 years, the *El Niño* and *La Niña* events are bigger, droughts are more severe, and hurricanes are stronger. Tropical storm Stan brought with it a record volume of rainfall. The small streams that cross the city of San Salvador broke their banks, taking with them houses and vehicles. One stream in particular, known as 'El Garrobo', so small that it dries up

Eyewitness: When Hurricane Ivan hit

'Hurricane Ivan was devastating… I was affected very bad. Everything got damaged, my roof came off, my furniture got damaged, my animals them get killed. I didn't really make much preparation for Hurricane Ivan, just a little… Well I tried to nail down the house top, I tried to put the animals carefully, but I still get damage… I loose my roof, I loose everything.

I could have done more, I could have taken the animals to a safer place, and I think I could have put the most important things…at a safer place. All of me important papers, me birth certificate and whatsoever, all of those that got damaged…I think I could have put them more secure… I have to go back and reapply for me birth certificate and that take me a whole lot of time and a whole lot of money. I think it was late in the hurricane [when I lost my roof] because I didn't leave the house – I stayed until the morning. I tried to put the bed where no water was wetting, we tried to find a comfortable spot and we stayed until the morning. In the morning, we get up to take the smaller ones (children) to my mother. Then I returned and started to pack up what I can pack up, and then just pick up everything and leave.

The scariest part of the hurricane was when I was lying down on the bed and when I look up and see the sky - that was the scariest part… I feel as if everything was gone, everything was lost, because knowing that the roof is gone, you don't know what next. So I am not comfortable because I don't know what's going to happen next… I think that was a nightmare. It was hard to recover, because I had to spend about a month with my mother, before the things them could dry properly. And I had to start all over again.'

Pauline Adassa Grant, 42 years, domestic helper, Mocho, Jamaica, 12 December 2005[29]

for several months of the year, carried so much water that it left houses in a number of suburbs totally submerged, some of which were not just flooded but destroyed in the process.

The mountain range La Cordillera El Bálsamo, which crosses a large part of Salvadoran territory, suffered landslides, leaving some communities without communication, electricity, or water for five days; other homes in less accessible regions still suffer the consequences. At national level, 100 people lost their lives and tens of thousands were left homeless. In the neighbouring country of Guatemala a mountainside collapsed, burying a town and killing more than 2,000 people. It was impossible to recover the bodies, and the government of Guatemala declared the zone a national cemetery. Such problems came in spite of the fact that Stan lacked hurricane-force winds. The storm forced the Government to recognise the country's environmental vulnerability. For years, environmental groups, such as CESTA (Friends of the Earth El Salvador), warned of the increasing danger resulting from deforestation, turning areas that were originally natural watersheds into built-up areas and shopping centres, causing worse flooding. Local people now hope that Stan taught decision-makers a lesson that will change their approach to development.

Honduras…

"Over the past five years the rainfall has been variable. Previously, the rains fell during six months of the year (June–December). Nowadays the rains come together at one time, causing floods and droughts. There are places in Honduras where floods occur every year. The time lapse between floods has been shortened from five years to one year. Storms are more and more frequent. For example, during March (summer) there have been regional storms. Previously there would not have been a single storm during the month of March."[30]

How Cuba gets it right: Lessons in disaster reduction[31]

Cuba is a small and poor country whose geographical location gives it a high and recurrent risk of hurricanes. Yet when Hurricane Wilma struck in October 2005, this small island evacuated 640,000 people from its path, with just one fatality. The sea went one kilometre inland and flooded the capital, Havana, yet there were no deaths or even injuries.

This was not a one-off response but built upon a depth of experience in dealing with hurricanes. In the seven years between 1996 and 2002, for example, six major hurricanes hit Cuba, yet a total of just sixteen people died. In each case, hundreds of thousands of people – sometimes 700–800,000 at a time – were successfully evacuated, often within 48 hours. What is Cuba doing right? And what can the US and the rest of Central America learn from it? Cuba has tangible assets that are like the moving parts of a machine. But its intangible assets are more important; these are like the oil in the machine that enables it to function properly.

Tangible assets:

- A strong, well-organised civil defence.
- An efficient early warning system.
- Well-equipped rescue teams.
- Emergency stockpiles and other resources.

Intangible assets:

- Effective local leadership.
- Community mobilisation.
- Solidarity and a population that is 'disaster aware' and educated in what actions to take.
- Local participation in evacuation planning.

At the heart of the system is a clear political commitment, at every level of government, to safeguard human life. This creates both a centralised decision-making process alongside a decentralised implementation process equally necessary for effective emergency preparedness and response.

A culture of safety amidst adversity

The Cuban population has developed a culture of safety. Many ordinary people see themselves as actors with important roles to play in disaster preparation and response. Education and training, a culture of mobilisation and social organisation, and government prioritisation of human life in emergencies promote this vision. The whole system has been tried and tested so many times now that there are high levels of mutual trust and confidence between communities and politicians at every level.

"Any child in school can give you an explanation – how you prepare, what you do. Students, they know what to do, they know the phases [the four emergency phases – information, alert, alarm and recovery], what to do in each phase… how to gather things in the house and put them away….shut off the water and electricity. All students, workers and campesinos get this training," explains Mr José Castro, Civil Defence, Cienfuegos.

Once a year, at the end of May, the whole country participates in a two-day training exercise in risk reduction for hurricanes. The purpose is to refresh everyone's memory of their role and to practice any changes from the previous year. The first day consists of simulation exercises. The second day is spent in concrete preparatory actions: identifying vulnerable residents, cutting down tree branches which might fall on houses, checking reservoir walls or dams, cleaning wells, identifying places to evacuate animals, and so forth.

It is remarkable that Cuba's economic crisis and the embargo by the US have not noticeably increased its people's vulnerability to hazards. In many other countries, as witnessed when Hurricane Katrina devastated New Orleans, hazards like hurricanes and earthquakes only turn into disasters – the large-scale loss of life and livelihoods – because of inequity, because the poorest and most vulnerable are left to fend for themselves.

In contrast, the Cuban political model is geared towards universal access to services, policies to reduce social and economic disparities, and considerable investment in human development. This means, for example, that over 95 per cent of the population is literate and has electricity – a striking success for any developing country, let alone one which has withstood one of the longest-lasting economic embargoes of recent times. Consequently its people can access excellent, clear information about how to prepare for, and what to do during, a disaster. A clear priority for human safety is placed over poorly managed economic development in risk-prone areas, and building codes are enforced.

Is the Cuban model replicable? The Cuban one-party system, and the strong social control that comes with it, is obviously highly unusual and subject to criticism, but some positive elements of the Cuban experience could be introduced elsewhere. In the US, it is possible that timely, massive and organised evacuation would save more lives. However, unlike in Cuba, US municipalities are not compelled to respond to decisions about evacuation from a national decision-making centre. If a municipality does decide to evacuate, there is no enforcement capacity at the municipal level.

In Central American countries, systems of government are less centralised, the risks faced are more varied and widespread, and populations are larger and more dispersed. Corruption is also a problem. There can be a lack of political will in national governments for reducing risks to the poorest. Nevertheless, willingness to improve preparedness often exists, particularly at local level, and there is a lot of potential for strengthening the role of local government and civil society in this respect.

Disaster-preparedness: working with Peruvian schools and communities[32]

Political and economic factors determine that people in poverty also live in areas of high risk to the impacts of climate change. Practical Action works in Latin America to develop training for local communities and organisations where the effect of government centralisation has been to weaken local ability to prepare for, and respond to, disasters. The region is prone to earthquakes and the landslides and floods caused by the *El Niño* phenomenon. Training led the Ministry of Education to build disaster risk reduction into the school curriculum. A regional network has developed a detailed database of local disasters enabling changing patterns to be tracked.

The benefits of the broader project include a transformation in local confidence and ability to understand the situation. Through drama performances, 17-year-old Lucia felt that she was able to change the minds of some of her audience. Her relationship with her parents improved because they could see she had learned useful skills and they allowed her more freedom to attend meetings. She spoke about how people now understood that disasters often had human causes, and were not merely acts of God. One mayor involved said that before the project, people did not know about the National Civil Defence System, which co-ordinates disaster preparedness and

Early warnings on the Radio[33]

Idalma crossed the bridge at full speed before the hurricane knocked it down. When she arrived at Radio Sandino in Pinar del Río, Cuba, she noticed that the revolving equipment they had to measure wind speeds of up to 350 km per hour was broken by the force of Hurricane Wilma. Remarkably, the hurricane did not kill anybody because warnings were given by radio. Idalma is one of the journalists who received training from the *Proyecto de Ciudadanía Ambiental* that works through community radios in seven Latin American countries. It promotes awareness of global environmental problems and action on climate change, the ozone layer, water, and biodiversity. An audience of millions in Mexico, Cuba, Costa Rica, Ecuador, Peru, Chile, and Argentina listens to the programmes.

Many listeners say they are now aware of how climate change affects everyone. Programmes increase understanding of the environmental connections between production, transport, and energy use in the home and at work. But as well as promoting the reduction of greenhouse gas emissions, the programmes also seek to prepare people for the inevitable impacts that climate change will bring. The radio project also has a campaign goal to persuade the State to take more responsibility for environmental issues. That means new legislation and education policies, planning in the medium and long term, local and national strategies, as well as financial resources and adequate technologies.

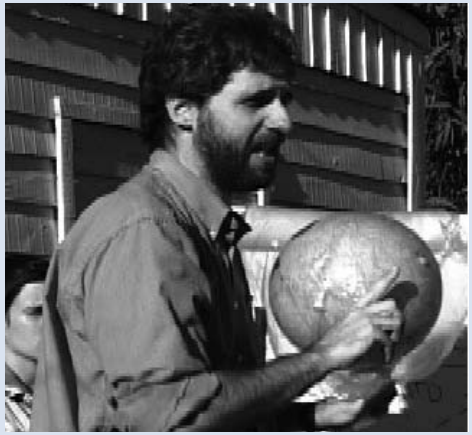
El Zanjón (The Big Ditch): how video helped the vulnerable community[34]

In April 2004 the Argentinean shantytown outside Buenos Aires, El Zanjón (literally 'The Big Ditch') flooded again. Three days later, with mattresses still drying outdoors, two filmmakers, Fabio Benavídez and Andrea Santoro, captured local people coming to terms with the twin problems of flooding and climate change. The resulting short film of their meeting is like a visual haiku of a community exploring its options for the future.[35]

"You never know when the river will rise," says one person, "We wake up with water up to our neck," says another. Researcher Pablo Suarez from Boston University is unsettled to hear such words from a community flooded on average three times a year. "Our scientific models have been predicting short-term floods in the Río de la Plata with sufficient lead time and accuracy. We *do* know when the river will rise," says Suarez, "The problem is that *they,* the ones who suffer the floods, do not."

Inequities in the flow of, access to and use of information remain a fundamental challenge. The most vulnerable members of the global population rarely benefit from climate forecasts. Either the information does not reach them, or they have insufficient knowledge, resources or empowerment to respond adequately. During the workshop in El Zanjón, and armed with knowledge that their floods were predictable and likely to become more frequent due to climate change, the community decided to act. They asked for the film to be aired on the local TV channel to raise awareness. They organised an advocacy campaign targeting the municipal government. They proposed a simple early warning system using whistles. As a result, a telephone line was provided, and now the Port Authority calls a local leader when a flood is imminent, triggering evacuation and other disaster-response strategies.

During a similar workshop in the Limpopo River flood plain in Mozambique, the short film from El Zanjón was shown to subsistence farmers (under a tree, using a laptop) revealing the potential of film as a universal language. One of the women farmers said, "I thought that all these recent droughts and floods were sent



Pablo Suarez

by God or our ancestors as punishment, and there's nothing one can do to prevent that punishment. But now in the film I see that white women in distant places are suffering just like us. If the climate is changing everywhere, then we should do something about it – we can." A simple video from an urban shantytown in Latin America had helped an African rural community to change its understanding of the climate problem, and to seek solutions.

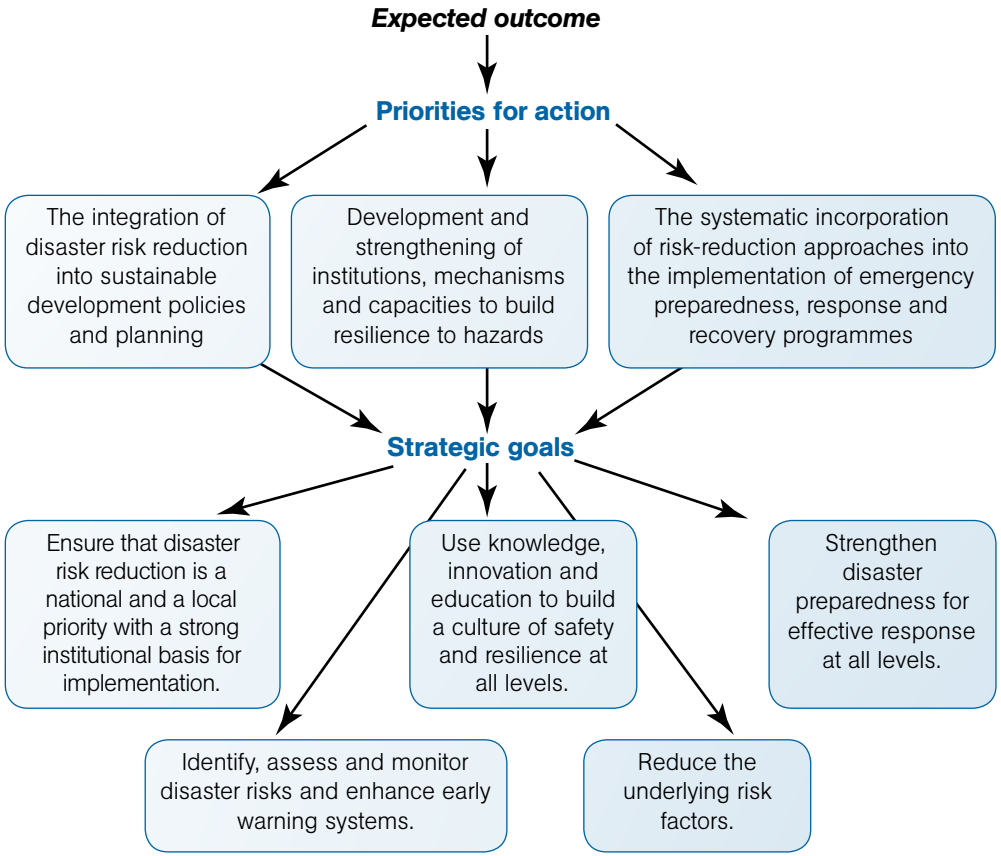
Advances in digital technology create new opportunities to use video for community-level adaptation to climate change. While health sciences have taken up video, climate adaptation research and practice have yet to take it seriously.[36] Video can help vulnerable communities, particularly in Latin America where common languages allow successful pilot projects for raising awareness to be scaled up. The transfer of best practice then gets easier, building adaptive capacity and strengthening participatory processes that enable poor communities to prepare for a changing climate.

response. The project also reached out to women and children for the first time. People now understand what to do in an emergency. They know where to go to for safety.

Building resilience to disasters: governance and the Hyogo Framework for Action 2005–2015

In January 2005, The World Conference on Disaster Reduction in Kobe, Japan showed that disaster risk reduction is strongly linked to poverty alleviation and development and concluded that it should move to the heart of development policy. A ten-year action plan was agreed for the international community: *The Hyogo Framework for Action 2005–2015.* Although not legally binding, it aims to substantially reduce the loss of life as well as reducing social, economic and environmental losses by identifying three priority actions and five strategic goals.

The Hyogo Framework for Action 2005–2015



Guatemalan women seek opportunities after Hurricane Stan

Piles of rocks now lie where people's homes used to stand in the town of Tacaná in western Guatemala. Clearing the rocks so they can build new homes is just one of the many tasks facing the townspeople after rains and landslides triggered by Hurricane Stan in October 2005 wiped out crops and hundreds of houses, devastating their livelihoods. The major problems affecting the communities hit by Stan in Guatemala are access to food and health. Single mothers are particularly vulnerable and are desperate to obtain some sort of income in order to get back on their feet. This sometimes means leaving their children and their village for a whole day, sometimes even a whole week.

Source: United Nations World Food Programme. See www.reliefweb.int

Floods and mudslides in Bolivia[37]

In January and February 2006, continuous serious floods triggered by heavy rains affected several Departments across Bolivia. The Government declared a state of emergency at the beginning of February and appealed for international assistance. Floods have affected 27,500 families, 12,742 of which are in need of humanitarian aid. To date 23 people have died and 9,374 families have been evacuated. Most affected areas are situated in the south of Pando Department and in the north of Beni Department along the rivers Beni, Madre Dios and Orthon. These areas are difficult to access by road. Some 103,000 ha of crops have been flooded (64,000 ha of corn, soya, sorghum and rice; 30,000 ha of pasture; and 3,000 ha of other crops). Immediate support is required to prevent the spread of water- and vector-borne diseases.

Work by ActionAid shows that people's vulnerability due to the poor design of risk reduction measures results from weak and ineffective state institutions, corruption, lack of transparency and political will, and international structures that create poverty and vulnerability. Yet their vulnerability is itself a failure of governance. To promote people-centred disaster risk-reduction governance, ActionAid has identified eight key policies for governments:

1. **Participation**: In order for development policies to adequately meet the needs of the poor and the excluded, governments need to find ways of ensuring that vulnerable people participate in accountability and decision-making processes.

2. **Accountability**: Governments must be held accountable for the promises they make and the policies they either do, or do not, implement.

3. **Decentralisation**: Strengthening local government helps to ensure that decision-making is appropriate and enhances government accountability.

4. **Freedom of and access to information**: People need to have access to adequate information on policies, rights, and important government decisions to ensure participation in disaster reduction.

5. **Legally enforceable obligations**: Government policies and their obligation to protect citizens need to be legally enforceable; without this governments can evade responsibility.

6. **Access to justice**: Justice for all, based on appropriate legislative framework, is essential to protect people, especially the most marginalised and vulnerable.

7. **National co-ordination and co-operation**: For disaster reduction to be effective there is a need for national level co-operation between the many different organisations and institutions involved.

8. **International cooperation and coordination**: Because disasters do not respect international boundaries, agreements ensuring transnational accountability are important to promote safety across borders.

There is a long history of aid money being used to bandage the wounds rather than prevent the injuries, with the international community concentrating much of its efforts on disaster response. This must now change. As a Senior Programme Officer with UNICEF observes, "In light of increasingly fragile social, political, economic and natural environments, the longer we delay in addressing risk reduction and preparedness, the greater the impact, scale and cost of emergencies."

Churches point to a 'spiritual crisis' regarding climate change[38]

Andres Tamayo, a Catholic priest from Honduras and Director of the Environmental Movement of Olancho, was one of eight speakers from around the world to address the Global Warming 8. This was a counter-summit to the G8 meeting of world leaders in Edinburgh in July 2005 organised by the UK Working Group on Climate Change and Development.

When he spoke, he talked of the impact of deforestation and global warming on his region. "Our forests could play a part in climate change mitigation" he said, "but sadly, 64 per cent of them have been cleared in the last 30 years". He said that mild climates had become deserts. Springs had dried up forcing entire communities to migrate. He said tropical storms are more frequent and more intense, "The temperature has risen 1.8–2°C in the last 50 years and there have been more forest fires as a result, which produce 25 per cent of the greenhouse gas emissions from Honduras." He described the Central American Free Trade Agreement (CAFTA) as a "monster", threatening to open up Honduran forests to faster deforestation.

Fr Tamayo organised two Marches for Life where thousands of Hondurans walked to the capital city, demanding a logging ban. Cardinal Oscar Rodriguez, Archbishop of Tegucigalpa and head of the country's Catholic Church, joined them.

Elsewhere the Catholic Bishops of Northern Mexico criticised lumber companies for having "no vision of the future" and "placing economic incentives before all else". In 2005, a Brazilian Catholic bishop succeeded in stalling a huge irrigation project for Brazil's impoverished Northeast by staging a hunger strike. Bishop Luiz Flavio Cappio vowed to keep up his hunger strike until death unless President Luiz Inacio Lula da Silva's government cancelled a US$2 billion project to divert water from the Sao Francisco River. Around 70 per cent of the water from the project would go for production of shrimp, grapes, flowers, and other farm exports. Only about 4 per cent would go to the homes of poor families in arid areas. Campaigners believed it would exacerbate problems already being felt due to climate change.

Latin American work stemming from the World Council of Churches (WCC) Climate Change initiative is co-ordinated by Carlos Tamez, a Presbyterian pastor in Mexico. He was part of the WCC delegation at the climate conference in Montreal in December 2005, where he outlined his region's vulnerability to increasingly severe and frequent hurricanes, to drought and desertification, to hunger, and to forced migration – a litany of perils that he attributed to climate change. At the same event, the Argentine ecumenical patriarch Elias Crisostomo Abramides described the effects of climate change in Argentina, from melting and receding glaciers to eroding coastlines, as well as intensifying desertification and increasing outbreaks of tropical diseases, such as malaria and dengue fever in formerly temperate zones. "We are dealing not only with a technological issue," he said, "but with a spiritual crisis that has taken us to the present situation."

Water of life

Glacial retreat in South America[39]

Southern South America accounts for about 65 per cent of all Andean glaciers. The main areas in the region are the northern Patagonia ice field with an area of 4,200 km^2, the southern Patagonia ice field with an area of 13,000 km^2, and Cordillera Darwin with an area of 2,000 km^2. There are glaciers in drastic retreat in the region. The O'Higgins Glacier has shrunk back 15 km over the last century in what is probably the largest retreat in all of South America. A recent thinning of 14 meters a year has been measured at Upsala Glacier, and a record thinning of 28 meters a year has been detected at HPS 12 Glacier in Falcon Fjord.

The Chacaltaya Glacier in Bolivia, which provides water resources to the city of La Paz, is predicted to melt completely within the next 15 years if the present atmospheric warming trend continues. The incidence and speed of glacial retreat has generally accelerated during the last decades, with most glaciers expected to collapse within our own lifetime. This is the case in the Northern Andes, covering Ecuador, Peru and Bolivia, but also in Chile and Argentina, for example, the Echaurren Glacier in Santiago, and Piloto Este Glacier in Mendoza.

Peru, meanwhile, with 470,000 ha covered by what is known as 'eternal ice', possesses 70 per cent of the mountain glaciers within the Earth's tropics. According to officials at the glaciology unit with Instituto Nacional de Recursos Naturales (INRENA), the ice-covered area of the Peruvian Andes has been reduced 22 per cent over the 1970–1997 period. Mount Huascarán, Peru's most famous mountain, has lost 12.8 km^2 of ice – around 40 per cent of what it covered 30 years ago.

"The acceleration of the de-glaciation process is a catastrophic danger in the short and medium terms," says Carmen Felipe, president of the governmental Water Management Institute. In the short term, the melting could cause overflows of reservoirs and trigger mudslides, and in the medium term, reduction in water supplies. The latter could disappear in 20 to 30 years. The examples below indicate the comprehensive nature of impacts that can be expected.

Ecuador's big melt[40]

Glaciers in Ecuador are also shrinking rapidly due to global warming. The ice surface on the volcano Cotopaxi reduced by 31 per cent between 1976 and 1997, and the glacier has shrunk from 21.2 km^2 to 14.6 km^2, according to a report by the French Institute for Development (IRD) and the Ecuadorian Instituto Nacional de Meteorología e Hidrología (INAMHI). Over the next 10 to 20 years the country will lose at least four of its eight most important glaciers.[41]

The phenomenon is linked to the growth of arid areas and soil loss and desertification, as well as native ecosystem loss, the disappearance of species, and loss of agricultural land. All this puts the country's ability to feed itself at risk and has a special impact on Andean indigenous culture by forcing indigenous people to migrate.

A warming climate forces people to farm at higher altitudes to grow their staple crops, adding to deforestation.[42] This in turn undermines water sources and leads to soil erosion. And there is also a cultural impact. The displacement of millenary Andean cultures to higher lands means the loss of the places where their culture is rooted, putting its survival at risk.

The native communities of the Imbakucha Basin in Otavalo,[43] Ecuador, already feel the impact of climate change. Unexpected frosts and long drought periods affect all farming activities.[44] The older generation say they no longer know when to sow because the rains do not come as expected. Migration offers one way out but represents a cultural nemesis and the human and social price to pay is high. The same is true for other communities living in areas between 2,500 and 3,500 metres above sea level, who depend on rain for cultivation. Coastal communities are also affected.

Carbon sequestration through forest growth is said to mitigate global warming, but where plantation monocultures of exotic plants replace the fragile ecosystems of the *páramos*, the sequestration benefits are questionable. Helped by weak legislation in Ecuador, these plantations make it easier and cheaper for high-polluting rich countries to offset their greenhouse gases emissions in developing countries rather than at home.[45] But not all the costs are being counted: the plantations negatively affect the hydrological cycle and also reduce the amount of land available for the indigenous population. Not only is the climate changing, so, too, are the lives of the indigenous population and farming communities.

Changes to the water cycle are not only caused by shrinking glaciers in South America's mountain ranges; problems are also striking Central America and the Caribbean, as the following examples show.

Community water resource management in Ibans Lagoon, La Mosquitia, Honduras[46]

Ibans Lagoon is located within the Río Plátano Man and Biosphere Reserve (RPMBR) in the Mosquitia area of north-eastern Honduras. The reserve covers an area of over 8,300 km^2. It has been recognised as a World Heritage Site since 1982 due to its exceptional diversity of marine and terrestrial ecosystems that include coastal wetlands, tropical broadleaf forests, and areas of pine savannah.

Vanishing glaciers in the Colombian Andes[47 48]

Photos: (from left to right): Erwin Kraus (1946, reprinted with permission from Diego Samper Editores); Oliver Hill / Roberto Ariano (2006), and; Photshop editing courtesy of John French (2006).

In glacial terms, 60 years is normally a blink in time. But in the Colombian Andes, the meaning of the term 'glacial' is changing – fast.

In the northeast of Colombia, near the Venezuelan border, El Cocuy National Park covers 306,000 ha ranging from 600 to 5,330 metres above sea level and including a mountain range that is home to Colombia's largest glacial mass (30 per cent of Colombia's total – see Figure 1 and Table 2).

The glaciers of Cocuy are an integral part of the hydrological cycles of several ecosystems, including lowland and Andean forests and high-altitude savannas known as *páramos* that are mainly found in Colombia. Due to its geological history, up to 80 per cent of the rock substrate in El Cocuy has the potential to store and regulate underground water resources, making the area an important provider of environmental services. Other important features the systems possess are high-altitude lakes, most of which have developed since the last major period of glaciation. Together, these systems are vital sources of water and environmental services for the indigenous U'wa and other communities living in and around the Park.

During the Little Ice Age (1600–1850) glacial cover in El Cocuy extended down to 4,300m above sea level. Since 1850, glaciers stopped growing and, in the

Figure 1. Ecosystems and altitudes in El Cocuy National Park

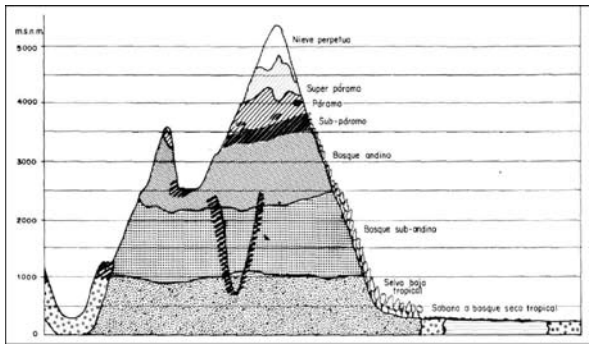
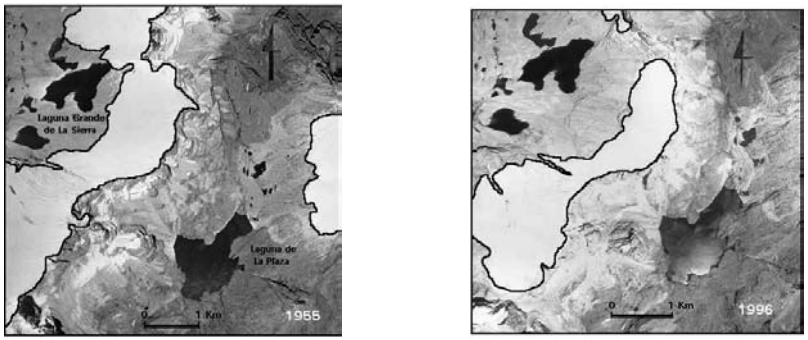


Table 2. Estimated area and volume of Colombia glaciers, 1850 and present

Glaciers	Max. alt. above sea level (m)	Area 1850 (Km^2)	Area 1979 (Km^2)	Area 1997 (Km^2)	Volume 1850 (m^3)	Volume 1979 (m^3)
Huila	5,750	33.7	15.4	13.3	769.2	255
Tolima	5,280	8.6	2.1	1.0	112.1	15.4
Santa Isabel	5,110	27.8	7.3	5.3	586.4	88.5
Ruiz	5,400	47.5	17.0	9.3	1,248	293.1
Santa Marta	5,775	82.6	12.4	11.1	2,223	81.1
Güicán, Cocuy y Chita	5,430	148.7	35.7	23.7	4,964	352.5

Figure 2: Retreating glaciers in El Cocuy in the Sierra Nevada comparing 1955 with 1996



past 60 years, glacial melting has accelerated rapidly, in line with global warming over the same period. It is estimated that the area of glacial cover in El Cocuy is now only a quarter of what it was in 1850 and that this represents a 14-fold decrease in the volume of ice locked in the glaciers.

In 1983, observations by Fabre based on Kraus' and van der Hammen's photographs from the 1940s and 1960s led to estimates that glaciers had receded some 250 metres (horizontal /linear measure), at a rate of 6.5 metres per year.[49] This rate of change meant that the glaciers would have lasted another 300 years. Flórez subsequently used aerial photographs from 1979 and found the glaciers were receding at a rate of 24 metres per year.

Today, the Colombian Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) is monitoring five glaciers in El Cocuy using satellite imagery and physical observations; three expeditions to measure glacial recession have been mounted with Park staff since 1995. The last measure (2004/05) of year-on-year melting found an average rate of recession of 15 metres per year. At this rate – without accounting for potential non-linear escalation of glacial melting – park staff estimate that El Cocuy will lose all of its glacial cover by 2030.

The ecosystems created and supported by the glaciers on and around El Cocuy act like giant sponges, absorbing and releasing water flows that supply communities and systems lower down the mountains. For decades, these systems have been under assault from below as rural communities marginalised by Colombia's conflict and inequitable socio-economic system have taken agriculture and livestock grazing higher and higher up the mountain. Now we are discovering that global warming may be an even greater threat from above.

As the glaciers melt and total volumes of water decrease, the ecosystems and communities that depend on them will experience two waves of change. Currently, higher rates of recession correspond with greater flows of water that contribute to higher rates of erosion, flooding and mudslides in lowland areas when and where the giant sponge cannot serve as a buffer. As the glaciers disappear, flows will tail off dramatically to comprise only rain and snowfall; the giant sponge will dry out and the surrounding communities will be exposed both to lower net flows of water and greater risks of flooding, mudslides and erosion due to the degradation of the environment.

The IDEAM-El Cocuy National Park team has established a site for a new climatic station to help monitor glacial recession with real-time information of the northern section of the Sierra Nevada. The Park staff has also begun to discuss the implications of these changes with surrounding communities, but progress is slow. They have launched improved environmental management of the *páramos*, micro-basin management, alpine lake research, and efforts to reduce human impacts on the *páramos* and the Sierra Nevada to create greater awareness of the vital importance of the glaciers, the *páramos* and their water resources. There is a critical need to conserve these highlands to guarantee water resources for future generations. These efforts are already stretching the Park's limited human and financial resources. The speed and scale of the changes underway means that more effective adaptive responses are imperative.

Roberto Ariano, El Cocuy National Park, December 2005

A human tragedy in Belle Anse, Haiti[50]

On 22 May 2004 over a period of 36 hours, rainfall caused unprecedented flooding in the communes of Belle Anse, Haiti. Over 1,000 people died and property sustained massive damage. Deforestation is having a devastating impact on life in Haiti. Less than 2 per cent of this mountainous country is covered by forest. Haiti faces floods caused by regular rainfall and tropical cyclones, both probably exacerbated by climate change. The country's problems are another example of the lethal interaction of bad development and environmental factors.

Parts of some towns are surrounded by mountains where trees have been replaced by small homes and farms, creating particular vulnerability to floods. Over 100,000 inhabitants living in this area are exposed to the consequences of deforestation and climate change.

Flooding in Mapou Town

Jean-Baptise Anthony Rabel, a resident of Mapou Town, lost his family and livelihood in the 2004 flooding. "We are facing serious environmental problems in our hometown. A lot of trees are cut down to make charcoal and our government is not upholding its responsibilities," he said. "We pay the consequences: the place is turning into a desert and there is nothing to keep the water when it rains. Moreover, the climate is warmer than in the past. I am fifty and it was our first flood last year. In my neighbourhood, the homes were made with stones linked together with cement and covered with sheet. Before the floods, I had my home, my farm and livestock. I used to grow coffee and several other crops in my farm. My wife was also a small merchant. We were able to survive on the money we earned.

It started raining in the afternoon of Saturday, 22nd May, 2004. It kept raining until Sunday night. By 8 pm the drum in our backyard was full of water. I woke up my wife and my kids and I told them we had to get out. It was the first time this had happened to us. I tried to open two doors but I couldn't. My nine-year-old boy was trying to help me break the third door when my wife cried: 'Anthony, we're dead; our home is destroyed.' All I knew was that I was floating in the water trying to hold my son in the air.

A wave came and with the water went my son; all I had left was a shirt in my hands. My arm was broken. I stayed there until the water receded. I had nothing other than the clothes I was wearing that night. I lost everything: my wife and three kids, my home, my livestock and part of my land."

The reserve is home to three indigenous groups – Miskito, Pech and Tawahka – as well as members of the Garífuna ethnic group and Ladinos from other parts of Honduras. Most people live on the coast or along the major rivers where they farm, hunt, fish, and gather useful products from the forest, including firewood, timber for building houses and canoes, and medicinal plants.

The reserve's coastal wetlands consist of a series of lagoons, canals and swamps. Ibans is the second-largest lagoon in the reserve. It covers approximately 64 km^2 and becomes brackish during the drier times of the year. Several Miskito communities are located on the thin strip of land between the lagoon and the sea, sharing the lagoon and its associated ecosystems, including the forests of the water catchment area. Rapid population growth and the immigration of landless farmers from other parts of Honduras into the zone are putting pressure on the area's natural resources leading to deforestation, over-fishing, over-hunting, erosion, sedimentation, and soil and water pollution. Climate change is adding to these pressures.

One of the most pressing concerns for the communities is the erosion of the narrow coastal strip caused by the waves from both the lagoon and the sea, particularly during bad weather. This is exacerbated because much of the shore vegetation – including mangroves – has been removed for firewood, to create space to build houses, for boat landings, and to provide access to the lagoon for bathing and washing clothes.

The older people tell of when they used to have a house or land in areas now covered by water. During Tropical Storm Michelle in 2000, in some parts of the village of Cocobila several metres of land were lost with the result that at the narrowest point there are now fewer than 100m between the lagoon and the sea. As this is an area frequently affected by tropical storms, and sometimes hurricanes – notably Hurricane Mitch in 1998 – the high rate of erosion increases the risk of flooding in the villages and therefore damage to infrastructure and housing.

Also during Michelle, along the coast towards Palacios, the main river that drains the lagoon broke through the sand bar into the sea in an uninhabited area where much of the vegetation had been removed. As a result, the salinity of the lagoon has increased because salt water now makes its way up river during high tides or when the river is low. Although the effect on fish stocks and the general lagoon ecosystem has not been monitored, this is likely to cause substantial changes.

Reforestation in Ibans Lagoon

In 2002, MOPAWI, a Honduran NGO, began to work with the communities of the coastal strip to identify the scale of the environmental problems and how to tackle them. During a series of workshops involving men, women and children from 15 different communities, participants were encouraged to develop a community action plan for the management and protection of the lagoon and its associated ecosystems.

Photo: © Greenpeace/Daniel Beltra

Workshop participants gave highest priority to reforesting the lagoon shore with mangrove and other species to reduce erosion and improve fish habitats. Other activities included better waste management, greater application of the law in relation to resource extraction and house construction on the lagoon shores, and training of farmers and foresters in sustainable techniques.

Unfortunately, although the importance of community involvement in the process had been discussed at length, not all of the workshop participants shared the results with their communities. Individuals or small groups therefore carried out some of the first activities with little wider local consultation or participation. As a result, reforested areas were not respected and, as people went down to the lagoon to bathe, play and wash clothes, trees and 'living stakes' were trampled, pulled up and damaged by having clothes hung on them. Many were also eaten by cattle and horses.

In the next phase of the project, MOPAWI encouraged village groups, including local councillors, to take account of the need for access to the lagoon for washing clothes, bathing and transport. These groups were more successful in involving their neighbours and quickly established several plots, fenced to keep out animals. One village planted mangroves but elsewhere, close to settlements, it was decided to plant other species because mangroves tend to harbour biting insects. In some areas people planted crops such as manioc among the trees to make the most of the protected area. Living fences have helped to stabilise the soil; they also last much longer than normal fences as the posts do not rot or suffer from termite damage. With some species the new growth can be sold for firewood or as posts. The new, fenced-in plots have so far been very successful. Everyone in the area knows their objective and many have helped to establish them.

The 2005 hurricane season

During the 2005 hurricane season, the storms that caused most damage in the Mosquitia region were Wilma, Beta and Gamma, all within a period of three-and-a-half weeks. Heavy rain in the hills caused the rivers to rise with alarming speed, washing away houses, crops and livestock in river communities. One of the rivers burst through the narrow coastal strip into the sea in a new place, taking with it 39 houses and tragically killing two people. MOPAWI and the Honduran Government provided short-term emergency help – mainly food, fuel, and water purification – through the recently formed local emergency response committees. However, as well as the longer-term needs for building materials, the loss of nearly all the local crops means that many communities will face food shortages for a long time to come.

Livelihoods

Agricultural land (excluding pastures) represents about 19 per cent of the land area of Latin America. Up to 4 out of 10 working people in the region (30–40 per cent) are employed in agriculture. But, according to the IPCC, in countries like Brazil, Chile, Argentina, and Uruguay, global climate models and crop research indicate that global warming will lead to lower yields of key crops, particularly during *El Niño* events. Production of barley, grapes, maize, potatoes, soybeans, and wheat are expected to fall, "even when the direct effects of carbon dioxide fertilization and the implementation of moderate adaptation measures at the farm level are considered".[51] Global warming could also worsen the impacts of a range of pests and diseases affecting livestock and crops, further lowering production.

Resource-poor farmers need technical advice and training in order to reduce their vulnerability to this range of environmental risks. Mountainous regions, such as the Andes, are especially challenging. There, the struggle by smallholder farmers to secure their livelihoods is accentuated by seasonal variations in climate, which can bring drought, floods, frost, or hail within a single growing season and where climate change is likely to lead to more extreme cold spells.

Faced with a decline in government support, private support services have grown. But in poor countries the situation is incomparable to the levels of support that farmers in rich countries take for granted, and few resource-poor farmers in the South are able to pay for private services. As a result, the emerging private sector is directed at larger commercial farmers. Now, however, there are a small but growing number of approaches that better complement the needs of smallholder farmers and their ability to pay. These initiatives are characterised by the training of farmer-to-farmer agents who operate largely unsubsidised.

Increasing climatic resilience and reducing environmental damage in western Honduras, Central America[52]

A whole range of problems face people in the Honduran province of Lempira. Ensuring enough food to eat is as hard as getting and holding on to the land needed to grow it. Farms produce less than they could and get too little financial or technological support from the state. To face these challenges, producers from 34 rural communities joined together to focus on increasing the productivity of their farms.

After Hurricane Mitch caused regional devastation in 1998, the development association APDI (Asociación Popular de Desarrollo Integral) devised a new strategy to respond to environmental vulnerability with support from the Community Fund and Progressio (formerly CIIR). Working with community groups they chose to tackle four main problems identified by local women and men:

1. Contamination of water sources.
2. The high cost of artificial fertilisers.
3. High household wood consumption.
4. Poor soil management on farms.

Activities commenced with community and group meetings to establish how environmental and productivity problems should be discussed, and to raise awareness of the fragility of natural resources. Through consensus, this helped plan the actions to take, with particular focus on gender and agro-ecology. The first steps were the development and sharing of skills on the actual plot of land. Working together, people were able to capture and share local farmers' valuable knowledge of the soil, native species, plagues, diseases, rainfall patterns, and more.

They worked to reduce contamination of the community water sources. They used a range of approaches including new management plans, declarations of sources to be protected by the Municipal government, tree planting and new fruit-tree nurseries, and reforestation campaigns in areas at risk.

The majority of the communities inhabit the coffee-growing highlands. Coffee processing produces a lot of waste pulp and water run-off (*aguas mieles*) both of which are powerful pollutants that can contaminate community water sources and negatively affect aquatic life and the health of the community. As a result of the new work, these unsustainable practices are gradually decreasing.

Organic fertilisers were developed using local resources, such as harvest waste, manure and household waste. These are mixed with low-cost materials, such as cane sugar candy and green copper, which are permitted in organic agriculture.

Instant organic *aboneras* (structures to make compost) were built using local materials. They took just two to three hours to build and could be used immediately. The compost produced can be used on everything from coffee plants to domestic vegetables and fruit trees.

Excessive fuel-wood use is a burden on both the environment, due to deforestation, and on the women and children who collect and deliver it. To reduce the impact on people and ecosystems, APDI provided training for the construction and use of more efficient, improved stoves and ecological furnaces, reducing the use of fuel-wood by half and consequently reducing the pressure on the forests. Even better, by cutting smoke inside households, health for women and girls was also improved, and cooking was less arduous.

Some women built communal ovens and made bread to sell and raise their income. Distances between houses are long, so another group built individual ovens, each helping the other with materials until they all had their own.

Soil management plans helped recover the soil's natural fertility for growing staple grains and coffee. The emphasis on soil and water conservation meant an end to clearance burning, and more use of levelling and contour lines, as well as green fertilisers. Crop residues were left with minimal tillage, and organic fertilisers were used in both communal and individual plots dedicated to growing maize, beans, coffee, sugar cane, and garden vegetables. As a result, natural soil fertility improved with more meso- and micro-organisms present. The structure of soils improved, as did their capacity to retain moisture and tolerate sudden changes in temperature and rainfall.

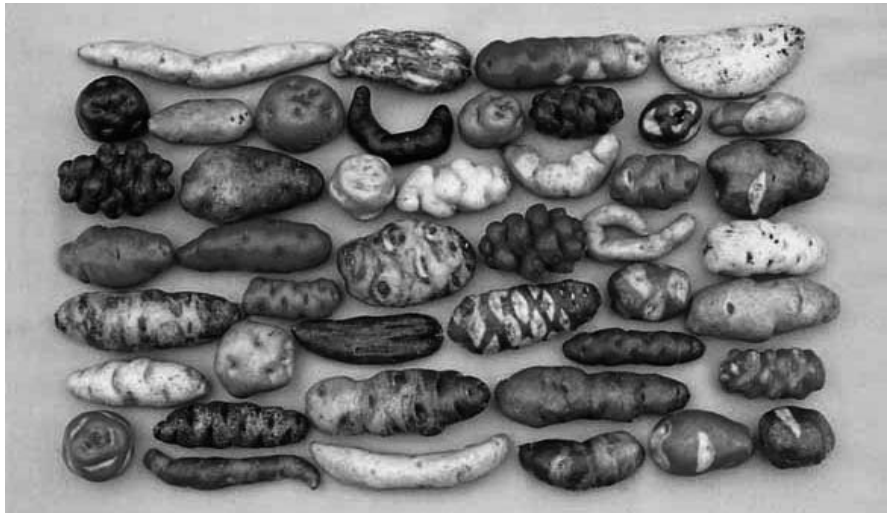
Analysing the soil to check its nutrient balance was a novel activity for the farmers. Both women and men were trained to teach others in their communities the technique. Use of chemical fertilisers was reduced but production actually increased. Costs fell and the soil is now treated and worked with as a live system.

Mexico…

"Crop yields are less reliable due to the potential droughts, frosts and potential rains that sweep away the maize, strong winds that damage the plants, and less land now suitable for cultivation due to soil erosion. We have reached the point where we import 40% of the maize and beans needed to feed the population."[53]

Local crops for local people

In extreme environmental conditions, such as those expected under climate change, locally adapted food crops are invaluable in producing sufficient food for survival. The conservation and development of local agricultural biodiversity is crucial in the face of climate change. In the high Andes of Peru and Bolivia, local potatoes, or *papas,* and alpacas provide the basis for survival in inhospitable conditions. Communities living at altitudes above 3800m get help from the UK-based group Practical Action to commercialise native potatoes as niche products in local markets. Native potato varieties are consumed by the people who grow them; they like their taste and find them easy to cook. Potato varieties that have been introduced to the area, which are bigger and



A selection of the 256 varieties of potato that can survive the harsh conditions of the high Andes. The biodiversity of this staple food is crucial in case any particular variety fails. Source: Practical Action

of poorer quality, tend to be sold at markets. To improve alpaca production, training is provided on how to improve local pastures and treat common animal diseases.

Family incomes in this area are typically less than US$500 a year, and the mortality rate in children is higher than one in ten. Over 60 per cent of small children are chronically undernourished.

Work in the area set out to increase the availability of native potatoes available for local consumption and to generate extra production for commercial sale to help raise incomes. Benefits are aimed directly at 600 peasant families of Quechua communities in the high areas of Canchis, Sicuani, Cusco, Peru, and are hoped to reach 1,500 families in total. The approach has been to set up a revolving fund for native potato seeds and seeders for local production. This is complemented by a local system to provide technical assistance. Technical leaders, or *Kamayoq*, are chosen by the community to receive training.

A direct relationship was found between local well-being and the level of biodiversity in two important areas. Higher levels of biodiversity reduced the risks from insect attacks and climate change. And being able to provide a greater range of dishes at meal times gave both status and social recognition.

In higher lands, conserving biodiversity is a particularly important survival strategy. Yet, development that promotes agricultural modernisation reliant upon high inputs and monoculture approaches, has led to the loss of biodiversity. New participative methods are needed to revaluate appropriate technologies, and to value the culture that has produced such a diversity of potato varieties.

Farmers help each other where government support is missing: Peru

For many communities living over 3,500 metres above sea level the most common crops are maize, potatoes and beans. Many families also have one or two head of cattle, some sheep and a number of guinea pigs (a food staple in the Andes). These communities are poorly served by government agricultural support, so-called 'extension services'. Training farmer-to-farmer 'extension agents' has become a focus of Practical Action's work. Locally the agents are known as *Kamayoq*, a name associated with the Inca empire in the 16th century.

A *Kamayoq* school was established in 1996. The course covers identification and treatment of pest and diseases for crops and livestock; improved irrigation; and breeding and rearing of guinea pigs. Since the school opened, over 140 *Kamayoq* have been trained, one in five of whom are women.

The trainees' mother tongue is Quechua. The *Kamayoq* help local smallholder farmers with both their plants and animals and they are paid in cash or in kind. Farmers can afford to pay because of the assistance they get, which raises production and sales. It is the farmers' willingness to pay that makes the *Kamayoq* model so interesting. Apart from the initial cost of training, it is, in effect, an unsubsidised farmer-to-farmer service.

The *Kamayoq* also help farmers to adapt through experimentation to changing environmental, social and economic circumstances. Good examples of this process of joint problem solving include the treatment of a fungal disease of maize; the control of mildew on onions; and the discovery of a natural medicine to treat *Fasciola hepatica*, a parasitic disease of animals. Some specific results of working with the *Kamayoq* model include:

- Farm households who have adopted improved guinea pig breeding techniques, now raise bigger and heavier animals for their own consumption, as well as for sale.
- Technical advice that farmers have received on irrigation, improved pasture, and treatment of animal diseases has led to increases in milk production of up to 50 per cent.

In December 2005, the UK newspaper, *The Independent,* reported on the experience of one *Kamayoq*, Felicitas Quispe Pucho.[54] She would wake at 4.30am to feed her family before setting off to apply her skills in animal husbandry, immunisation, construction, and accounting. "The Incas were all-knowing even though they didn't use books or pens," says Felicitas. "We're trying to recapture some of the wisdom of the Incas. We need book-learning. We had been losing our culture and this is a way to regain it." Her thoughts were echoed by fellow graduate Alfredo Montezinos, "The Spanish came and fought off the Incas and some of their knowledge was lost," he says. "They imposed their technologies and methods on us and we lost touch with our real ancestors. We're not using chemicals any more; we're trying to use natural materials. We need to get back to a better balance between nature and men." This is one of many innovations, a combination of ancient and modern approaches, that will be needed to help the Quechua and others to cope with how climate change is set to alter life in the high Andes.

Dealing with extreme cold in the Andes[55]

Just as one paradox of global warming may be to slow or switch off that part of the Gulf Stream which warms the UK, another is that Peru's highlands are experiencing what they call the *friaje*. It is a new phenomenon, thought to be linked to climate change. In 2004 temperatures fell to -35ºC, killing 50 children and leaving an estimated 13,000 people suffering bronchitis, pneumonia and hypothermia. But there was also lasting damage to livelihoods as between 50 and 70 per cent of alpacas died, animals which the community and local economy depend on. Without alpacas, farmers cannot transport their goods to market. The animals also give nutritious milk and cheese and thick wool with fantastic insulation properties.

Waves of cold were felt between June and August caused by the arrival of frozen winds from the South Pole. These came with unusual storms followed by frosts that killed crops and pastures for the alpaca. The Quechua responded and were helped by the *Kamayoq*. Sheds were built to protect baby alpacas and weak animals. Forage was produced and stored, with alfalfa being grown hydroponically (in a non-soil substrate with nutrient-enriched water pumped through). Provision was made to treat animals when they got sick. As one newspaper reported, "There are few climate change sceptics at this altitude." One farmer, Huallipe, said, "The temperature shifts here are getting more extreme. We are peasants; we didn't know what to do about these things." Cold winters have been followed by hot, dry summers and, recently, electric hail storms.

Peru…

"Crop growth is affected by the irregularity of rains and often the hailstorms which damage them – they don't obtain the expected level of growth."[56]

Learning from gender analysis and the experience of women[57]

Awareness of gender issues is vital for ensuring that initiatives tackling climate change are appropriate for the realities facing communities throughout Latin America and the Caribbean.

In El Salvador and Guatemala the primary source of fuel is wood and it is the job of women and girls to gather it. Extreme stress is placed on the environment through deforestation and greenhouse gas emissions. There is also great pressure on women and girls. Many spend about 3–4 hours, 3–5 times a week, searching for wood. When they cook food for their households, they are exposed to toxic cooking smoke. Agencies promoting clean, renewable energy, such as solar ovens, have found it vital to target groups of women in their own neighbourhoods where they can learn from one another whilst practising new technologies.

Construction of Alpaca shed: Photo: © Practical Action Peru

Latin American and Caribbean women are far less likely to have received formal education than men. In rural Peru 45 per cent of women are illiterate; in Guatemala it is 60 per cent, and even higher for indigenous Mayan women. Illiteracy and poverty often go hand in hand, and day-to-day survival is a bigger priority than looking to long-term environmental issues. Environmentally responsible behaviour can be enhanced by formal education which links into the wider world, raising awareness, for example, of the link between burning fossil fuels, climate change, and changing weather patterns.

Yet women's practical knowledge of the environment is too often undervalued. Women are responsible for 45 per cent of household food production in Latin America and the Caribbean. They achieve this despite unequal access to land and information. Women's specific knowledge of maintaining biodiversity, through the conservation and domestication of wild edible plant seeds and food crop breeding, is key to adapting to climate change. Since women are responsible for collecting water in their communities, they are sensitive to the changes in seasons and climatic conditions that affect water quantity and accessibility. In many coastal villages in El Salvador, women have already shifted their livelihoods from selling firewood in order to preserve the mangrove forests that protect them from floods, which are increasing due to climate change.

Gender-specific vulnerability-reduction measures are vital. On a warmer Earth, women will walk further to provide food, firewood and water. Increased heat-related illness will add to the burden on women as the primary carers of children and the elderly. Women's informal rights to natural resources may be undermined as those resources become scarcer.

Women and water management in the Andes

Ines Rivasplata, a small-scale farmer in Peru's Jequetepeque River valley, prays for water. Like most of Peru's Andean mountain communities, her village has been struck by a four-year drought with no relief in sight. But Ines has learned to maximize the scarce water that is available after getting help from a natural resource management project run by CEDEPAS, a local non-profit organisation working in the state of Cajamarca and supported by Progressio (formerly CIIR).

CEDEPAS focuses on improving irrigation techniques and the organisation of water management groups, known as irrigation committees. Ines says the training programme has made profound changes in her life. "Before women were not allowed to participate in (training programmes)," she explains. "They were supposed to stay on the farm. But with these workshops, that notion is changing."

It was realised that traditional systems of water management, which vest control in the hands of men, needed to expand to include women and children. Unfortunately most water-related projects in the region have focused on male household heads – excluding women and children – when, in reality, women and children do most of the daily water resources management.

Ines says that the presence of one particular development worker helped break the stereotype that water is a man's domain. As a highly qualified female water engineer, she created a space for dialogue between men, women and children on water issues, ensuring that no group was excluded whilst respecting traditional power structures. CEDEPAS also produced a groundbreaking irrigation manual, based on the experiences of a fictional local family, which included the mother, father, grandparents, and children.

Standing in the midst of her lush, green mango orchard, Ines says she has learned new techniques that have improved her farm's production. She points with pride to circular ditches dug carefully around the base of each tree, joined by a system of inter-connecting irrigation channels. Gone is the exhausting old system of watering by bucket. Now water rushes through the irrigation channels to each tree in the orchard.

The experience of CEDEPAS in Peru proves that water management training and strong local organisations can help combat the negative effects of drought. But such projects will not be enough to withstand the devastating impacts of global warming if northern countries do not make the necessary reforms to curb climate change.

Urban stress[58]

In 2000, 47 per cent of the world's population lived in urban areas. This is projected to increase to 53 per cent in 2015 and 60 per cent in 2030. According to the UN, "nearly one billion people alive today are slum dwellers…with that number likely to double in the next thirty years". Cities increasingly contribute to climate change, and the consequences affect those living in urban areas, and especially those living in poverty.

According to urban development expert David Satterthwaite, urban areas concentrate more than three-quarters of the Latin American and Caribbean region's population, around 90 per cent of its economic activities, most of the region's greenhouse gas emissions, and a very large part of the population most vulnerable to the direct and indirect effects of climate change who will carry the burden of adapting to a warming climate. Urban areas also concentrate people and enterprises that, in time, must change their ways if greenhouse gas emissions are to be reduced.

What is done within urban areas has a very large influence on whether the risks arising from the direct and indirect effects of climate change can be reduced. Well-planned and well-governed urban areas can greatly reduce these risks – while unplanned and poorly governed cities can greatly increase them – especially risks of flooding and extreme weather events. Most of the region's largest cities are coastal cities and so are vulnerable to sea level rise; many are very vulnerable to extreme weather events; and many Pacific Coast cities relay on glacial melt for their water supplies during dry summers – a source that will be severely depleted within 20 years at current rates of glacial melt.

While it is impossible to calculate the exact proportion of greenhouse gases generated in urban areas, worldwide they are likely to account for most human-driven emissions. This takes account of the concentration of industry and wealthier social groups with high-consumption lifestyles. It also factors in the greenhouse gas emissions from activities that serve urban areas, such as agriculture, forestry, oil and natural gas exploitation, air and road transport, and electricity generation.

The region is unusual in having the highest proportion of its population in 'mega-cities', (cities with 10 million or more inhabitants) compared to the rest of the world. Mega-cities housed just 11.4 per cent of the region's total population in 2000, whereas urban centres with less than half a million inhabitants housed 37 per cent. Around one in five of the national population of Argentina, Brazil, Chile, Colombia, and Peru live in urban centres with less than 50,000 inhabitants – with higher proportions in such urban centres in Cuba, Costa Rica and Guatemala.[59]

In the context of development, this region is also unusual in having a high proportion of the population living in urban areas who suffer from the kind of deprivation that includes under-nutrition, inadequate and unstable income, and lack of access to adequate water, sanitation and healthcare.

Climate change and urbanisation in Brazil[60]

Brazil entered the twenty-first century with over eight out of ten of its 182 million inhabitants living in urban areas. In 2001 there were over 55 million people living in poverty in Brazil, with 76 per cent of these living in shantytowns. In the last 10 years, the central areas of major cities have grown by 5 per cent while the outskirts have grown by 30 per cent.

The urbanisation process, characterised by forest loss and the hardening of ground surfaces (soil compaction), contributes to increases in temperatures. Insufficient public transport and growing numbers of private cars are adding to greenhouse gas emissions. Cities like São Paulo, Rio de Janeiro and Recife are suffering from floods and mud slides. The consequences hit everyone but the worst affected are those who live in poverty, especially women and children, whose vulnerability is increased.

In spite of the links between cause and effect, getting social and environmental movements to work together is difficult. But working on urban challenges means that building bridges between such groups is essential. In one Brazilian debate on a new national law about the occupation of urban land, legalising shantytowns was seen as a crucial conquest for campaigners working for the homeless and slum dwellers. Yet Brazilian ecologists vehemently opposed the law. What is the best solution? Should they be moved to remote areas, increasing the need for transport, or should urban expansion be controlled to preserve the forests? Urgent dialogues are needed to build bridges between both views and face the real threat: the underlying pattern of use and the appropriation of natural resources.

Honduras…

"A number of producers have been forced to leave their life in the country and have to devote themselves to non-agricultural work…Many of those living there (where there is drought) are forced to leave their homes."[61]

Photo: © Nigel Dickinson/WWF-UK

Reducing Emissions from Mexico City[62]

With a population of over 18 million, Mexico City is one of the largest metropolitan areas in the world. Famous for its air pollution problems, Mexico City also contributes significantly to greenhouse gas emissions, accounting for 20 per cent of the country's total emissions and 2.1 per cent from Latin America as a whole. The carbon footprint in 2004 was estimated at 33.5 million tonnes of carbon dioxide (or its equivalent). This figure is expected to reach 66 million tonnes by 2012. Due to rapid growth it is difficult for Mexico City to establish an emissions reduction target, so the city aims to limit the growth of emissions, rather than reduce emissions absolutely.

Proaire 2002–2010 is a strategy that integrates air quality and climate protection in Mexico City. It aims to cut emissions of air pollutants and greenhouse gases over an eight-year period. Activities include energy-efficiency improvements, protection of forests and green spaces, and public transportation enhancements.

Many of the Proaire measures focus on transportation, which constitutes 37 per cent of emissions within the federal district of Mexico City. The municipal government plans to replace 80,000 of Mexico City's oldest 109,400 functioning taxis between 2001 and 2006. By paying US$1,300 towards each old vehicle with the owner paying the price difference for a new, lower-emissions vehicle, daily emissions from taxis will be reduced by about 31 per cent. Dedicated traffic lanes to run fuel-efficient, high-capacity buses to cut emissions and congestion are being developed. The first Bus Rapid Transit Corridor on Avenida Insurgentes, the city's major north-south thoroughfare, opened in June 2005. It carries about 250,000 passengers per day.

Proaire also targets improving the efficiency of low-income housing. Water and energy efficiency systems will be installed into 30,000 new social housing units and retrofitted into 45,000 existing units over a three-year period. Systems include compact fluorescent bulbs, low-flow showerheads, and tap aerators. The estimated annual emissions reduction from these changes is 31,000 tonnes of carbon dioxide. Over a five-year period, solar-powered heating systems will be installed in 50,000 new social housing units.

Energy

Energy cooks the food we eat; it heats our schools, lights our hospitals, and powers our industries; it is central to all human economic activity. Access to basic, clean, safe, and affordable energy services is essential for sustainable development and poverty eradication. Poverty and energy are inextricably linked. The greatest child killer, acute respiratory infection, will not be tackled without dealing with smoke from cooking fires in the home. Without light in their homes to allow them to read, children will learn less. Water cannot be pumped or treated without energy. Although some 800 million people have been connected to power grids in the last 20 years, nearly two billion people still do not have access to electricity, particularly in rural areas.

The Latin American region is home to examples of both good and bad practice in relation to energy and climate change. The region has enormous potential for community-based micro-renewable energy, but it is also the site of major extractive industries focused on fossil fuels. Pollution, deforestation, and the infringement of the rights of indigenous people are widely reported.

As the prices of oil and gas rise on the global markets, the pressure to exploit Latin America's fossil fuel resources increases, too. The industries have a chequered recent history in terms of their environmental and human rights records.

British company BP has strong links in Colombia, for example, in exploiting the Cusiana-Cupiagua oil field. Oil revenues in Colombia have funded the country's internal conflict and, in turn, companies have had to pay to protect their commercial operations.[63] In July 2006 BP were forced to pay a reported £3 million in compensation and legal costs to Colombian farmers left destitute by the building of a major oil pipeline through their land. Lawyers representing the farmers, Leigh Day & Co, accused BP of failing to compensate farmers for damage reaching back to 1995 and of gaining advantage from terror tactics employed by others to guard the pipeline. According to the UK newspaper, *The Financial Times,* oil comprises one-third of Colombia's export revenues. And, in 2002, the Bush Administration sought the authorisation of Congress to spend US$98 million to train Colombian troops to protect an export pipeline used by Occidental's Caýo Limýn field. Rebel sabotage of the pipeline cost Colombia about US$500 million in lost revenue last year.

Oil company Chevron is the subject of a campaign over its activities in Ecuador. It is involved in a trial over what has been called locally the 'Rainforest Chernobyl'. Eighty affected communities are seeking legal redress over the alleged dumping of toxic waste.[64]

Table 3. Latin America: below average greenhouse gas emissions but high vulnerability to global warming

Region	Population *(million)*	GDP *(2000$b)*	CO_2 emissions *(Mt CO_2)*	Electricity consumption *(kWh per capita)*	CO_2 emissions per capita *(t CO_2 per capita)*
OECD	1,154	26,792	12,794	8,044	11.08
Latin America	432	1,443	850	1,601	1.97
World	6,268	33,391	24,983	2,429	3.99

Source: IEA 2005[65]

British Gas, meanwhile, has been caught up in controversy over its involvement in plans to expand natural gas extraction in Bolivia. Following major new finds, increased exports are envisaged for the US, Mexico, Chile, Argentina, and Brazil. There are fears that existing environmental and social costs will be worsened by such developments, whilst local people still fail to accrue benefits. Pressure group Amazon Watch, referring to the new Bolivia-Brazil pipeline, reports that "Santa Cruz indigenous organizations have also voiced concerns about (the developers') failure to adequately inform and consult with them about the proposed expansion and the divisive tactics being used to undermine established indigenous authorities."[66] The recent election of Evo Morales as president, however, threw the future of the industry into turmoil as he promised to repatriate more benefits to the Bolivian people.

Brazil

Brazil is the fifth-largest country in the world. Its economy is roughly equal to that of all other South American countries combined. Energy-related greenhouse gas emissions are, per person, less than half of the world average, largely due to its heavy reliance on bioethanol and hydropower, which provide more than 75 per cent of the total power generated. However, Brazil's energy demand is expected to grow by 5 per cent per year in the next decade, as energy-intensive industries develop and consumer demand increases. The conventional response focuses on expanding centralised power supply by relying on a massive number of new, large-scale power plants, whether hydropower- or fossil-fuel based. This would be risky both from a development and an environmental perspective.

Meeting that growing demand without increasing global and local impacts is a great challenge for national policy-makers, industry, and civil society. The energy choices Brazil makes over the next 15 years are critical.

If Brazil decides to follow the current energy model used by most industrialised nations, then many of its new power plants are likely to be run on fossil fuels. For instance, fossil fuels could supply 70 per cent of the 3,286 megawatts (MW) of electric power auctioned by the Brazilian Government in December 2005. Under a 'business-as-usual' scenario for Brazilian development, electricity-related CO_2 emissions will grow by more than 300 per cent from 21.6 millions tonnes in 2004 to 72.2 million tonnes in 2020.[67]

Around 84 per cent or 70 GW of installed capacity of electricity generation in Brazil comes from large dams,[68] the construction of which has lost over 34,000 km^2 of productive lands and forests and forced one million people from their homes and their land. Despite this, the Government has plans for more mega-dams in the Amazon region. Energy planners say they are preparing even larger and riskier projects for future offers to investors, including a two-dam complex on the Madeira River. If constructed, this would provide over 7,000 MW in new generating capacity. An 11,000 MW dam is also proposed on the Xingu River, also in the Amazon. Both dams could drown areas of enormous biodiversity and displace indigenous peoples.

Claims that dams are the cheapest source of power are misleading. The true costs of dams never appear on the balance sheet. Hidden extras of reservoir development would include biodiversity loss and community resettlement costs. The downstream effects of such large plants are also considerable, as natural-river flows and fish migration are severely disrupted.

Brazil also faces the return of an old fuel ghost: coal. Decades of mining and burning in the states of southern Brazil have caused irretrievable ecological damage and left the health of mineworkers permanently affected. Although the coal sector speaks of 'clean technologies' and 'environmental accountability', projects such as Jacuí and Candiota III (350 MW each) are unconvincing as 'new energy'. These adaptations of old plants, stored for over 25 years, were bought from England and France who would now consider such plants to be dirty and old fashioned. The other projects – Seival (550 MW), CTSul (650 MW) and USITESC (440 MW) – presented as the latest technology, burn low quality pulverised coal and produce a high level of ash (50 per cent) and a sulphur content of 1.5 to 3 per cent. These five coal projects alone, if implemented, will pump 11 million tonnes of CO_2 into the atmosphere per year. This is more than four times the emissions planned to be saved by a huge national programme called Profina that aims to promote electricity generated from non-traditional renewable energy resources, such as wind, sustainable biomass and small hydropower.[69]

Research by the University of Campinas, published by WWF Brazil, outlines alternative future scenarios for the development of the Brazilian power sector by 2020, without increasing global and local, social and environmental impacts.[70] Besides reducing impacts, it will cut the national electricity bill by US$15 billion while creating eight million new jobs.[71] It estimates that, by 2020, the country could provide the same or better energy services to business and domestic consumers and, with improved energy efficiency, lower electricity generation by 40 per cent. This difference is equivalent to avoiding the construction of about 78,000 MW, equal to about 65, new, 1,200-MW-capacity fossil-fuel plants.

The solutions for a sustainable power sector include increased efficiency at both the electricity production level and the consumption level. For instance, the introduction of highly efficient electrical appliances available on the international market could provide energy savings of up to 40 per cent. The research proposes doubling the use of small-to-medium scale renewable energy (wind, biomass, solar and small hydropower) relative to current levels by 2020 to make up 20 per cent of the total power supply. The scenario would also prevent the need for expensive investments in power infrastructure and provide a net economic benefit to the Brazilian economy. There would be lower electricity bills and significant emissions reductions. By 2020, Brazil's overall power bill could be reduced by more than US$15 billion.

The overall reliability of the electricity grid would improve through the increased use of distributed generation, including small-scale renewable energy and on-site cogeneration. This would increase industry efficiency, through production of both power and heat, while drastically reducing transmission and distribution losses. Under this alternative future scenario, emissions could be stabilised at roughly the 2004 level, equivalent to avoiding a total of 413 million tonnes of accumulated CO_2 emissions over 15 years.[72]

Bumps on the road to biofuels[73]

President Luis Inacio Lula da Silva frequently describes Brazil's pioneering use of bio-diesel – a mixture of conventional diesel and vegetable products – as the country's 'energy revolution'. More than 70 per cent of all cars sold in Brazil in December 2005 can run on ethanol made from sugar cane. This equates to over 183,600 'flexi-fuel' cars. The sales figures for biofuel cars are growing each month: December was up 16 per cent on November, which was up 15 per cent on October. In total, 33 per cent of all the fuel used in Brazil's cars is now from sugar. This is due in part to the addition of 25 per cent of ethanol to vehicle fuels. A new target is to replace 5 per cent of diesel with biodiesel by 2012. Brazil's share of fossil fuels in its general energy mix is low compared to developed countries or to the global averages.

But Brazil's growing biofuel industry is not without its problems or its critics. One problem is that land is used to produce fuel instead of food crops. Rising prices and demand for oil, coupled with the coming peak of global oil production, are radically,

and positively, changing the economics of biofuels. But, in the process, they are sparking the first skirmishes in what may prove a long-term battle for land between food and biofuel producers. "The line between the food and fuel economies has suddenly blurred as service stations compete with supermarkets for the same commodities," observes Lester Brown, president of the US-based Earth Policy Institute. In the five years up to 2005, global production of ethanol, the leading biofuel, increased by 165 per cent. Colombia opened one new ethanol distillery per month from August 2005 till the end of the year. As biofuels are used increasingly to meet new demand, and as a substitute for current oil use, the pressure on food crops will increase. In 2004, 12 per cent of the US domestic corn crop weighing 32 million tonnes, was used to make 3.4 billion gallons of ethanol.

Pressure to bring more land into production stands to further erode biodiversity by destroying habitats. The logical endgame of these trends could be an ugly struggle between rich and poor as Brown points out, "Higher oil prices are thus setting up competition between affluent motorists and low-income food consumers for food resources, presenting the world with a complex new ethical issue." Though some may conclude that the issue is only complex if you consider the luxury consumption of the already-rich to be more important than the basic needs of the less wealthy. The 32 million tonnes of US grain converted in ethanol would be enough to feed 100 million people at average world consumption levels, according to the World Watch Institute.[74]

In addition, according to government data, Brazil is set to produce most of its biodiesel from soya beans, which have virtually no advantage over conventional fuels in terms of overall greenhouse gas emissions, let alone the millions of hectares of tropical forest that have been cleared for their large-scale plantations. The environmental group WWF believes that only biofuels with net environmental benefits, both in terms of reducing greenhouse gas emissions and lowering pollution locally, should be promoted. The organisation is calling for a mandatory eco-certification scheme for all biofuels based on environmental and social criteria, which is also flexible enough to meet local conditions.

Mining's irreversible impact on ecosystems

The vast El Cerrejon Norte coal mine in northern Colombia is one of the world's largest open-pit mines, occupying an original area 31 miles long and 5 miles wide. El Cerrejon is constantly expanding and eating up villages in its path; it touches on reservation land of the indigenous Wayuu people. The mine is operated by a consortium owned by British-based multinationals Anglo American and BHP Billiton, together with Swiss company Glencore. In 2001, the Afro-Colombian village of Tabaco was demolished by the mining company and the nearby village of Tamaquitos is now threatened. The surrounding vegetation is contaminated with coal dust and local children suffer from respiratory problems and malnutrition. The end product, coal, produces even more carbon dioxide when burnt than oil or gas.

In southern Peru, BHP Billiton had to temporarily close its Tintaya copper mine during June 2005 when local villagers stormed its offices. Christian Aid's 2005 report on mining in Peru argues that the Tintaya mine has displaced communities that lived in the area for generations. Left without their land and with contaminated water, air and soil, many feel they are poorer today than 20 years ago, when the mine was built. Claims by the mining industry and international financial institutions that investment would contribute to sustainable development in Peru, have not been borne out.

The Yanacocha gold mine in Cajamarca, Peru, is the largest gold mine in Latin America and one of the most profitable in the world. It is owned jointly by US and Peruvian mining companies and the World Bank. It operates in an environmentally sensitive area full of farms that rely on water from the mountains in the mine area. Locals state that since Yanacocha was established in 1992, farm production has dropped and water has become contaminated. They strongly oppose proposed expansion plans because of concerns over contamination of the watershed supplying an entire valley of farmers and the city of Cajamarca. Climate change will further exacerbate these problems as glacial melting poses additional threats to water supplies.

The Pascua Lama project, straddling the border between Chile and Argentina, seeks to extract gold, silver and copper starting in 2009. Local and international opposition has been mounting, however, since it became known that the project intends to move three Andean glaciers that cover the proposed mine site. The glaciers sustain the mountain and valley ecosystems, and local communities fear that their fertile agricultural valley will suffer. They also fear that the proposed project will use dangerous chemicals, especially cyanide and sulphuric acid. These generate toxic waste matter, such as acids and heavy metals, that will contaminate the land, water, air, and rivers.

Large-scale mineral resource exploitation has had a devastating and irreversible impact on fragile ecosystems in Latin America. In addition, climate change is still not being factored into the planning processes for the mine projects of the world's big mining companies.[75]

Getting electricity to the rural poor[76]

Providing electricity to the rural poor is a major challenge. Electricity is needed for small industries and enterprises, to run health clinics, and to light schools. The conventional approach to electrification tends to marginalise rural communities that are located far from the grid. Rural population densities are generally low and the cost of energy supplied from new grid connections is high, compared with densely populated areas. Electricity companies – public or private – have little incentive to provide services to these areas.

Micro Hydro Power House. Photo: © Practical Action/Colin Palmer

There is a need for a new approach based on small-scale, sustainable energy options where centralised systems have failed. Decentralised energy options using local resources – wind, biogas, photovoltaic, micro-hydro – offer many advantages for meeting the needs of the rural population. Decentralised alternatives can make use of local manufacturing and technical capabilities, and can be controlled by the communities themselves. The options for decentralised rural electrification are either through diesel or renewable energy sources. Renewable energy has distinct advantages over diesel as it has much lower running costs; the energy source is local; it does not run out; it is much cleaner; and it does not contribute to global warming.

A micro-hydro system with a capacity of six kilowatts is enough to drive a mill and provide electric light to a community of 20 families. Once the system is in operation, local people pay a small charge to use the electricity. This covers maintenance and the eventual cost of replacement.

Such micro-hydro systems are designed to operate for a minimum of 20 years if properly cared for. Local people are trained to build and maintain their own systems. Once schemes are set up, they should continue to function indefinitely without any more external funding. Unlike traditional power stations that use fossil fuels, micro-hydro generators have practically no effect on the environment. And because they do not depend on dams to store and direct water, they are also better for the environment than large-scale hydro-electric stations. By reducing the need to cut down trees for firewood and by increasing farming efficiency, micro-hydro has a positive effect on the local environment.

Developed to death: the rise of mega-infrastructure[77]

Closely allied to growth of the extractive industries is a plan for huge new infrastructure projects across South and Central America. Economic integration has become a key driver of public policies and private investment and the rise of regional blocks comes in the wake of the push for trade liberalisation. Transport and energy sectors, in particular, are central to the economic integration paradigm, seen as a means to increase the access to, and export of, raw materials to the United States, Europe and Asia. Such grand plans are in stark contrast to the poor state of existing infrastructure for many local communities, such as roads in rural areas.

The Initiative for the Integration of Regional Infrastructure in South America (IIRSA) is a powerful example launched by the 12 governments of South America, the Inter-American Development Bank (IDB), the Andean Development Corporation (CAF) and the Fund for the Plata River Basin (FONPLATA). It proposes increasing the region's competitiveness by promoting physical integration of the continent by financing large-scale projects in the transport, energy and telecommunication sectors, and by pushing new regulations across the region. IIRSA would fund oil and gas pipelines and energy processing plants, whilst related investments (oil and gas wells) would be funded separately.

Reducing deforestation and providing power in Peru

Peru has 24 million inhabitants, more than seven million of whom live in rural areas. Eight out of ten of the rural population have no access to electricity. Most of the rural population of Peru live in the Andes and the Upper Amazon areas. Their isolation, due to the lack of roads and transportation, makes supplying them with fuel difficult, expensive and unreliable. Micro-hydro is therefore an important energy option for these people.

Practical Action has developed a number of such micro-hydro systems with communities in Peru. To work they simply divert water from the stream or river, channel it into a valley, and 'drop' it in to a turbine via a penstock (pipeline). Besides providing power for domestic lighting and cooking needs, village hydro schemes can also be used for charging batteries or for income-generating activities, such as grain milling, depending on community needs.

The potential for hydro power in Peru is around 65,000 MW, including the rivers of the Andean and the Upper Amazon regions. Of this, only 5 per cent is exploited. The potential for small hydro schemes has not been estimated but there are a large number of small rivers and streams, which offer numerous sites where micro-hydro schemes could work successfully.

IIRSA and related infrastructure investments are bad news for climate change. It is easy to predict that an expansion of large-scale infrastructure in the region is likely to accelerate deforestation rates and increase greenhouse gas emissions, especially considering the emphasis on oil- and gas-related infrastructure and transport.

Ten trans-boundary axes of economic integration would host 40 large 'anchor' projects, in turn comprising 335 individual components ranging from roads, bridges, dams, ports, and airports to river dredging, waterways, electric networks, energy plants, and pipelines.

IIRSA proposes to bring US$37.4 billion in financing to make this vision a reality. For example, in the last 8 weeks of 2005 alone, the Government of Peru awarded 16 new contracts (with 10 additional ones pending) for oil and gas exploration. These contracts now cover 50 per cent of the Peruvian Amazon.

The environmental and social implications of this vision are potentially staggering. In the words of IIRSA's co-ordinator at the IDB: "Our vision is nothing short of a massive plan designed to change the face of South America… [and] overcome the region's geographical obstacles with a continental grid of highways, waterways and energy distribution and communication networks."[78] The region's geographical obstacles are, in fact, the relatively intact, fragile habitats that act as unique repositories of global biodiversity; providers of environmental services and important carbon sinks; and the home of numerous indigenous groups and small-scale forest users – the Amazon, the Pantanal, the Guianan forests to name a few.

Experience to date suggests that, without appropriate planning and strong enforcement of environmental and social standards, large-scale infrastructure projects lead to large-scale conversion and degradation of natural habitats. Evaluations of previous projects suggest that local inhabitants tend to shoulder most of the social and environmental costs whilst getting few of the benefits.

Associated migration and industrial expansion tend to multiply a project's immediate impacts. In this sense, the fact that IIRSA proposes to improve "access to areas of high productive potential that are either isolated or sub-utilized" and promote "large economies of scale either for internal regional consumption or export to global markets" implies that natural-resource use will accelerate rather than decrease.[79] The concentration of multiple infrastructure projects in hubs is likely to worsen any impacts of individual projects.

WWF is working to introduce strong social and environmental standards to apply to IIRSA focused on activity in the Amazon Basin. Both the IDB (as the primary multilateral investor in Latin America) and national governments are key targets.

Photo: © Steve Collins/Tearfund

Micro-hydro brings power to the mountains in Bolivia

The majority of people in Bolivia live in the mountains. The mid-Andes have good rainfall and productive soil but steep terrains and scattered populations, making grid-based rural electrification impractical. Lack of access to power is one of the factors that drive younger people from country villages to search for work in the towns and cities.

But Andres Calizaya and his organisation Prodener successfully brought small-scale hydro electricity to communities around Corioco, the main town of the Nor Yungas area. The power runs everything from homes to schools, from health centres to local businesses and restaurants. Walter Monroi, chairman of the construction committee that built the system for the community of Calle said that, "In the villages on the (main) grid, the electricity is not sufficient and is too expensive; they put on the light just to find a candle. At night the village of Calle is lit up like a Christmas tree, while all the other villages around are dark. I want to help other communities get themselves organized to have a micro-hydro system, it will help them as much as it has helped us."

Local benefits have been comprehensive. "The children could not study properly with candles, now with electricity, they can study very well," said Don Dionisio, the chairman of the San Juan electricity co-operative, adding, "We do not just want light, we want to use the electricity to earn income." Numerous examples of the successful application of micro-renewable energy schemes such as this are being highlighted by the Ashden Awards for Sustainable Energy.[80]

Environment

Global warming represents a serious threat to the survival of many plant and animal species. The loss of habitats, such as the tropical rainforest, will have a double impact, contributing to both climate change and to the loss of biodiversity. In the absence of serious efforts to reduce climate change, recent estimates suggest that up to one-third of plant and animal species globally could disappear by 2050.[81] Deforestation and illegal logging represent extra threats.

The danger of diminishing biodiversity[82]

Cloud forests harbour the relatives of many major crops, like tomatoes, beans, potatoes, avocadoes, and the tree from which quinine was originally extracted. They are also uniquely susceptible to climate change. There is evidence that global warming can lift the cloud base above the altitude of the forest. The subsequent drying out of the Monteverde Forest in Costa Rica has been linked to the extinction of the golden toad and other amphibians, and to the declining flow of streams. The natural environment adapts to gradual climate change that occurs over thousands of years. Rapid change, however, causes widespread species extinction and the collapse of ecosystems.

Mountains at lower latitudes support exceptionally high levels of biodiversity, probably a result of the way that different life zones tend to succeed one another with increasing elevation. Mountain species with narrow habitat tolerance are at high risk from climate change. Climate impacts on biodiversity can include such things as shifting ecosystem boundaries, sharp increases in the rate of extinction, and more severe pest and disease outbreaks. Loss of biodiversity entails both the disappearance of species and genes and the weakening of ecosystems. The flow of nature's life-supporting 'goods and services' is diminished as a result. The success of agriculture in the Andes is based on plant genetic variety and on people themselves who have mastered appropriate agricultural practices. Some communities cultivate more than 150 distinct potato varieties. Such diversity reduces the impact of the failure of any one.

Just as global warming has an impact on biodiversity, it is also clear that biodiversity affects how well local communities adapt to climate change. Mexico's Sierra Tarahumara region in Chihuahua State has a high biodiversity value. More than 300 of the native plant species are used for food and medicinal purposes. Maize, squash and beans form the staple diet.

Yet, illegal logging continues to destroy the environment here, as it does elsewhere on the continent from Colombia to Honduras. Colombia's Andean region is exceptionally rich in biodiversity, but two-thirds of the area is so highly affected by human activities that some ecosystem types are now greatly reduced in extent, and many species are at risk. Here, huge areas – including parks and natural reserves – have been deliberately defoliated and poisoned by Plan Colombia, under which large-scale drug crop fumigation is carried out using herbicides. Non-target crops and plants have been destroyed, too, and human health has been damaged. Conservation of biodiversity and maintenance of ecosystem integrity are vital to enhancing the adaptive capacity of local communities to cope with climate change.

Amazonian biodiversity under threat[83]

The Amazon Basin contains a staggering portion of the world's biodiversity, and thousands of people support themselves by working its land and forests. It provides everything from building supplies to medicine. The Amazon contains an unknown range of biodiversity: at least 40,000 plant species, 427 mammals, 1294 birds, 378 reptiles, 427 amphibians, 3,000 fish, and over one million insect species identified. The Amazon River is the largest single source of freshwater runoff on Earth, representing some 15 to 20 per cent of global river flow. Subsequently, the Amazon's hydrological cycle is a key driver of global climate – and global climate is therefore sensitive to changes in the Amazon. Climate change threatens to substantially affect the Amazon region, which in turn is expected to alter the global climate and increase the risk of biodiversity loss.

Empirical and modelled data suggest that the Amazon Basin is at particular risk to climate change effects. Projected changes of warmer temperatures and decreased precipitation during already dry months could manifest in longer and perhaps, more severe droughts and substantial changes in seasonality. Coupled with land use changes, these changes could lead to devastating impacts, including increased erosion, degradation of freshwater systems, loss of ecologically and agriculturally valuable soils, loss of biodiversity, decreased agricultural yields, increased insect infestation, and the spread of infectious diseases.

Conflict in the Honduran forest: the case of the Río Telica Valley, Salamá Olancho[84]

In 2000, Honduras submitted its first report on climate change,[85] stressing that its forestry policy[86] should focus on sustainability and abandon the present felling trend and illegal activities. Yet, five years on little seems to have changed.

In the valley of Río Telica, Olancho, it is politics as usual. Studies and recommendations have been ignored by a State that allows the destruction of natural resources by privileged groups. The valley, situated to the east of Tegucigalpa, about 180 km by road,

Hawksbill Turtles declining in the Caribbean[87]

Hawksbill turtles (*Eretmochelys imbricata*) are a 'keystone species' in coral reef and seagrass ecosystems, surviving on a diet of invertebrates and sponges. About 15,000 to 25,000 females nest annually worldwide, 5,000 of which nest in the Caribbean. Mexico is probably the most important nesting region with 1,900 to 4,300 nests per year. The global hawksbill population has declined by over 80 per cent during the last century. Like other marine turtles, they are threatened by habitat loss due to coastal development, egg-collection, damaging fishing practices, pollution, and climate change. Climate change effects include:

- Loss of nesting and feeding habitats due to sea level rise and coastal erosion.
- Extreme events, such as storms, which damage nesting sites, and excessive rainfall, which can flood nests.
- Increased sand temperatures, which can lead to changes in sex ratios (reducing or eliminating male turtle production) or even mortality.
- Increased ocean temperatures leading to coral bleaching and damage to turtle feeding grounds.
- Changes in ocean currents, which can modify migration pathways and feeding patterns.

is witness to an unequal battle. On one hand there are farmers who want to protect water sources, and on the other hand there are logging companies that covertly and illegally obtain permits from the State Forest Authority – AFE-COHDEFOR – to fell the forest.

According to independent observers, forest sustainability, environmental impacts, and local livelihoods have been ignored by officials issuing permits. Timber concessions are taking priority over water conservation and the lives of farming families. Some believe that uncontrolled logging is causing a change in atmospheric temperature, rain patterns, and the disappearance of water springs across this and other basins. Farmers believe that the disappearance of 26 out of the 46 sources of water in the La Muralla National Park is due to uncontrolled felling.

After a four-year drought, the farmers of the Río Telica valley benefited in 2005, ironically, from the otherwise catastrophic Stan and Beta weather events. Thanks to the rainfall they could at last harvest at the end of the year. Farmers in nearby areas, however, and other countries in Central America, lost everything, including their lives.

In 2001, the UN Food and Agriculture Organisation identified the potential of the Honduran forests to mitigate climate change.[88] Honduras submitted a proposal to use the Clean Development Mechanism (CDM) to reinforce the forest management programmes and rescue the forests from the process of destruction and degradation.

These proposals are not without their critics. For example, it is difficult to demonstrate that avoiding deforestation here will not lead to deforestation elsewhere. How to measure the amount of carbon sequestered is also controversial. But the proposal identifies 47,620 km^2 of forests (42 per cent of the total country area) that could potentially absorb 233 million tonnes of carbon.[89] The sale of this carbon could make the Honduran forests self-sustaining, stop the destruction of the environment, and raise the farmers' living standards. But the Honduran Government is yet to take this opportunity. Reportedly this is due to opposition from the logging industry, which views the demands of environmental management as a barrier to their preferred method of clear felling. Large profits with low responsibilities rule the day.

Recent investigations have alleged that government officials acting in the interests of the loggers have created a network of corruption, destroyed the social fabric, and promoted displacement of the communities of the Río Telica Valley.[90] With few resources, the Movimiento Ambientalista de Olancho – Environmental Movement of Olancho (MAO) – has campaigned against the destruction. MAO reports that its leaders have been threatened, persecuted, and even murdered; farmers are repressed, ignored and looked down on by Government. Recently, due to international advocacy, their voices have been heard in the European Union and the United States.

The problems of the Río Telica Valley, also known as 'the Salamá case', are unresolved. The felling continues in all the areas surrounding the headwaters of the river, and there is little sign of the Government changing its attitude in the face of destruction.

Benefits of the Clean Development Mechanism (CDM) under question[91]

The CDM was established under the Kyoto Protocol. It allows developed countries with targets for reducing greenhouse gas (GHG) emissions, to take credits from emission-reduction projects undertaken in poor nations. The CDM therefore provides opportunities to share benefits with poor nations from projects designed to combat climate change. The idea was that flows of finance and green technology would enable poorer countries to leapfrog to cleaner and more sustainable development.[92]

The emission-reduction benefits of each CDM project are measured according to internationally agreed standard units known as Certified Emission Reductions (CERs).

The government hosting the CDM project defines its own sustainable development objectives. While few projects make significant progress in meeting all social, environmental and economic aspects of sustainable development, the following three projects in Latin America aim, or claim, to contribute to some aspects of sustainable development. In some cases, however, serious criticisms have been made.

The Jepirachi wind power project. Located in Wayúu Indigenous Territory on the north-eastern Colombian coastline the Jepirachi project aims to build 15 windmills, which will provide emission reductions of 1.2 million tonnes of CO_2 over 21 years.[93] The project aims to contribute to sustainable development in various ways, such as channelling investment and building wind-power capacity in Colombia. Construction will also inject US$21 million in the Colombian economy. The project is on land belonging to the Wayúu, one of Colombia's poorest people. They should benefit from community-driven activities financed by the project, which include training for job creation; refurbishing a local school, cemetery and health centre; provision of small, water storage pits; and establishing a desalinisation plant. By targeting water supply, education and health services, the project is supposed to address priorities identified by the community.

Electricity generation from waste incineration in Brazil. Garbage is a huge problem in Rio de Janeiro. Designed by the Climate Center at the Federal University of Rio de Janeiro (UFRJ), and based on technology developed by the Usina Verde Company, this new project burns municipal garbage, while generating electricity. A pilot plant began operations in May 2005 on the campus at UFRJ and is already converting 30 tonnes of garbage daily, producing 2.6 MW of electricity. Recyclable and non-combustible materials are separated from the waste that the plant receives from an urban sanitation company. The gases and vapours produced by combustion at temperatures of 850 to 1,000 degrees are cooled and then cleaned to prevent contamination, a process that results in mineral salts and water ready to be reused. According to the developer, the carbon credits arise from the reduction in emissions of gases that contribute to global warming, that is, the methane normally produced by garbage dumps and the carbon dioxide from electrical energy production fuelled by petroleum or coal. Emissions will also be reduced because the garbage trucks no longer have to travel to distant landfills.

But Brazilian NGOs do not consider the project clean or sustainable. The incinerators are sources of persistent organic pollutants (POPs), like dioxins, furans and heavy metals, condemned by the 2001 Stockholm Convention because they harm human health over the course of several generations. Dioxins are carcinogenic, affect the endocrine system and are transmitted through the food chain, including through mothers' milk. POPs present in the gases, ash and other residues from incineration are dangerous, even in proportions lower than those allowed by national regulations. The approval of the project in the context of the Kyoto Protocol could encourage the development of waste incineration across Brazil, to the detriment of waste prevention and other better options, such as recycling. The sponsors of Usina Verde hope to sell facilities like the Rio de Janeiro plant to municipalities throughout the country. Recycling generates more jobs and stimulates the organisation of waste-collection co-operatives, in a movement of social inclusion that now could be blocked by the incineration of its raw materials.[94]

The Plantar Project, in the state of Minas Gerais, Brazil. This project aims to use 23,100 hectares of old eucalyptus plantations to produce 9.9 million tonnes of charcoal, which will substitute for the use of coal/coke in the production of 3.8 million tonnes of pig iron over the next 21 years. Replacing fossil fuels with biomass will cut the emissions of 3 million tonnes of carbon. The charcoal will be produced according to Forest Stewardship Council (FSC) criteria. Such certification is designed to ensure environmental, social and economic sustainability, but the costs of getting certification are often too great for small forestry operations in poor countries. The project claims local environmental benefits, such as reduced air pollution and erosion, recovery of degraded areas and shelter to wildlife.

The eucalyptus trees, however, provide only limited biodiversity and livelihood benefits. For each 100 ha of planted forests, at least 20 ha of indigenous cerrado forests are meant to be maintained. Biological corridors have been constructed and fire control mechanisms introduced. The project should provide around 3,000 jobs. Plantar has said it will promote healthy and socially sound working conditions, and is sponsoring local education and training programmes.[95] However, the project has been strong criticised.[96] Greenpeace challenged the permanence and stability of carbon sequestration,[97] and others have condemned the disastrous local environmental impacts of eucalyptus plantations. The project developers are accused of a wide range of abuses from expelling local people from their land, to burning large amounts of native cerrado forests, fraudulently acquiring community land, poor community consultation, circumvention of Brazilian labour and environmental law, poor employee care, destroying alternative local industries, and incorrect carbon accounting.

There are many challenges needed to guarantee development benefits from CDM projects. Effective national institutions that determine whether sustainable development objectives accrue in each country are key. Poor guidelines on what constitutes sustainable development and how it should be measured means that CDM projects with sustainable development 'frills' could be priced out of the market. The complexity of meeting sustainable development objectives may chase away potential investors and lead to a 'race-to-the-bottom' of standards to reduce barriers to investment. Many of the poorer regions of the world struggle to compete with regions that traditionally receive more direct foreign investment or have large volumes of CERs to sell, like China, India, Mexico, Brazil, and South Africa. Participants in the CDM process will need strengthened institutional capacity and more training to ensure benefits materialise. Learning-by-doing and sharing information among developing countries will be vital.

Photo: © Greenpeace/Daniel Beltra

Deforestation in Brazil

Brazilian forests are the largest on the continent, and critical due to their size and influence on climate, both regionally and globally. A substantial amount of the world's carbon emissions stems from deforestation, and the Brazilian Amazon is a prime source. Friends of the Earth, Brazil, says it accounts for about three-quarters of the country's total emissions and that forest conversion alone, not including burning, is enough to make Brazil the fourth-largest carbon polluter in the world. Amazon deforestation has ranged from 18,000 to 27,000 km^2 per year in this decade, implying a carbon release of between 200 and 300 million tonnes per year. About 80 per cent of all logging in the Brazilian Amazon is illegal. Between August 2003 and August 2004, 27,200 km^2 was lost – roughly equivalent to the size of Belgium. Three-quarters of this destruction was estimated to be illegal: an area 10 km long by 7.5 km wide lost every day; more than 3 km^2 lost every hour; or a football pitch lost every eight seconds.

As well as being bad news for the global climate, this has also been criticised as being against national interests. Deforestation is said to have made little contribution to raising incomes or increasing development for the local population. Even from the narrow measure of national income (GNP), its contribution proves insignificant. Illustrating the degree of ecological inefficiency, even supporters of the commodity export-oriented economic model admit that no more than 2 per cent of the forest area so far converted is responsible for producing all the exports of beef and grains from the Amazon region.

Because the marginal costs of reducing one tonne of emissions from deforestation are much lower than, say, reducing one tonne of emissions from the energy or transport sector, it is hard to understand the low priority the issue is given. Strategic debates have begun which raise a crucial dilemma: replacing fossil fuels with biofuels could put increased pressure on forests because of the land demand for biofuel crops. Depending on how this is managed, the balance of carbon-emission reductions might be positive, neutral, or even negative.

In February 2006, an area of the Brazilian Amazon twice the size of Belgium – equivalent to the amount lost to deforestation over the previous three years – was given greater protection by Presidential decree. In a partial victory for many Amazon communities, 1.6 million ha will be permanently protected. Another 2.8 million ha will be used for sustainable logging concessions to prevent deforestation and ensure good forest management and development guidelines will be improved in an additional 2 million ha of forest. But, the protected areas represent less than 2 per cent of the total Brazilian Amazon and constant threats from logging, soya plantations, and cattle ranchers remain.[98]

Trial and tribulation: a postcard from the Mosquito Coast, Honduras[99]

This is a case study about mahogany and the search for true sustainability in tropical rainforest management.[100] The Honduran Mosquitia is often referred to as Central America's 'Little Amazon' due to its extensive moist, tropical broadleaved forests and maze of coastal wetlands. It was largely ignored by the Spanish colonists who satisfied their desire for gold in the cooler central and western highlands of the country. Incursions into Mosquitia were rapidly repelled by the indigenous Miskito people who were encouraged to fight the Spanish by British pirates and the British Government. Honduras eventually gained independence from Spain in 1821. Now the traditional way of life of the zone's indigenous inhabitants and the biodiversity on which they depend are increasingly threatened by colonisation prefigured by large scale deforestation.

The chain of events usually begins with illegal loggers who enter the forest looking for mahogany and royal cedar (*Swietenia macrophylia* and *Cedrela odorata*) for the export market. High transport costs dictate that this is the only timber which makes a profit. When the loggers have gone, landless farmers from other parts of Honduras come to clear and burn plots to grow their subsistence crops. Then, after one or two years, wealthier cattle ranchers buy the plots and convert them into pasture. The subsistence farmers then move further into the forest, and so the process continues.

With a minimal state presence, colonists tend to take justice into their own hands, resolving disputes with the barrel of a gun. In new communities there are no road links to the outside world, no schools, no health services. Chronically under-funded government forestry services cannot cover this huge area and suffer at the hands of corrupt officials. Drug trafficking increases social instability, Mosquitia being one of the preferred smuggling routes between Colombia and the US.

Community Forestry Co-operatives with legally designated forest areas managed by the communities themselves are seen as one potential mechanism for halting encroachment. The most advanced co-operative in Mosquitia is in the small community of Copén in the Sico Paulaya Valley on the northwest boundary of the Rio Platano Reserve. This co-operative manages an area of 4,149 ha including a protected water catchment area for the community and an area for the sustainable production of mahogany and royal cedar, producing the only Forest Stewardship Council (FSC) certificated sources in Honduras.

The forest managed for timber is rich in diversity. The members of the co-operative, however, have received, at most, a basic primary education and their lack of experience in administration and organisational issues has at times severely hampered the efficient functioning of the group. In fact, lack of transparency and outright corruption was such a problem in the initial years that a total change of leadership was necessary.

The economic realities faced in Copén are difficult. Production costs are high. There is a lot of waste at the stump – timber is cut with chainsaws both crossways and lengthways into rough blocks. Mules carry the timber out of the forest but to reach the market, a torturous full-day trip is taken by pickup truck along deeply rutted tracks which eventually connect with the paved road network. In wetter months these tracks are impassable and the only alternative is to float the timber 60 miles downstream to the mouth of the River Sico and then take it by small cargo boats 100 miles along the coast to the nearest city. Consultants' fees and FSC audit costs further reduce margins. To date the extra income derived from having a legal product, let alone an FSC-certified product, has been minimal. The co-operative is competing with high volumes of timber from illegal loggers who have lower costs and there is always the temptation to follow the clandestine route.

Training and support from NGOs have helped to produce better administrative practices and FSC requirements for transparency have helped to drastically improve accountability among the co-operative leaders.

Adding value to timber at source could secure economic viability. To do this the co-operative needs intensive training in furniture making and other carpentry skills, but lacks the funds to pay for it. Improved transport links are needed to reduce the high risk of damage to products in transit. But without adequate controls in place to protect the zone's forests, better transport could result in the entry of even more illegal loggers and landless farmers, accelerating deforestation.

The experiences in Copén show the importance of long-term investment in training and support if truly sustainable solutions are to be found. Such communities on the colonisation frontier have complex social, environmental and economic problems which demand a multidisciplinary approach. With the State virtually absent, locally led initiatives offer one of the few viable solutions for the sustainable management of the area's natural resources. Pilot projects like Copén are generating valuable learning experiences from which other communities in similar circumstances can benefit.

The soya invasion

Because the growth of soya plantations encroaches on the rainforest, it threatens both biological diversity and to fan the flames of global warming. In 2004, Brazil's soy fields totalled 22.7 million ha, an area about the size of Great Britain, and in Mato Grosso State cultivation increased 89 per cent in the decade to 2004.[101]

In 2004–05 around 1.2 million ha of soya, 5 per cent of the national total, were planted in the Brazilian Amazon rainforest. Three US-based agricultural commodities giants – Archer Daniels Midland (ADM), Bunge, and Cargill – are responsible for about 60 per cent of the total financing of soya production in Brazil. Although the biofuel industry is growing, 80 per cent of the world's soya production is fed to the livestock industry. Europe buys half the soya exported from Mato Grosso, where 90 per cent of rainforest soya is grown.[102]

Paying to leave the forests intact?[103]

Of all the ideas about how to tackle climate change, paying countries in the tropics not to cut down their trees has always been one of the most controversial. The use of cost-benefit analysis to commodify and value the natural world has been widely criticised, as has the viability of mechanisms for trading carbon. But some believe it should be encouraged. Every hectare of rainforest contains around 200 tonnes of carbon, and developing countries could be granted carbon credits for those rainforests that they save from destruction. These credits could be traded on the international market under the Kyoto protocol, giving tropical countries and local landowners, an incentive to keep their forests. A hectare of rainforest might cost US$300 to clear for pasture, and then be worth only US$500 to its owner. At current market values for carbon, the same hectare of rainforest, if left intact, could be worth thousands of dollars.

The Coalition for Rainforest Nations, led by Papua New Guinea and Costa Rica, has argued that the issue should be put back on the table at international climate negotiations. Challenges include: measuring the 'baseline' rate of deforestation – the amount of forest a country typically fells each year – in order to calculate the quantity of emissions avoided; demonstrating that slowing deforestation in one place will not simply lead to increases elsewhere, and that reductions in deforestation are permanent; and, ensuring that carbon money gets into the hands of the impoverished small-scale farmers and not the landowners who are responsible for much of the deforestation. Monitoring is especially challenging in remote regions such as the Amazon, where law enforcement and land tenure is often precarious.

Climate change adaptation in the MesoAmerican reef (MAR) system[104]

The MAR system contains the largest barrier reef in the Western Hemisphere, extending approximately 1,000 km along the Caribbean coasts of Mexico, Belize, Guatemala, and Honduras. A wide variety of productive ecosystems are found within the region and the culturally diverse human population is largely dependent on coastal and marine resources. Over-harvesting of fish populations and poorly-managed tourism, however, are contributing to a decline in the health and integrity of this fragile ecosystem, along with pollution – largely from farming – coral bleaching and a growing variety of coral diseases.[105]

Coral bleaching is a result of warmer water. It involves the loss of algae that coexist with the coral and provide it with much of its food. This loss can result in diseases, failed reproduction, and the partial or even complete death of affected coral colonies. Coral reefs have been referred to as the 'canaries of the sea' due to their high sensitivity to rising temperatures and other stresses from human activity, notably global, climate-change-related increases in annual sea surface temperatures and occurrence of ENSO events, such as in 1997.

Reefs in Belize experienced their first widespread coral bleaching event in 1995 affecting over half of the corals and resulting in an estimated 10 per cent experiencing some mortality.[106] The 1998 global coral bleaching event triggered the most devastating global loss of coral reefs on record including reefs of MesoAmerica. Both the 1995 and 1998 coral bleaching events that occurred throughout the MAR system coincided with periods of high sea temperatures and calm seas. The 1998 event resulted in greater mortality of corals, a loss of as much as 50 per cent of live coral.[107] It is not yet known to what extent the reef will recover, or how long this recovery may take – if it occurs at all, given the variety of other coastal development and pollution-related threats to reefs. Thus, climate change and coral bleaching could be the last straw that pushes many reefs beyond the threshold of recovery.

The predicted rise in coral bleaching due to climate change in the Caribbean poses a major threat to valuable resources. Economic losses from damage to fishing, tourism and livelihoods dependent on the MAR system could reach US$16.5 million attributable to climate change and US$52.5–130.5 million due to the full range of causes of coral reef degradation.

A number of organisations are supporting new Marine Protected Areas (MPAs). Tourism and fisheries, two of the region's economic mainstays, depend on maintaining the health of the reef. The effects of climate change and coral bleaching could push many reefs beyond the threshold of recovery. Yet this threat has not been integrated into most reef-management plans. Developing adaptation strategies to improve the resilience of the reef and livelihoods based on them is crucial to helping the region survive the effects of climate change.

WWF are initiating a climate change adaptation strategy for the whole reef system, aiming to enhance its long-term viability and the role it plays in livelihoods and in the protection of coastal communities from natural disasters. The strategy will be based on regional models capable of predicting with greater accuracy the impacts of climate change on specific reefs, and increasing the capacity to monitor climate change risks. It is also hoped that information gathered will increase awareness of other cumulative effects and threats, and foster more sustainable use of the reef.

Health

Since the first IPCC Report in 1990, there has been a dramatic improvement in awareness of the impacts of climate change on health. The World Health Organisation (WHO), the World Meteorological Organization (WMO) and the UN Environment Programme (UNEP) published an extensive overview of impacts.[108] Uncertainties remain, as everywhere in science, but there is a growing consensus that we face greater impacts.

The effects of climate change on health, globally and in Latin America, are likely to be extensive. They will also be felt most acutely by people living in poverty in vulnerable communities in the developing world who are least responsible for causing climate change. Some health effects will be direct. For example, an increase in the frequency and severity of extreme weather events will result in more frequent humanitarian emergencies, particularly affecting populations in high-risk areas such as coastal zones, river valleys and cities. The number of excess deaths caused by extremes of heat and cold will rise in vulnerable groups: those already suffering from heart and breathing problems, the very young, the elderly, and the frail.

Other effects will be indirect, creating environmental impacts on a variety of local factors which will in turn have measurable effects on human health. Drought and changes in rainfall patterns will damage agricultural systems, threaten the ability of millions of people to grow sufficient, healthy food, and worsen existing hunger for millions of others.

In Latin America and the Caribbean, climate change will also lead to increased rates of infectious disease, including various vector-borne and water-related diseases. Changes in temperature and surface water are factors that can affect the life-cycle of mosquitoes – diseases such as malaria and dengue fever, currently largely confined to tropical or subtropical regions, may spread to countries in temperate climates as a consequence.[109] Diarrhoeal diseases, including cholera, cryptosporidium, giardia, shigellosis, and typhoid may increase as a result of more frequent and severe floods and drought.[110] For example, flooding caused by Hurricane Mitch brought a six-fold increase in cholera in Nicaragua.[111] Climate change is also expected to lead to an increase of rodent-borne diseases, due to a warmer climate changing habitats and allowing rodents to move into new areas. These include leptospirosis, tularaemia, viral haemorrhagic diseases, lyme disease, tick-borne encephalitis, and hantavirus pulmonary syndrome.

El Niño – Changing ocean temperature and health in Latin America

El Niño conditions, which are predicted to become more frequent and severe in a warming world, can be used as an indicator of what the health impacts of climate change will be. For example the *El Niño* events in 1982–83 and 1997–98 (the most recent) were the largest this century. *El Niño* is associated with increased morbidity and mortality most of which results from weather-related disasters, such as floods and droughts. In 1997, Central Ecuador and Peru suffered rainfall 10 times higher than normal, which caused flooding, extensive erosion and mudslides with loss of lives, and the destruction of homes and food supplies. In the same year nearly 10 per cent of all health facilities in Peru were damaged.

Ecuador, Peru and Bolivia suffered serious malaria epidemics after heavy rainfall in the 1983 *El Niño*. The impact of malaria in Ecuador was intensified by population dislocation following related flooding. During the 1997 *El Niño*, Brazil suffered extensive drought, exacerbating the huge forest fires. Smoke inhalation from these fires was a major public health problem, with large numbers of patients with respiratory problems visiting already over-stretched health facilities.

Recently, there has been growing recognition of the links between *El Niño* and disease. Cycles of malaria in Latin American countries appear roughly every five years. Such cycles in Venezuela and Colombia have now been linked to *El Niño*.[112]

Cholera had been absent from Latin America for nearly a century when the first cases appeared in Peru. They were spread out over a coastline of nearly 1,000 km. Many theories for the reappearance of cholera were suggested, including contamination from the infected sewage discharge from passing ships originating in Asia. But it now appears that the epidemic was the result of the combination of a bloom of algae in rivers, estuaries and on the ocean coastline, caused by the *El Niño* of 1991 and then spread by poor hygiene and contaminated foods. Climate change will make such outbreaks more likely.[113]

Climate change and its impacts on human health will combine in unpredictable ways in Latin America. Population movements resulting from drought and environmental degradation, as well as economic drivers, lead to unexpected health consequences. For example, as climate change provokes poverty and mass migrations, people forced to leave their home and lands may be faced with unsanitary refugee camps. Increasing poverty in urban areas as well as deforestation and environmental damage in rural areas could create new breeding sites for insects and other parasites that transmit diseases including malaria and dengue fever. Climate change is set to exacerbate these already serious problems.[114]

Migration[115]

Many of Latin America's rural migrants are environmental as well as economic refugees, whether arriving at burgeoning cities or trying to cross into the US or even across to Europe. People forced to leave their homes and land because of the impacts of climate change may be met with violence, racism and human rights abuses. In one global estimate there could be 150 million environmental refugees by 2050, around seven times the estimate for the global peak of conventional refugees in the early 1990s. The majority of them will be in developing countries.

Brazil's northeast region is an example of the connection between climate and migration. The precarious, arid conditions and the devastating episodes of periodic drought have caused large movements of people for decades. Families who do not own land, but depend on agriculture as a means of subsistence, are the first to lose work when rains are inadequate to support a full crop. They feel there is no alternative but to migrate in search of income. In fact, one out of every five people born in the northeast emigrates to another Brazilian region. Up to 75 per cent of the land in the northeast is at risk of being turned into desert. With even higher rainfall variability predicted due to global warming, migration is likely to increase.

Mexico…

"Impacts on food security have caused a significant drop in production of basic grains: maize and beans. The climate changes have especially affected the agriculture of the poor because they most depend on the seasons. This great instability in the seasons, and therefore instable production, is causing increased migration to the USA, reaching over 400 thousand immigrants last year, the majority being from the indigenous population, the poorest of the poor in Mexico."[116]

In the past, impoverished migrants were likely to head for the Amazon region. Once arrived, clearing land to start new farms added to deforestation pressures. Today, it is more common for people to end up in shantytowns surrounding Brazil's cities and mega-cities. There they face a precarious existence, especially where settlements are established in flood-prone areas or on unstable hillsides. Millions live in sub-standard housing which is vulnerable to weather-related hazards and associated landslides and mudslides. Over the past decade, hundreds of people have been killed or seriously injured and thousands left homeless by landslides in Caracas, Guatemala City, Medellín, Mexico City, Rio de Janeiro, and Sao Paulo. Poor migrants are the most likely sector of society to be living in settlements in the drainage valleys of rivers and streams, where flooding frequency is already increasing as a result of climatic variability.

In terms of the nature of migration flows there are multiple rural-to-rural and rural-to-urban movements. Migration to many of the region's largest cities has actually stopped or slowed dramatically in the last couple of decades. It now tends to be towards coastal areas where it has contributed to the deforestation of mangroves and the destruction of coral reefs, making Latin America's coastlines more vulnerable to storm surges and tsunamis. In Mexico, a country prone to coastal hazards, more than 65 per cent of mangroves have already been lost. Around 60 per cent of the region's population lives in coastal states and provinces, and 60 of the 77 largest cities are located on the coast. Major coastal erosion problems are likely in South American population centres like Rio de Janeiro, Brazil and Mar del Plata, Argentina. Migration continues to feed into the already high levels of human concentration in the coastal zones which are increasingly vulnerable to climate change, including rising sea levels.

Peru…

"It causes families to be separated when the head of the family and older children have to migrate to other places to find work to generate an income, leaving the women and younger children."[117]

"Because weather and climate events already are affecting environmental conditions, climate change may be expected to have a host of direct and indirect effects on human settlements (including migration)."[118]

Photo: © Nigel Dickinson/WWF-UK

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44 There are no irrigation systems in this area.

45 In the case of Ecuador, one tonne of carbon costs US$0.79 cents, whilst in Holland it is US$8.04. The Dutch company FACE therefore markets carbon from Ecuador. See: Verónica Vidali Oltra. Programa de Doctorado en Ciencias ambientales. Universitat Autónoma de Barcelona. España.

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Natural Savannah burnt during severe drought and forest fires in Roraima State, the Amazon, Brazil.
Photo: © Nigel Dickinson/WWF-UK

Supporting organisations (The Working Group on Climate Change and Development)

Formerly CIIR

Written and compiled by: Andrew Simms (**nef** policy director) with Hannah Reid (IIED) and based on contributions from the Working Group on Climate Change and Development.

Foreword by: Juan Mayr Maldonado, Former Minister of Environment, Colombia, President of the first Conference of the Parties to the UN Convention on Biological Diversity

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Edited by: Mary Murphy

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new economics foundation, 3 Jonathan Street, London SE11 5NH, United Kingdom
Telephone: +44 (0)20 7820 6300 Facsimile: +44 (0)20 7820 6301
E-mail: info@neweconomics.org Website: www.neweconomics.org

International Institute for Environment and Development, 3 Endsleigh Street, London WC1H 0DD, UK
Tel: +44 (0)20 7388 2117 Fax: +44 (0)20 7388 2826 E-mail: info@iied.org Website: www.iied.org

Progressio (formerly CIIR), Unit 3, Canonbury Yard, 190A New North Road, Islington, London, N1 7BJ
Telephone: +44 (0)20 7354 0883 Fax: +44 (0)20 7359 0017
E-mail: environment@progressio.org.uk Website: www.progressio.org.uk

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