

Bolivia

Climate change, poverty and adaptation

October 2009



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time for climate justice
7 dec 09, Copenhagen

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International

“ *We indigenous peoples will continue to talk until we achieve real change. Our voice comes from way back. Our voice is the voice of the snow-capped mountains which are losing their white ponchos.* **”**

Ten commandments to save the planet, humanity and life
Evo Morales

Bolivia

Climate change, poverty and adaptation

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Abbreviations

CENDA	Centro de Comunicación y Desarrollo Andino
CEPAL	Economic Commission for Latin America
CIDOB	Confederación de Pueblos Indígenas de Bolivia
CIPCA	Centro de Investigación y Promoción del Campesinado
CNMCIQB-BS	Confederación Nacional de Mujeres Campesinas Indígenas Originarias de Bolivia – Bartolina Sisa
CONAMAQ	Consejo Nacional de Ayllus y Markas del Qullasuyu
CPESC	Coordinadora de Pueblos Étnicos de Santa Cruz
CSCIB	Confederación Sindical de Comunidades Interculturales de Bolivia
CSUTCB	Confederación Sindical Única de Trabajadores Campesinos de Bolivia
FAO	Food and Agriculture Organisation
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
IRD	Development Research Institute
NGO	Non-governmental Organisation
PNCC	Programa Nacional de Cambios Climáticos
REDD	Reduction of Emissions from the Deforestation and Degradation of Forests
SENAMHI	Servicio Nacional de Meteorología e Hidrología
UNDP	United Nations Development Program
VIDECICODI	Viceministerio de Defensa Civil y Cooperación al Desarrollo Integral



Erminia Guaji. Community Member involved in the camellones project, Beni. Photo: Mark Chilvers / Oxfam

Executive Summary

Bolivia is particularly vulnerable to the impacts of climate change for six basic reasons:

1. It is one of the poorest countries in Latin America and suffers from one of the worst patterns of inequality. Low-income groups in developing countries are the most exposed to climate change impacts.
2. It is the country in South America with the highest percentage of indigenous people, where much of the poverty and inequality is concentrated.
3. It is one of the most bio-diverse countries in the world, with a wide variety of ecosystems that are vulnerable to different impacts from climate change.
4. More than half of the country is Amazonian, with high levels of deforestation which adds to the vulnerability to flooding.
5. Located in a climatically volatile region, it is one of the countries in the world most affected by 'natural' disasters in recent years.
6. It is home to about twenty per cent of the world's tropical glaciers, which are retreating more quickly than predicted by many experts.

In July 2009 a team of Oxfam researchers travelled to three areas of Bolivia (Trinidad in Beni, the Cochabamba valleys and Khapi under Mount Illimani, in La Paz) to take a snapshot of how poor families are experiencing the changing climate, and how they are adapting to it. The researchers also interviewed key government and international officials, social movements and NGO representatives. The main findings and recommendations of this report are:

Main findings:

- Poor women and men throughout Bolivia are already experiencing the consequences of climate change, but in most cases are ill-equipped to adapt to the present and future impacts.
- The perception of many villagers and local farmers is that the climate is already changing in terms of the unpredictability of the rainfall, more extreme weather events and higher temperatures, with negative impacts for their livelihoods.
- Oxfam International has noted that in recent years the frequency and magnitude of damage from the extreme weather events have increased. Women are often the hardest hit, as they are often the ones left to tend families and small farms, and have fewer alternative livelihoods when crops are lost.
- Bolivia can expect five main impacts as a result of climate change: less food security; glacial retreat affecting water availability; more frequent and more intense 'natural' disasters; an increase in mosquito-borne diseases; and more forest fires.
- Of these, Oxfam International is particularly concerned that poor women and men and indigenous peoples will be affected by the effect of unpredictable weather on agricultural production as this could lead to less food availability and/or higher food prices.
- Oxfam International believes that it is deeply unjust that poor communities and families in Bolivia and other South American countries are having to pay a high price for a situation for which they have virtually no historical responsibility.
- In the three areas visited for this report local people, and particularly women, are already experimenting with ways of adapting to the changes in the climate. The 'camellones' project in Trinidad offers a promising example of poor women using ancient technologies to find a way of improving food security, adapting to flooding and reducing deforestation.
- The government of President Evo Morales is beginning to take climate change seriously. However, it is still in the early stages of developing national policy and practical adaptation programmes. A major effort will be required to scale up the institutional, financial, and technical capacity to address the climate challenge.
- Oxfam International's concern is that the opportunities being opened up by the change process in Bolivia to reduce poverty, particularly amongst the indigenous population, will come under severe pressure from climate change impacts.
- The establishment of the Platform of Social Organisations against Climate Change is a positive development to put pressure on national and international governments to combat the impacts of global warming. It is already having a major impact on government policy and awareness-raising.

Recommendations

A full set of recommendations is found in the Conclusions of this report. In summary Oxfam International recommends that:

- Delivering climate justice must be at the heart of a post 2012 agreement on Climate Change, in particular through rich countries committing to deep emissions cuts and ensuring a massive transfer of resources and technology to vulnerable countries. Annual public financing from developed to developing countries should be at least US\$150 billion for adaptation and low-carbon development.
- In the shift to a low-carbon development model, the international community should engage with and learn from Bolivia's vision for more sustainable approaches to development.

- Bolivia needs to develop and implement an overarching national policy on climate change, in particular by integrating climate change into the new legislative framework, which will implement Bolivia's new Constitution. The government should also ensure that climate change is properly mainstreamed throughout its national strategies for eradicating poverty.
- Disaster risk reduction needs to be made part of long-term planning at all levels of government and institutional capacity in this area strengthened.
- An agricultural insurance scheme should be introduced in order to protect food security. This should be a priority for international adaptation funding.
- There needs to be a focused effort to improve water conservation, storage and management, particularly in urban areas.



Camellones, Beni. Photo: Mark Chilvers / Oxfam

- The needs and roles of women should be at the centre of national and international adaptation policies.
- Access to weather information and early warning systems should be improved, in particular for agricultural producers.
- Social movement initiatives, like the Bolivian Platform Against Climate Change, should engage fully in promoting and shaping new government policy on climate adaptation and mitigation, and the platform should be further supported and strengthened.
- There needs to be a concerted campaign, supported by government and social movements, to raise public awareness on climate change and the consequent behaviour changes needed to address this challenge.



Camellones, Beni. Photo: Mark Chilvers / Oxfam

Introduction

In April 2009 the Guardian website published a dramatic account of how the Uru Chipaya, an indigenous community who had survived for 4,000 years in the south-west of the altiplano (highlands) and had outlasted the Inca Empire and the Spanish conquest, now faced extinction.¹ Part of the reason was climate change. The river Lauca on which they depended for their water supply was drying up partly due to erratic rainfall and drought. Many members of the Uru Chipaya were being forced to migrate to cities to survive, leaving fewer than 2,000 in their traditional homeland.

As the article made clear, the lack of rain water was not the only cause. Competition with upriver communities had exacerbated the water

shortage. The combination of climate change and existing local factors posed a grave threat to the community. But water was at the heart of it. As one local man expressed it, 'if there is no water, the Chipaya have no life.'

The story of the Uru Chipaya encapsulates why climate change is such an important issue for Bolivia. The changing climate adds an additional, potentially devastating, layer of vulnerability and risk to hundreds of thousands of women and men who are already exposed to poverty and environmental problems other than climate change. In addition, the fate of the Uru Chipaya is a reminder that Bolivia is the country in South America with the highest percentage of indigenous peoples, equivalent to around 66 per cent of the population. They include the

¹ Rory Carroll and Andres Schipani, *Bolivia: water people of the Andes face extinction*, The Guardian, 24 April 2009, available at <http://www.guardian.co.uk/world/2009/apr/24/andes-tribe-threat-bolivia-climate-change>.

Aymara and Quechua but also more than 30 other indigenous groups spread out both in the highlands and lowlands.

There are six other reasons why climate change is a matter of such great importance to Bolivia:

- **Poverty and inequality:** by many socio-economic indicators, Bolivia is the poorest country in South America and one of the most unequal. Sixty five per cent of its population of about 10 million live in poverty (under US\$2 a day), whilst 40 per cent live in extreme poverty (less than US\$1 a day). Historic inequalities mean that that poverty is concentrated amongst the indigenous population. As the 2007 IPCC (Inter-governmental Panel on Climate Change) reports stressed, it is low-income women and men within developing countries who are most at risk from climate change.
- **Bio-diversity:** Bolivia is one of the most bio-diverse countries in the world. It covers a huge area of more than one million square kilometres (roughly the size of France, Germany and the UK combined) across a great variety of eco-systems including Andean mountains, the Chaco desert, humid and arid valleys, and the Amazonian rainforest. The diversity of Bolivia's ecosystems means that climate change can have various impacts in different parts of the country.
- **Deforestation:** contrary to many people's perceptions of Bolivia as an essentially Andean country, it is also an Amazonian country. More than 60 per cent of its surface area is rainforest or savannah. Since 1990 the rate of deforestation there has been increasing. The United Nations calculates that it is around 300,000 hectares a year. It is largely caused by soya and cattle production in the departments of Santa Cruz and Beni. The deforestation not only adds to greenhouse gas emissions but also increases the devastation caused by flooding as natural forms of protection have been removed.
- **Disasters:** Bolivia is exposed to a wide variety of 'natural' disasters. These have encompassed drought in the Chaco, flooding in the Amazonian departments and ferocious hailstorms in the altiplano. According to Germanwatch, a widely-respected NGO that monitors disasters, for the first time ever in 2007 Bolivia entered the list of the top ten countries in the world most affected by disasters.² In 2007 and 2008 it faced the worst emergencies of the past 25 years.
- **Glaciers:** Bolivia is home to around 20 per cent of the world's tropical glaciers.³ Cities like La Paz and El Alto are particularly vulnerable to the accelerated retreat of these glaciers as a significant amount of its drinking water comes from them. Thousands of poor Andean farmers are dependent on glacial melt for part of their water supply to irrigate their crops.
- **Opportunity:** the current government of President Evo Morales is pursuing policies aimed at improving the lot of the poor, indigenous majority. The worry for Bolivia is that these great opportunities being opened up to reduce poverty, improve indigenous participation and enhance the status of women are going to come under severe threat from the impacts of climate change.

2 Sven Harmeling, *Global Climate Risk Index 2009*, Germanwatch, December 2008, available at <http://www.germanwatch.org/klima/cri2009>. Bolivia entered the list in sixth position.

3 James Painter, *Deglaciation in the Andean Region*, UNDP occasional paper 2007, available at http://hdr.undp.org/en/reports/global/hdr2007-2008/papers/Painter_James.pdf



Simulation of disaster relief camp, Oxfam. Riberalta, Beni. Photo: Pedro Laguna / Oxfam

Bolivia is not alone in the Andean region in being very vulnerable to climate change. Peru, Colombia and Ecuador are also very exposed to similar sets of problems. Oxfam International is particularly concerned about the deep injustice of poor communities and families in Bolivia and other South American countries having to pay a high price for a situation for which they have virtually no historical responsibility. Most of the current global warming has been caused by the developed world and in particular the greenhouse gases (GHGs) from the coal, gas and oil that drove the industrial revolutions in Europe and America from the middle of the 19th century onwards.

According to widely-trusted figures from CAIT (Climate Analysis Indicators Tool), in 2004 Bolivia was responsible for just 0.04 per cent of world emissions of Greenhouse gases (GHGs), one of the lowest percentages in the world.⁴ However, this figure did not include emissions from changes in land use (mainly deforestation), which accounts for nearly 80 per cent of Bolivia's total GHG emissions.⁵ If these emissions are included, in 2000 Bolivia was responsible for 0.35 per cent of world GHG emissions, compared to 16 per cent for the United States and 12 per cent for the European Union.⁶ By either measurement, Bolivia is one of the countries least responsible for global warming. Yet it is one of the most exposed to its effects.

This report gives a snapshot of three areas in three key eco-regions of Bolivia – the

highlands, valleys and lowlands – which are already experiencing climate change in different ways. Testimonies collected during the research for this report reveal the widespread perception from local women and men that the climate is changing in terms of the unpredictability of the rains, the warmer temperatures, and weather extremes. It is not possible to assert for sure that these changes are the result of human-induced global warming. But it is reasonable to expect that these sorts of changes will become more commonplace or more intense if global emissions of GHGs are not reduced rapidly.

In the three areas selected – Trinidad in Beni, the Cochabamba valleys and the communities living under Mount Illimani – local people, and particularly women, are already experimenting with ways of adapting to the changes in the climate. These villagers are not waiting passively to become victims of global warming. They are working with national NGOs to explore different ways of adapting to the new realities and in some cases drawing on ancestral knowledge and technologies. Communities throughout Bolivia, and in particular in the Andean highlands, have a long tradition of adapting to changes in the climate. However, the sheer scale of the climate changes expected will test such experience to the limits. It will remain a daunting task for the government and NGOs alike to spread good practice and adaptation techniques fast enough and widely enough to respond to the enormity of the changes over the coming decades.

4 <http://cait.wri.org/cait.php?page=yearly>. Bolivia came 90th in the world measured by absolute volume of emissions, 115th by per capita emissions. By the same criterion, in that year USA was first followed by China, the EU, Russia, Japan and India. China has since overtaken USA. Measured by per capita emissions the order was Qatar, Kuwait and the UAE.

5 Oscar Paz Rada, *El cambio climático y sus implicaciones en Bolivia*, in Lidema, Estado Ambiental de Bolivia 2007/8, La Paz, December 2008, p. 525.

6 CAIT, *ibid*. Expressed as per capita emissions, in 2000 Bolivia was responsible for 16.9 tonnes of CO₂ per capita, putting it in 21st position in the world and the highest in Latin America.



Area of deforestation, Beni. Photo: Mark Chilvers / Oxfam



Poverty, vulnerability and climate change



'The face of poverty and inequality in Bolivia is that of an indigenous woman.'

National Change Strategy, Oxfam in Bolivia, 2008

Bolivia's economic development for the last five hundred years has been shaped by its insertion into the global economy as an exporter of commodities. Most famously, silver exports from its Cerro Rico mountain made a massive contribution to the financial underpinning of the Spanish empire, yet the department of Potosi where the mountain is situated remains one of the poorest, if not the poorest, area in South America. At various times in its history, Bolivia has exported rubber, tin and now oil and gas in response to international demand.

Such an economic path of development where most of the value of the exports has ended up outside the country has resulted in the concentration of wealth in the hands of a small national elite, who depended on cheap (usually indigenous) labour to extract the primary resources. This has left a terrible legacy of a highly skewed income distribution. Bolivia has one of the worst Gini ratings for inequality in Latin America. According to CEPAL, in 2007 it was 0.56, one of the highest in Latin America. What this means in practice is that the richest ten per cent of the population earn 19 times more than the poorest 10 per cent.

This inequality of income has been made worse by internal colonialism which over several centuries has excluded the majority indigenous population from economic progress, political

participation, national decision-making and access to basic rights. According to the last census in 2001, two-thirds of the population defined themselves as indigenous, and almost half of them speak other languages like Aymara and Quechua. But being indigenous means you are more likely to be poor:

- An indigenous man from the rural areas has a 70 per cent likelihood of living in extreme poverty.
- Nearly half of the indigenous population lives in extreme poverty compared to 24 per cent of the non-indigenous population.
- 28 per cent of indigenous children face chronic malnutrition compared to 16 per cent among the rest of the population.
- Infant mortality rates among the indigenous population are 62 per 1,000 live births, almost double the rate for the non-indigenous population.

A larger percentage of people living in poverty are women, particularly in rural areas, where as many as 45 per cent of women do not speak Spanish, limiting access to basic services and political participation. In rural areas, nearly 95 per cent of women do unpaid domestic and agricultural work. In urban areas, thousands of Aymara and Quechua women work informally or as domestic servants, usually on very low

wages and without social protection. Women are twice as likely to be illiterate as men. According to a recent Oxfam report, 'the face of poverty and inequality is that of an indigenous woman'.⁷

This cold litany of statistics masks the grim human suffering that lie behind them. The testimonies of poor men and women - whether from Khapi in the highlands, Loma Suarez in the lowlands or Aguirre in the valleys – speak of how their daily life has become even more of a struggle due to unreliable rainfall, flooding or drought.

The election of Evo Morales in December 2005 (Bolivia's first indigenous president) represented a sharp break with the past. His victory was largely due to the grass-roots social movements supporting the MAS (Movement to Socialism), to which he and his government remain very responsive.

The new government has introduced or deepened a whole swathe of social programmes, and extended indigenous rights. These programmes include universal health insurance, programmes to eradicate malnutrition and illiteracy, an educational 'bono' or payment worth US\$30 to 800,000 primary school children, a monthly pension for the elderly worth US\$30 a month, subsidies for the price of bread and petrol, and improved access to water, sanitation and social housing.

The programmes have been largely financed by a new hydrocarbons tax on oil and gas companies. According to government figures, this has resulted in a huge increase in revenue

from this source from US\$1 billion in 2005 under the previous government to US\$2.6 billion in 2008.⁸ The state has also massively increased its reserves, which were worth around US\$8bn in mid-2009 – a historic record.⁹

These are still relatively early days for the Morales government, but poverty statistics (measured by income) remain stubbornly high. According to CEPAL, at a national level, extreme poverty (less than a US\$1 a day) dropped from 2004 to 2007 (34.7 per cent to 31.2 per cent of the population). The average for Latin America is 12 per cent. 'Moderate' poverty (less than US\$2 a day) decreased in the same period from 63.9 to 54 per cent.¹⁰ Other sources suggest that in rural areas extreme poverty actually increased from 62.9 to 63.9 per cent.¹¹ One of the main reasons for the lack of significant improvement expressed in percentage terms is that every year probably around 130,000 extra people need jobs.¹² Bolivia's population grows annually at more than two per cent. For example, it rose from 7.7 million in 1997 to 9.8 million in 2007. Over the same period, the numbers in absolute poverty increased from 4.9 million to 5.9 million (about 100,000 a year), and those in extreme poverty from 2.9 million to 3.7 million.¹³

Another obstacle to reducing poverty is that the recent high economic growth is based on dynamic sectors like mining, gas and commercial agriculture which do not have strong multiplier effects through the rest of the economy. According to the research organisation, Oxford Analytica, most workers in the mining sector are informal and their

7 Oxfam, *National Change Strategy Plan*, mimeo, La Paz, August 2008. The report is also the source for the statistics on poverty.

8 Ministerio de la Presidencia, *Logros de gestión de gobierno*, facsimile, La Paz, 2009.

9 La Razón, *Las reservas internacionales de Bolivia alcanzan un récord*, 23 July 2009.

10 Quoted in Oxford Analytica, *Bolivia: Growth reduces poverty, but not much*, Oxford, 19 May 2009.

11 Fundación Jubileo, *Balance económico social*, La Paz, May 2009, available at www.jubileobolivia.org.bo.

12 Luis Carlos Jemio, *El problema del empleo en Bolivia*, mimeo, 2009. Figures are difficult to estimate accurately, in part due to the number of children who are already working.

13 George Gray Molina and Ernesto Yañez, *The Dynamics of Inequality in the Best and Worst of Times, Bolivia 1997-2007*, Working Paper, April 2009.

incomes are very small; the natural gas sector is highly capital intensive and provides little employment, and construction of pipelines that helped boost employment in the sector in the late 1990s has ended; and commercial agriculture - located principally in Santa Cruz - is highly mechanised, providing relatively little employment except at harvest.¹⁴

It will remain a difficult task to create secure, better-paid jobs in other sectors than the gas and mineral economy such as the small manufacturing sector, small-scale agricultural production and micro-commerce where a majority of women dominate. It will also be a huge challenge to bring the poverty figures down by effectively managing the increased resources and transferring them to the poor in a transparent way. However, for the moment, there can be no doubting the government's deep commitment to poor indigenous men and women, and Evo Morales' high popularity level. This is largely due to a greater sense of dignity that has been given to large numbers of his indigenous supporters (see box 1.1).

Vulnerability

One of the reasons why it is so important to reduce the numbers living in poverty in the longer-term is that poor men and women are, and will be, the ones to bear the brunt of the climate change. Vast areas of Bolivia are already vulnerable to the threat of flooding and drought (see maps 1 and 2). Bolivia already has a high percentage of its population at risk.¹⁵

Those living in rural areas are very likely to be the ones even more exposed to the more frequent and more extreme weather events. Women, older people and children are often the ones left in villages to tend plots of land and animals whilst the men migrate to the cities. Their remoteness often adds to their vulnerability. Those living in precarious housing in marginal urban areas, particularly on the hillsides of La Paz, will doubtless be the most exposed to landslides caused by heavy rainfall. And those without a mains water supply, who already pay more for their water from itinerant suppliers, will be the most affected in the event of water shortages.¹⁶

Box 1.1 Evo Morales and Change

"You cannot understand the support President Evo Morales enjoys if you only consider the advances in people's objective conditions (like work, better income, economic growth) and do not bear in mind the improvements the government has achieved in subjective conditions like symbolic and cultural aspects.

Bolivian politics show that in colonial societies people put the same value on dignity as per capita income. This is because differences are not just based on income but also on

ethnic differences which determine your class position and place in society.

So by recognizing equality between citizens and 'the right to have rights' for indigenous peoples, President Morales' initial support has turned into a real faith and confidence that they are living a cycle of change that will transform the history of the country".

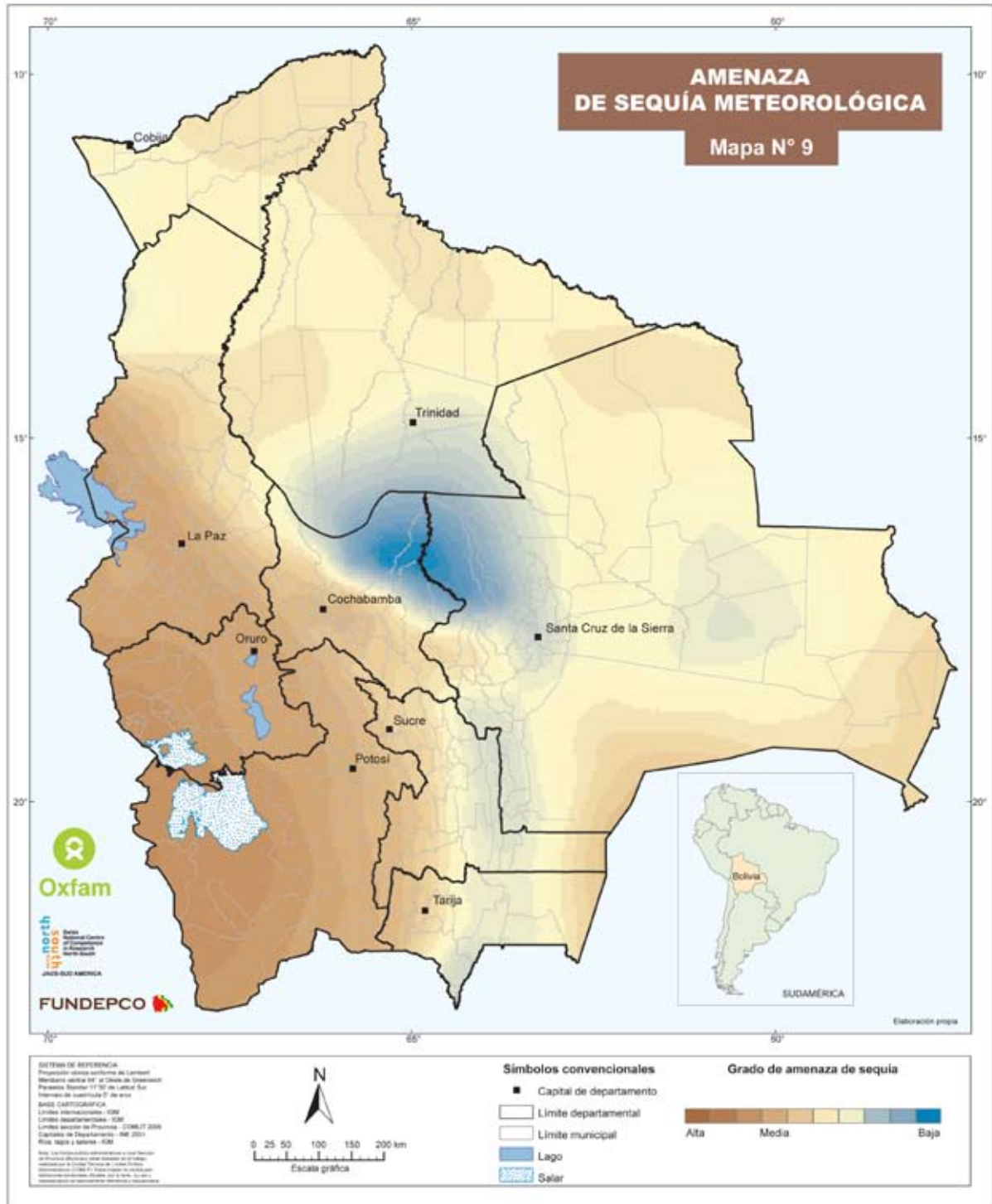
Source: Interview with Simon Ticehurst, Oxfam GB Country Director, La Paz.

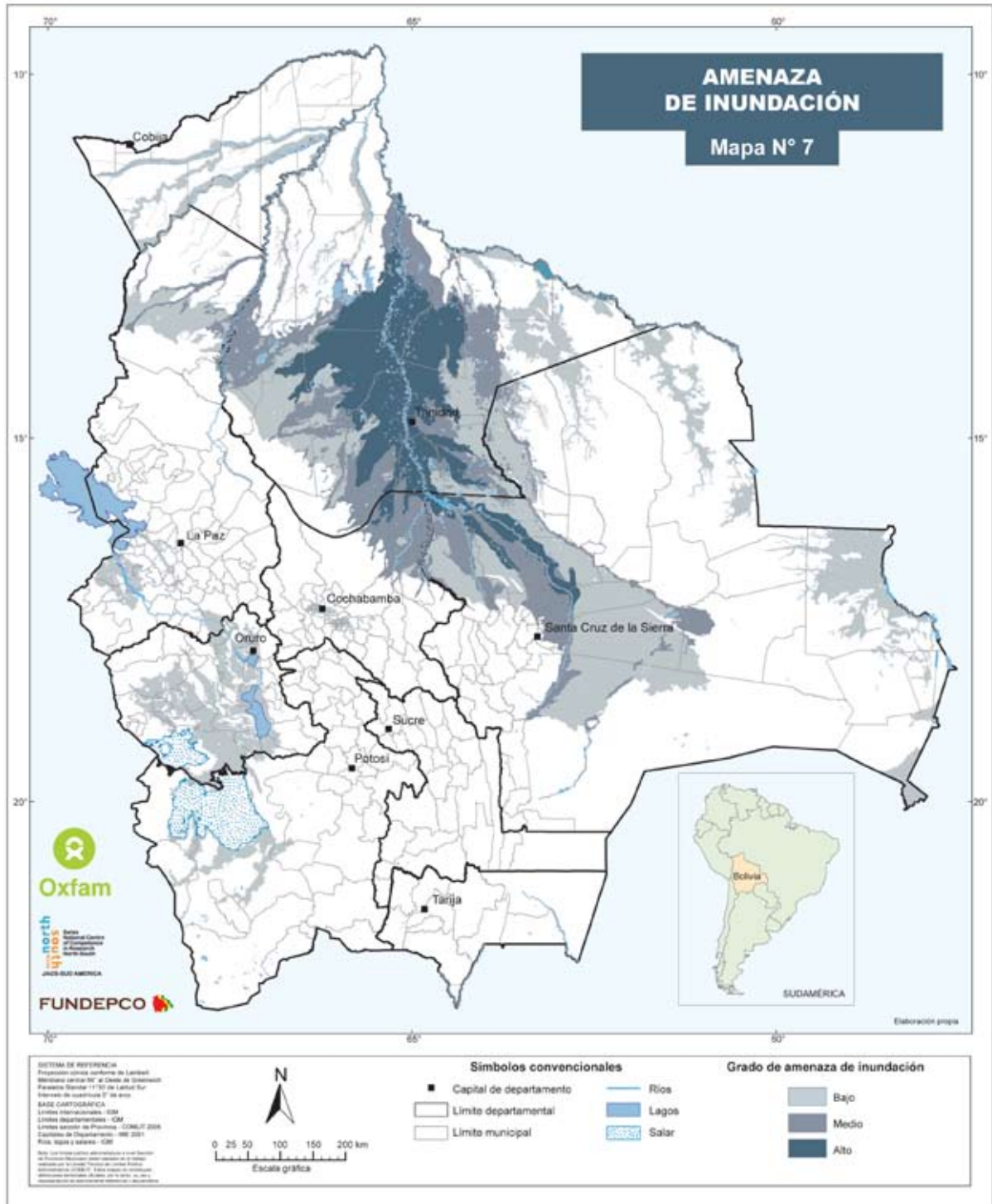
14 Oxford Analytica, *ibid*.

15 Risk to a person or community is usually defined as a correlation between an external threat (disasters) and vulnerability (internal conditions or likelihood of being affected by an external threat). If you live in a solid house, then you are less likely to be affected by an external threat. You can live in precarious conditions but are not at risk if it is in an area not normally associated with extreme weather. The problem for Bolivia is that a high percentage of its population is at risk from the combination.

16 James Painter, *ibid*, pp.7-9.

Maps 1 and 2 Areas of Bolivia prone to flooding and drought





Source: *Atlas: amenazas, vulnerabilidades y riesgos de Bolivia*, Oxfam - NCCR - FUNDEPCO, La Paz, 2008

A worrying development is that Bolivia is already experiencing more ‘natural’ disasters. Historically Bolivia has suffered from them on a regular basis, but Oxfam International has noted in recent years the frequency and magnitude of damage from these weather events has increased. The period from 2001 to 2004, for example, saw the highest number of declarations of emergency in the last 70 years (see box 1.2). In the period from 1997-2007, flooding was the most common event, followed by landslides, epidemics and droughts. Around 420,000 Bolivians were affected by flooding over this ten year period.¹⁷

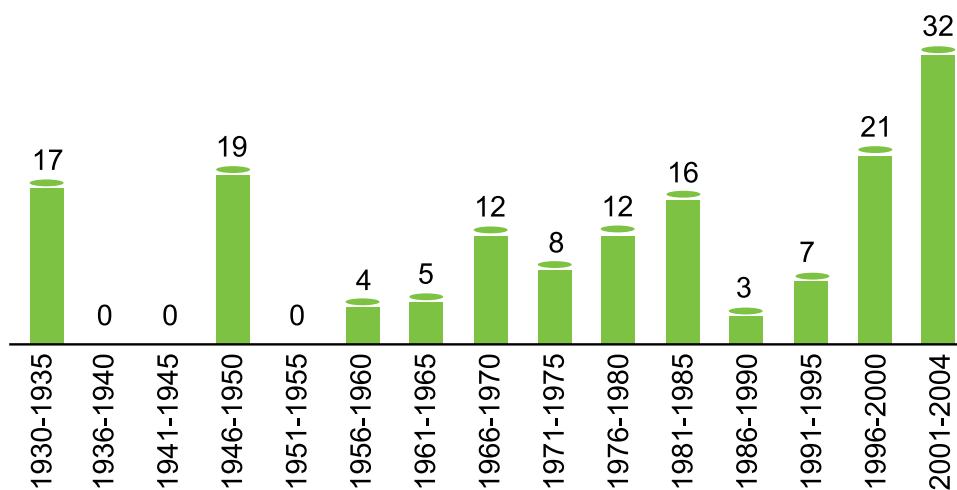
The last three years (2006-2008) have been even worse, with regular flooding, rivers overflowing, landslides, hail and frost. The numbers of women and men affected were very large: 560,000 in 2006/7 and 618,000 in 2007/8, which was equivalent to about 6 per cent of the country’s population. In 2006/7, the total direct and indirect economic cost was estimated by CEPAL to be US\$443 million, and in 2007/8 US\$547 million.¹⁸ That’s the equivalent of between 3 and 4 per cent of Bolivia’s GDP annually, a huge sum of money for a poor country.

It is the extremely poor families (living on less than a dollar a day) who are the most vulnerable. During the last three years, 45 municipalities in three of the most important river basins in Bolivia - the Amazon basin, the Plata basin and the Lake Titicaca basin - were badly affected by the flooding and other extreme weather. These same three areas have levels of extreme poverty that varies between 33 per cent of the population (Amazon) to 42 per cent (Plata) to more than 60 per cent (Titicaca).¹⁹ In other words, areas with high incidence of extreme poverty are also some of the most vulnerable to climate change-induced disasters.

In the most recent extreme weather events, which lasted from November 2007 to April 2008, there was terrible flooding in Beni (see section 5 below), and severe frosts, hailstorms and intense rainfall in parts of the altiplano. The three departments with the highest percentage of families affected were Beni, Oruro and Chuquisaca. Again, there is evidence for the link between vulnerability and poor living conditions:

Box 1.2 Bolivia and ‘natural’ disasters

Emergency Situations declared by the Bolivian government, 1930 – 2004



17 Figures are from Oxfam International, *Contingency Plan*, La Paz, January 2009.

18 The figures are taken from CEPAL, *Evaluación del impacto acumulado y adicional ocasionado por la Niña*, Bolivia 2008, p.4.

19 Oxfam Internacional, *ibid*.

- The same three departments have some of the worst indices of homes without access to drinking water (in the rural areas in the case of Oruro and Chuquisaca and in urban areas in Beni).
- Beni has a particularly high incidence of houses with a mud floor (86 per cent in rural areas), whilst Oruro and La Paz (another of the badly affected departments) have the

highest incidence of homes without a roof or walls made of strong building materials.²⁰

Box 1.3 gives a partial list of the geographical impact of the extreme weather events in 2007/8. Even in 2008/9, a 'good' year for avoiding extremes of weather, by March 28,000 families, mostly in the altiplano, had had their crops affected by hailstorms, flooding and strong winds amongst other weather events.²¹

Box 1.3 Extreme weather events 2007/8

January 2007: Beni runs the risk of being cut off because of the rains. 90 per cent of the country is affected by above average rainfall. In some parts of Potosi, there is drought due to the absence of rain.

February 2007: 100 communities in the north of Santa Cruz are covered by water because of heavy rainfall and burst banks. More than 1550 families are now affected throughout the department.

March 2007: The bursting of the banks of the Rio Beni affects several communities in the North of La Paz department.

March 2007: Parts of Cochabamba suffer drought, whilst others suffer flooding, burst banks and landslides.

October 2007: Tarija-Bermejo road cut in 17 places by torrential rains.

November 2007 – April 2008: At least 50 dead and 120,000 families affected by heavy rainfall mainly in the eastern cordillera, southern lowlands, eastern valleys and the Amazonian departments of Beni and Pando. These areas suffered a mixture of landslides, burst river banks and flooding on the plains. In contrast, parts of the altiplano suffered frost, hailstorms, and an initial deficit in rainfall followed by intense rains.

²⁰ CEPAL, *ibid.*

²¹ Cambio, *Efectos climáticos afligen a más de 28 mil familias*, 4 de marzo 2009.



Climate change impacts: past, present and future



'Bolivia's contribution to climate change is very small. But it will be indigenous and poor peasant farmers like us who will feel the effects the most. We are very vulnerable because historically the Bolivian state has not formulated policies to protect us'

Cristian Domínguez, peasant leader, CSUTCB

In July 2009, Bolivia's leading glaciologist, Edson Ramírez, was sitting in his office at the University of San Andres in La Paz, displaying pictures from his visit the month before to Chacaltaya. 'It's gone', he said simply, referring to the 5,300-metre glacier that as recently as 20 years ago was the world's highest ski run (see photos). As he pointed out, he had predicted that it would disappear in 2015, so he was out by six years.

Scientists like Dr Ramírez are constantly revising downwards in what year they estimate other low-lying glaciers like Chacaltaya will disappear completely. Chacaltaya has become an icon of the accelerated glacial retreat happening throughout the tropical Andes. When the IPCC launched its Fourth Assessment report on Impacts, Adaptation and Vulnerability in April 2007²², photos were flashed up at its press conference of what had happened to Chacaltaya as a symbol of rising global temperatures.

For Bolivia, the loss of the glacier is not just symbolic. Nor is it simply a matter of less tourists travelling to the mountain to have the

ultimate skiing experience. Nearby glaciers provide a significant amount of drinking water, particularly in the dry season, to hundreds of thousands of women and men living in El Alto and La Paz. The Zongo glacier, which is much larger than Chacaltaya, is also retreating. It is one of several glaciers contributing water to the hydroelectric power stations that give the country 40 per cent of its electricity.

Irrigation schemes are used in only 10 per cent of Bolivia's cultivated land, a relatively small percentage compared to Peru and Ecuador.²³ The remaining 90 per cent depends on a regular supply from precipitation, underground aquifers and glaciers. Thousands of poor farmers living at high altitudes rely on the water from glaciers for part of their irrigation supply (see section 3).

The retreating glaciers are just one of the five main impacts – both now and in the future - that Bolivia is facing as a result of climate change. The other four are food security, the frequency and intensity of disasters, mosquito-borne diseases and forest fires.

22 IPCC, Climate Change 2007: Impacts, Adaptation and Vulnerability, available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm

23 María Teresa Oré et al, *El Agua, Ante Nuevos Desafíos*, Oxfam Internacional and IEP, Lima, 2009, p. 177.

Rapid glacial retreat

According to a study released in early 2009, the Paris-based Development Research Institute (IRD) estimated that the glaciers in the Cordillera Real mountain range in Bolivia had lost more

than 40 per cent of their volume between 1975 and 2006. The IRD said that the volume had remained pretty constant until 1975, but had diminished quickly since then.²⁴ Figures used in a report for the UNDP suggested a 30 per cent drop in surface area over a similar period.²⁵



The snow-capped mountain of Chacaltaya. La Paz, Bolivia. Photo: Bernard Francou



²⁴ La Razón, *El volumen de los glaciares se reduce en 43 por ciento*, 13 de febrero 2009.

²⁵ James Painter, *ibid*, p.15.

The main cause is generally considered to be the rise in near-surface average air temperatures. Studies show an average increase of about 0.10°C per decade since 1939, with the bulk of the warming occurring over the last two decades. The rate of warming has almost tripled since the mid-1970s to between 0.32 and 0.34°C per decade.²⁶

Dr Ramírez has carried out a detailed study of the Tuni-Condoriri basins which supply water to at least one million inhabitants of El Alto and La Paz.²⁷ By examining aerial photographs since 1956, he estimates that the Condoriri glacier has lost 44 per cent of its area between that date and 2006, whilst the Tuni glacier has lost 55 per cent. He calculates that the Condoriri glaciers will have disappeared completely by 2045, and the Tuni glacier in just 16 years' time (2025).

The key question is how much of the water supply comes from the melt from a particular glacier as compared to precipitation, and at what time of the year. Dr Ramírez estimates that in the case of Tuni-Condoriri it could be as much as 30 per cent, although he stresses that more research needs to be done. It is known that semi-arid mountainous ecosystems like those in Bolivia are highly vulnerable to the disruption of local hydrological patterns. For example, the retreat of the glaciers and higher temperatures could have a major effect on the central role *bofedales*, or highland wetlands, play in regulating local water supplies and releasing it during the dry season.

It should be emphasised that there are a lot of unknowns. The retreat of the glaciers may mean that in the short-term there is a net annual increase in water availability in some basins, which could raise expectations of

water consumption which are unsustainable in the longer-term and cause adjustment problems.²⁸ Many models predict greater 'seasonality' of water supply, where run-off from the glaciers will increase in the wet season but decrease in the dry season, which could last for longer periods than at present and could combine with less precipitation. One recent study described this as a 'most dramatic change ... which would challenge future water management drastically'.²⁹ What is more certain is that the accelerated retreat and/or eventual disappearance of the glaciers add another layer of vulnerability to water supplies for agriculture, urban consumption, power generation and ecosystem sustainability.

In February 2009, for the first time in living memory, the local authorities in La Paz and El Alto asked citizens to moderate their use of water during carnival. They were concerned by the five-metre drop in the level of water in key reservoirs due to unusually low levels of rainfall during the rainy season. It would not be too alarmist a scenario to imagine much more severe restrictions on water use in the decades to come, when the lack of glacial water combines with a period of low levels of precipitation. El Alto's population for example is increasing at 3 per cent year, hugely increasing the demand on drinking water. It is already a highly politicised society organised around water issues. The potential for severe social conflict is high.

Food security

It is striking when travelling around Bolivia to hear so many women and men living in rural communities express concern about the climate changing. Some date the start of the changes to 30-40 years ago, others more recently. But

26 Vuille M., *Climate Change in the tropical Andes – Impacts and consequences for glaciation and water resources, Part I: The scientific basis*, report for CONAM and the World Bank, 2007.

27 Edson Ramírez et al. (2007), *Deshielo de la cuenca del Tuni Condoriri y su impacto sobre los recursos hídricos de las ciudades de la Paz y El Alto*, La Paz, Instituto de Hidráulica e Hidrología, Institut de Recherche pour le Développement, p. 179.

28 W. Vergara et al, *The Potential Consequences of Rapid Glacier retreat in the Northern Andes*, LCR Sustainable Development Working Paper no 32, World Bank, June 2009.

29 Juen I. et al, 'Modelling observed and future runoff from a glacierized tropical catchment (Cordillera Blanca, Peru)', *Global and Planetary Change*, <http://www.sciencedirect.com/science/journal/09218181> Volume 59, Issues 1-4, October 2007, Pages 37-48.

there is virtual unanimity that the last three years have been noticeably different in many parts of the country. Recent studies carried out by NGOs like CIPCA, Christian Aid and CENDA have documented local farmers' perceptions of the changing weather from all over Bolivia, including the Chaco, the altiplano, the valleys, Beni, Pando and Santa Cruz.³⁰

Historically in most parts of Bolivia the rainy season lasts from November to March, followed by a dry season from April to October. A common observation is that the rainy season now often arrives later and lasts a shorter period. This means that the growing season for those farmers without irrigation systems is shorter (often reduced from six to four months), which affects the volume and timing of food production. Other changes noted are:

- Higher temperatures, leading to changes in what crops can be grown and at what time.
- More insect plagues due to higher temperatures, leading to loss of some production.
- Less overall volume of rain over the rainy season.
- Less predictability about when the rains are coming.
- More extremes of weather such as severe frosts and hailstorms, often destroying crops, and often coming at unusual times of the year.³¹

It should be stressed that different zones of Bolivia have experienced different changes in the climate. For example, in the Santa Cruz department, local women and men speak of

more rain, not less, and more intense periods of drought. Moreover, different valleys within the same department can have a completely different micro-climate to one adjacent to it. However, in many cases the multiple environmental problems already faced by poor men and women such as soil erosion, water contamination and desertification are being exacerbated by the changing climate.

Figures from Bolivia's meteorological and hydrological office, SENAMHI, and from other studies suggest that the tendencies observed by farmers are confirmed by the official statistics. Maximum and minimum average temperatures in most of the northern altiplano and the valleys have risen by between 0.8 and 1.5 degrees centigrade over the past 30 years. There has been a slight decline in total volume of rainfall, but monthly distribution has varied considerably particularly in the last three years, being concentrated in the three months from December to February, rather than spread out over a longer period. In 2009 there was a considerable shortfall. In Santa Cruz, there was an increase of up to 2 degrees centigrade in the same period, while rainfall patterns varied from province to province.³²

A 2005 study carried out for Bolivia's National Climate Change Programme (PNCC) suggests similar results. Average maximum and minimum temperatures had gone up from the 1940s to 2004 in Santa Cruz, Beni, Cochabamba, Oruro, Tarija, and had gone down in Chuquisaca and Potosí.³³ In the altiplano, temperatures had increased on average by between 1.1 and 1.7 degrees centigrade. In general, most of the 28 weather stations monitored showed that rainfall had decreased from 1983 in comparison with historical levels.

30 CIPCA, *documental sobre cambio climático*, video, La Paz, 2009; Pablo Regalsky and Teresa Hosse, *Estrategias Campesinas Andinas de Reducción de Riesgos Climáticos*, CENDA-CAFOD, Cochabamba 2009; *Perceptions of Climate Change, Bolivian Altiplano*, mimeo, Christian Aid, La Paz 2007.

31 Their observations are remarkably similar to those of poor people around the world. See Oxfam, *Suffering the Science*, Oxfam Briefing Paper 130, July 2009, p.14.

32 Interview with Felix Trujillo, head meteorologist at SENAMHI, July 2009.

33 Oscar Paz, *ibid.*, pp. 527-533. The department of La Paz showed an increase in minimum temperatures and a decline in maximum temperatures, whilst Pando showed little variation.



Community member working on the camellones, Beni. Photo: Mark Chilvers / Oxfam

These changes can have different effects. In some parts of the country like the altiplano, higher temperatures can help the production of potatoes and maize if accompanied by sufficient water provision. In other parts, crops that could not be grown before, like fruit trees, can now be cultivated. In the more tropical areas, hotter temperatures can affect the productivity of soya, cotton, rice and sugar cane. According to the Food and Agriculture Organisation (FAO), agricultural production for the following regions is particularly at risk from climate change³⁴:

- Santa Cruz, where 40 per cent of the country's output is concentrated
- The lower valleys of Cochabamba where potatoes, maize and vegetables are grown
- Rice production in Chapare, Santa Cruz and Beni, which are vulnerable to flooding
- Peach cultivation in the La Paz and Cochabamba valleys
- Grape cultivation in Tarija

In general, the changing temperatures and rainfall patterns make agricultural production more risky for poor farmers and consumers. Unpredictable weather, different plant diseases affecting crops, and more extreme weather events have a negative effect on food security because they often lead to less agricultural output and therefore higher, or more volatile, food prices. For example, a cold snap can reduce cassava production by as much as 70 per cent. Two groups are most affected: small producers who would lose a good part of their income, and low-income consumers who eat a lot of cassava due to its low price. Another problem in Bolivia is that small-scale colonist farmers often travel

³⁴ See interview with the FAO representative in Bolivia, available at: http://aipe.org.bo/sac/public/mostrar_plugin.php?symbolic_name=LST_ENTREVISTAS&id_plugin=17&lang=es&id_entrevista=13&referer=.../sac/public/mostrar_plugin.php

to lower-lying areas such as in Beni to settle on the land there, and these areas are very vulnerable to flooding.³⁵

The NGO CIPCA is working in different parts of Bolivia to help farmers adapt to the changing climate by experimenting with new types of the same crop, diversifying into new crops, and using natural forms of pesticides. In the Chaco region for example, which is a dry area, in the last few years local farmers have experienced less rain or rain coming at different times of the year, more intense heat, and more plagues of insects. Local Guarani communities have been suffering from less agricultural output as a result. For example, often crop production is being lost during the flowering season, and rain levels are insufficient for feeding and watering livestock³⁶

As a result, CIPCA is working with farmers in the Chaco region to adapt to the changing climate. They are experimenting with the following strategies:

- Better use of local water and more water capture
- Better management of forest and wooded areas (keeping intact parts of the forest)
- Keeping cattle under the shade of wooded areas
- Using types of forage, maize and cattle which are native to the region.

Moreover, CIPCA is working with local producers and social organisations to raise awareness of climate change impacts and to push for local and innovative solutions that can reduce the threat to their food security.

Disaster frequency and intensity

As already noted, there is evidence to suggest that the number of climate-related disasters in Bolivia has increased in recent years, but it remains an open question to what extent this can be ascribed to global warming. Government officials and climate scientists blame the unusual weather and the disasters over the last three years on a particularly intense version of the El Niño/La Niña weather phenomenon, which happens as a result of changing temperatures in the Pacific Ocean.³⁷ 2006/7 was regarded as part of an intense El Niño cycle, which was followed in 2007/8 by a moderate La Niña cycle.

Some scientists believe that this cycle, which historically happens every four to seven years, will become more frequent and more intense in the decades to come.³⁸ However, other scientists think that global computer models are not sophisticated enough to capture the complexities of the El Niño/La Niña cycle to make any predictions with enough confidence.

In general though, most models predict more extreme weather events and higher temperatures for Latin America. For example, the IPCC has warned that 'the frequency of occurrence of weather and climate extremes is likely to increase in Latin America.'³⁹ It also said that under business-as-usual scenarios, temperature increases from a baseline period of 1961-1990 could range for the region from 0.4 to 1.8 degrees centigrade by 2020 and from 1 to 4 degrees centigrade by 2050.⁴⁰ However, the greenhouse gas emissions projections on

35 FAO interview, *ibid.*

36 Interview with CIPCA representative, July 2009; and article by CIPCA anthropologist, María Elena Moreira, 'Cambio climático un reto del presente', available at http://cipca.org.bo/index.php?option=com_content&task=view&id=1472&Itemid=7

37 El Niño is linked to warmer temperatures in the Pacific and can create more rainfall in some areas and drier conditions in others. La Niña is the opposite meteorologically of El Niño, and is usually associated with a drop in sea surface temperatures in the eastern and central Pacific Ocean by 1.5-2.0 degrees below the average.

38 See for example the Global Economic Facility, *It's raining, it's pouring, it's time to be adapting*: report of the second AIACC regional workshop for Latin America and Caribbean, GEF, Washington DC, 2004.

39 IPCC, *ibid.*, p. 583.

40 IPCC *ibid.*, quoted in World Bank, *Low Carbon, High Growth, Latin American Responses to Climate Change*, Washington DC, December 2008, p. 5.

which these scenarios were based have already been exceeded. There is much less agreement on future rainfall patterns for the different zones of Latin America.

Few results from climate change modelling for Bolivia have been published, in part because of the general uncertainties accompanying

downscaled models. But one of the few in the public domain suggests temperature increases of between 0.8 and 1.4 degrees centigrades by 2030, and wide variations in precipitation across different geographical zones.⁴¹ A 2007 study by the PNCC does show the enormous variety of possible impacts across the different ecological regions (see table 1).

TABLE 1: Possible impacts of climate change per region

Region	Change Scenarios	Expected Impacts
Altiplano	Greater concentration of rainfall More storms with higher number of rainy days More hailstorms Less waterflow in rivers	More frosts More need for water for irrigation for long periods without rain Problems with electricity generation Glacial retreat Little availability of water for human consumption and for animals Little refilling of aquifers, high altitude wetlands etc Competition over water usage
Valleys	Greater concentration of rainfall More storms with higher number of rainy days More hailstorms	Competition over water usage More need for water for irrigation for long periods without rain Problems with electricity generation Increased risk of landslides Erosion and desertification of soil Loss of biodiversity
Chaco	Less rainy days More rainless days during planting season Recurrent and intense droughts Less waterflow in rivers	Competition over water usage Loss of biodiversity Erosion and desertification of soil Hot periods during summer More pollution in water sources
Amazon flatlands	More water volume per event Higher presence of cloudiness Higher atmospheric humidity in summer Strong droughts in winter	Frequent floods Loss of road infrastructure Loss of biodiversity Loss of winter crops More cattle deaths due to lack of water More insect plagues and water-related infectious diseases

Source: PNCC, *El cambio climático en Bolivia: Análisis, síntesis de impactos y adaptación*, La Paz 2007, p. 83.

41 Oscar Paz, *ibid.*, pp. 534-6.

Urban areas where more than 60 per cent of Bolivians now live could be just as exposed as rural areas to the impacts of extreme weather, particularly as it is predicted that this could take the shape of heavier, shorter outbursts of precipitation. For example, a very heavy hailstorm in La Paz in February 2002 led to the death of 67 people and caused US\$50 million of damage in one day. In November 2008 hailstones the size of eggs caused widespread destruction in Tarija affecting more than 1,000 families in just 30 minutes. According to the NGO Red-Habitat, cities could become vulnerable to water shortages, food shortages, electricity rationing and more infectious diseases.⁴² The NGO warns that Oruro, Santa Cruz and Cochabamba get much of their water supply from underground aquifers, but this is already under threat from less water infiltration and more evaporation of the water in the soil.

Health

There is increasing evidence that the mosquito-borne disease malaria is becoming more present in some locations at higher altitudes where previously the climatic conditions would not have permitted it. In a path-breaking 1998 Harvard study of Tuntunani, an Aymaran community of around 200 inhabitants north of La Paz at 2,300 metres and above, it was discovered that more than 40 per cent of residents who contracted malaria had not travelled outside.⁴³ It was very probable that they had been infected in the area of the study. It was the first time that malaria had been reported there. At least five people died.

The case highlighted the vulnerability of isolated rural communities to the emergence

of the disease. Because it was so unusual to find malaria at such a high altitude, no treatment was available until two months into the epidemic.⁴⁴ A team led by the Bolivian health scientist, Marilyn Aparicio, has reported that a certain type of mosquito (*anopheles pseudopunctipennis*) has adapted to living at altitudes between 2,620 and 3,590 metres in the altiplano. Such conditions are very different to their usual environment, which is warm, tropical or subtropical and below 2,600 metres.⁴⁵

According to Aparicio, one of the main factors was that the temperature had increased by 0.85 degrees centigrade in the areas of study. This had changed the ecosystem and had developed an environment suitable for the mosquitoes to live in. The evidence suggested that the mosquito was able to live in dirty water at those altitudes and survive temperatures as low as 8 degrees centigrade. Four more cases of malaria were confirmed in November 2008 in the area around Oruro, at around 3,700 metres above sea level.

Dengue is another mosquito-borne disease considered very sensitive to climate change. In April 2009 the medical authorities were reporting more than 55,000 suspected cases, with 25 fatalities, mostly in the Santa Cruz department. Press reports spoke of 100 women and men a day arriving at San Juan de Dios hospital in Santa Cruz during the peak of the outbreak. Many were poor, who had to 'pay to enter the hospital (and usually for) their own saline solutions, painkillers, and other medicines'.⁴⁶ The national director of Epidemiology, Eddy Martínez, was quoted as saying that higher temperatures could have a role in the spread of the disease to higher altitudes due to the mosquito's ability to survive better.⁴⁷

42 Red-Habitat, *Cambio climático en las ciudades de Bolivia*, video, La Paz 2009.

43 Tina Rutar et al., *Introduced Plasmodium Vivax malaria in a Bolivian community at an elevation of 2,300 meters*, Am. J. Trop. Med. Hyg., 70(1), 2004, pp. 15-19.

44 Naomi Mapstone, *South America: Climate Change takes tropical diseases up the mountain*, Financial Times, 23 April 2009.

45 Cristina Pabón, *Malaria spreading on Bolivian high plains*, SciDev.net, 19 December 2008.

46 John Enders, *South Americans hit by dengue fever epidemic*, Miami Herald, 17 May 2009.

47 La Razón, *Cambio climático incidirá en la expansión del dengue*, 9 de marzo 2009.



Simulation of a fire, Riberalta, Beni. Photo: Pedro Laguna / Oxfam

In its 2007 reports the IPCC added its voice to several organisations warning of the greater geographical and altitudinal spread of dengue and malaria as a result of warmer temperatures.⁴⁸ Bolivia's PNCC has outlined why climate change has a direct and indirect effect on the behaviour of the mosquito.⁴⁹ The World Bank warned in a 2008 report that Latin America will be particularly vulnerable to malaria in the future. It said that in areas currently too cool for malaria and dengue vectors, higher temperatures could allow the expansion of the range and seasonal window of transmission.⁵⁰

In April 2009 a World Bank official was quoted as saying that the malaria threat was already happening across the Andes at elevations of 2,000m. 'I am talking about survival of the vector disease at higher altitudes because the minimum night temperature is increasing',

the official said. 'This is one of the very sad stories of climate change in the mountains of the Andes. These populations are going to be exposed to tropical diseases for the first time'.⁵¹

Forest fires

The cutting down of the Bolivia's Amazonian rainforest and savannah for soya, cattle and timber production, and the widespread burning of forested areas to clear land for small-scale production are significant contributors to world greenhouse gas emissions. Prior to 1990, Bolivia had a relatively low rate of deforestation, but since 1990 the FAO calculates that around 270,000 hectares of forest were cut down every year until 2005 due to government encouragement of soya, timber and cattle production. That amounts to an annual rate of 0.5 per cent and a total figure of about 4 million hectares, over the 15 year period.⁵²

48 IPCC, *ibid*, 2007.

49 *Malaria de altura: estudio de caso*, PNCC, chapter 8, La Paz 2008.

50 World Bank, *ibid*, p. 14.

51 Naomi Mapstone, *ibid*.

52 See FAO figures accessible at: [ftp.fao.org/docrep/fao/011/i0350s/i0350s04b.pdf](ftp://ftp.fao.org/docrep/fao/011/i0350s/i0350s04b.pdf)

UN figures suggest that Bolivia has about ten gigatonnes of carbon stored in the areas of high carbon density in the Amazon.⁵³ It is not known how much of this goes into the atmosphere every year due to deforestation, but it is not insignificant.⁵⁴ What is more certain is that the human-induced global warming caused by the



*Simulation of a fire, Riberalta, Beni.
Photo: Pedro Laguna / Oxfam*

release of greenhouse gases can also have a major impact on the climate in the Bolivian Amazon.

For example, one of the worst droughts recorded in the Amazon in 2005 was linked by scientists not to El Niño, but to warming sea surface temperatures in the tropical North Atlantic.⁵⁵ In October of that year, the Bolivian government declared the department of Beni a natural disaster zone as it was experiencing its worst drought since 1963. The Vaca Diez province of Beni suffered one of the worst forest fires in its history, which in just 15 days consumed 100,000 hectares of forest.⁵⁶ In total that year, an estimated 500,000 hectares of forest land and pasture went up in smoke as the fires burnt out of control.⁵⁷

As the PNCC has warned, 'the presence of longer dry periods combined with changing characteristics in the forested areas (dry species of ecosystems which can easily catch fire) and populated zones will increase the conditions for a larger number of forest fires in the future, which will also translate into significant losses of forest biomass and biodiversity.'⁵⁸ Keeping the forest cover intact would help to maintain local rainfall in the dry season, limit the spread of fires and stop surface temperatures rising too high.

53 UNEP, Carbon and Biodiversity: a demonstration atlas, UNEP-WCMC Biodiversity series no 29, p. 16 available at http://www.unep-wcmc.org/l/news/atlas/Carbon_and_Biodiversity__screen%20friendly.pdf

54 Greenpeace calculates that the Brazilian cattle industry is the largest single cause of deforestation in the world. See <http://www.greenpeace.org/raw/content/espana/reports/090601.pdf>. According to FAO figures, Bolivia's annual deforestation rate is approximately a tenth of Brazil's in absolute terms.

55 James Painter, *Amazon faces more deadly droughts*, BBC website, 23 March 2007.

56 Oscar Paz, *ibid.*, p. 546.

57 <http://rainforests.mongabay.com/20bolivia.htm>

58 PNCC, *El cambio climático en Bolivia: Análisis, síntesis de impactos y adaptación*, La Paz 2007, p. 37.



Beni. Photo: Pedro Laguna / Oxfam



The Highlands, Water is Life



'If we don't have water from the glacier, what are we going to live from? There's no life without water. Water is life.'

Lucia Quispe, Khapi community, Illimani.

Thousands of poor Aymara and Quechua families live at high altitudes in rural communities throughout the Bolivian Andes. Many of them are dependent on water coming down from the glaciers both to drink and to irrigate their small plots of land. It is not known with certainty how much of their water supply comes from glacial melt, compared to other sources of water like precipitation (such as rainfall, snowfall, and hail) or underground aquifers. But it is certain that it represents a significant proportion. The communities themselves believe that in some cases it may be as much as half.

Women in particular are vulnerable to any disruption in the supply of water. It is they who are often left to tend the plots of land as male members of the family migrate to urban areas to seek employment and a supplement to the family income. Life is a hard grind. They work long hours to provide food and water in addition to caring for the children and the home. Many of them are primarily responsible for making sure there is a supply of a variety of vegetables for domestic consumption, like potatoes, corn, beans and peas. They are often responsible too for the upkeep of the animals, such as cows, sheep and donkeys.

The Aymara communities tucked under the 6,400-metre Mount Illimani, just 50 kilometres

south-east of La Paz, are in many ways representative of what hundreds of villages are facing across the Bolivian Andes. They are usually poor and vulnerable to the vagaries of climate change as their household economies depend to a large extent on agricultural production for domestic consumption and sale in nearby markets. Most of them do not have systems to capture water and irrigate their plots in times of shortage.

Typical are the 40 families that live in Khapi at 3,600 metres above sea level. Most of them practice subsistence agriculture, and most are very poor.⁵⁹ On a clear day Illimani looms like a colossus above Khapi's grassy plaza. In the last few years they have become increasingly alarmed by two things: in the long-term, the water which Illimani provides from its ice and snow seems doomed to diminish significantly if not run out; and in the short term, the seasons which they used to be able to predict with a fair degree of certainty have become unpredictable.

Testimonies collected from various villagers tell an increasingly familiar story. They speak of the rains coming at odd times of the year compared to previous years when there was a clearly marked rainy season and dry season. According to one villager, it had rained in June this year which was most unusual. They also spoke of warmer temperatures, sudden

59 According to Agua Sustentable, 78 per cent of the population of the municipality of Palca, of which Khapi forms a part, live in extreme poverty.

changes in the weather and hailstorms coming at unaccustomed times of the year.

The higher average temperatures can bring some advantages. Some of the villagers were now growing peaches and maize higher up the mountain which they were unable to do previously. However, the unpredictably of weather brings with it a whole array of problems:

- most important of all, the villagers do not know when exactly to sow their main crops. In the past, they would do this in September, anticipating the rains in October and November. But the rains were now arriving much later, and periods of severe shortages of water were not uncommon in August and September.
- the warmer temperatures brought more possibility of insects affecting the quality and quantity of production.
- the abrupt changes in the weather leave them exposed to more health problems, such as respiratory illnesses.

The villagers are often left bemused by the changes in the weather. Unsurprisingly, theirs is not the technical language of global warming, greenhouse gases and carbon emissions. As Seferino Cortez, one of Khapi's community leaders expressed it, 'Our weather is coming up here from further down the mountain where it used to be.'

One of the elders of the village, 67-year-old Marcos Choque, has been watching the retreat of the snow line on Illimani with great concern. He is convinced that since 1952, the snow and ice have risen about 500 metres up the mountain due to the higher temperatures. He estimates that in 30 to 40 years' time Illimani will be completely black, or as he expresses it, 'peeled of its whiteness' (see testimony).

He says that in the hotter months like November, he waits until 4 pm in the afternoon for Illimani to provide him with water from the

melting snow and ice to irrigate his plot. He says in the colder, drier season, he has less water. However, his main concern is for the future. He worries that even though he will not be alive to see it, he fears for the young of the village who will witness the death of the glacier. 'There will be widespread hunger', he predicts.

Thirty-eight year old Lucia Quispe is most anxious about how her young children will cope in the future. 'It could mean great suffering for my son', she says. 'There could be a tremendous drought. There might be no more snow, no more water coming down. So how would we irrigate our plots of land? My son would have to leave and go somewhere else, to other countries' (see testimony).

It is hard to overstate the degree to which water and Illimani provide the essential backdrop to the lives of the Khapi villagers. They are interwoven into the fabric of their daily life, customs and religious beliefs. Every September, usually around the 8th of the month, they carry out a ritual, involving offerings called Waxt'a in Aymara. This involves the sacrifice of a llama and other offerings like coca leaves, alcohol and cigarettes to Illimani. They go through the elaborate ceremony so that, in their words, 'Illimani gives them water through the year'.

It is not certain for how many more decades Illimani will be able to give them their water. According to studies of photos of the Cordillera Real range carried out by the US National Aeronautics and Space Administration, NASA, about 45 per cent of the surface area of its glaciers has already been lost since 1986. However, the photos suggest that Illimani has lost less than the average - about ten per cent - over the same period, probably due to its higher altitude.

In the nearby community of Choquecota, the villagers are also dependent for part of their water supply on a glacier, which is called Mururata and has a lower altitude than Illimani of 5,880 metres. Bolivian scientists from the University of San Andres in La Paz have

studied historical photographs of the glacier to conclude that it has lost more than 20 per cent of its surface area since 1975 and probably more of its volume.⁶⁰ Bolivian glaciologist Edson Ramírez has stated that it is ‘terminally ill’.

Valerio Quispe is a villager from Choquecota who grows vegetables to eat and to sell, and also works as a day labourer in La Paz. ‘Mururata glacier is Pachamama (Mother Earth) to us,’ he told Oxfam International. ‘It is where we get our water from for everything: cooking, washing, drinking, watering our plots, feeding our animals. Without Mururata we won’t be able to survive here.’

Some of the communities living under Mt Illimani are active members of the Platform of Social Organisations against Climate Change, which is an awareness-raising and pressure group on climate change. One of the Platform’s demands is for the formation of an International Tribunal on Climate Justice (see section 6).

The Bolivian NGO, Agua Sustentable, works with several communities including Khapi to help them adapt to the effects of climate change, such as planting different crops or crop varieties. They are also considering ways of storing more water for the drier parts of the year.

Agua Sustentable, together with another NGO, Earthjustice, made a submission to the UN’s Office of the High Commissioner for Human Rights in Geneva this September⁶¹. In this, they urge the Human Rights Council to recognise the impacts of glacial melt on communities in Bolivia as a violation of human rights and the responsibility of major greenhouse gas emitting states for this violation. They recommend that the Human Rights Council should encourage the international community to take immediate action to decrease emissions and provide



Mururata glacier, La Paz. Photo: Sagrario Urgel / Oxfam

finances in line with their historic responsibility, to help Bolivia adapt. For example, through funding programmes or infrastructure for water conservation, storage and distribution.

Agua Sustentable argues that it is particularly unjust that these Andean communities, far away from the source of carbon emissions and some of the least responsible for global warming, should be amongst the most vulnerable to climate change. ‘What’s happening at Khapi is typical of what hundreds of poor, indigenous and vulnerable communities throughout Bolivia, Peru and Ecuador are facing,’ says Juan Carlos Alurrade, executive director of Agua Sustentable. ‘They depend on glacial melt for irrigation, but the glaciers are doomed’.

60 Edson Ramírez, *Deshielo del nevado Mururata y su impacto sobre los recursos hídricos de la Cuenca de Palca*, La Paz, December 2008.

61 This submission is available at www.earthjustice.org/.../earthjustice-and-agua-sustentable-bolivian-upr-submission-with-endnotes.pdf

Box 3.1 67-year-old Marcos Choque, Khapi

Q: Don Marcos, what changes have you seen on Illimani?

A. Since 1952, I have seen the snow advancing up the mountain. I think that in 30, or maybe as much as 50 years, there will be no more snow on the mountain.

Q. How much has the snowline receded?

A. It has risen about 500 metres in the last fifty years.

Q. How will it affect your community if there is no snow or ice on Illimani?

A. There will be no water. We will suffer drought. We won't have any crops. Everything depends on having water. We could even die of hunger.

Q. Is it also changing when the rains come?

A. It is changing. When there is no rain, there is not even any water for our animals. They start getting thinner and there is no pasture for them to eat. The wind comes and it gets colder too. We won't be able to raise animals. We need water for everything. When there is water, there is fodder for them to eat. When there is no water, there is no fodder.

Q. What do you in September to ensure there is water?

A. On 8 September, we offer a *Waxt'a* (Aymara for offerings) to the Pachamama so that there is water all the time, so that it doesn't dry out. If we don't offer this, we won't have water, so what would we live off? We wouldn't have produce to sell in La Paz. Without water, we are well and truly in trouble. If we have water, we live OK.



Q. Why in your opinion is the snowline rising so much?

A. The heat is increasing. In June, July and August, it's been very hot. From 8 am to 4 pm, it's really hot. When I was young, it was quite mild, not such a hot heat. That's why Illimani is melting. It's three times as hot. It did not use to be so hot.

Q. What emotion do you feel seeing Illimani as it is now?

A. I am very sad when I see the snowline going up. I don't want it to be like that. I don't have any children, but other *compañeros* in the community, they do have children. They are going to suffer the last days, if there is no water. I am 67-years-old, and I am not going to suffer as I am going to die. But the other villagers, yes they will suffer. That's why I am so upset that there is not going to be any water. I am going to live another ten to fifteen years, but the others...

Q. How will it affect them?

A. I am not going to see it. But the young will witness the end of Illimani.

Box 3.2 38-year-old Lucia Quispe, Khapi

My name is Lucia Quispe. I am 38-years-old. I have two daughters and one son, Javier Quispe, who was born here in the village.

Q. How do you feel when you see Illimani losing its snow and ice?

A. I am very worried. The snow and ice is disappearing and melting day by day, year by year. The sun is stronger. It doesn't snow as much. We are very concerned.

Q. Why are you so worried?

A. The snow and ice could disappear completely. So the water might not come down from the mountain at all. So we could have much less water. Already in recent years not much water is coming down in August and September, until November.

Q. Do you have a plot of land?

A. Yes, I grow corn, potatoes, broad beans and peas. It depends what we sow. Everything depends on water. If there is water, we can irrigate; if not, we can't.

Q. When do you think there will be no snow and ice left on Illimani?

A. It could be 30 or 40 years' time, or maybe a bit more.

Q. What would that mean for your son?

A. Great suffering for him. There could be a tremendous drought. There might be no more snow, no more water coming down. So how would we irrigate our plots of land? My son would have to leave and go somewhere else, to other countries.

Q. How do you feel when you see Illimani losing its snow and ice?

A. Sadness, but we are also very worried when we see it gradually losing its ice year by year.

Q. Why is it happening?

A. Because there's a lot of sun and it's a lot stronger. When I was young, the snow came down much lower. Now it is much higher, and we are left with a black mountain. It's true what they say about Illimani losing its white poncho. When it snows, it is not like before - just a little at the top of the mountain. But years ago, we could have had five centimetres of snow here in the village.



Q. Has anyone told you about global warming?

A. No, no-one has told me about it. But I have heard something about it on the radio. They say there is more pollution that comes from other countries, and multinational companies. It must be to do with the *capa solar* that is wasting away.

Q. Is it true that there is much less certainty about the seasons, and when the rain might be coming?

A. It does not rain when it should any more. At any moment, there might be clouds and the rain falls. Before, there was a season for rain, and a season for frost, and a period of winter. Now, it is not like that any more. In the last couple of years, the times of the seasons are all wrong. For the whole world it's the same, no? It rains, and then at the same time, it's sunny, at the same time, it's windy. Then we get more illnesses, more colds, more coughs, because of the sudden changes in the weather.

Q. What would help?

A. We need more help from the international community here in Illimani. For example, we need to build more irrigation channels. If not, how can we improve our situation? We women need more training too.

Q. When you think of the future for your children without water, how do you feel?

A. Sad, and very worried. If we don't have water, what are we going to live from? There's no life without water. Life is water. It could be that the Pachamama is offended. We have to carry out rituals and offerings on 8th September, and another ritual to try to prevent hail storms. If we don't do this properly, sometimes we don't get water.



The Valleys, Predicting the Weather



‘These days, when it should rain, it doesn’t, and when it is supposed to be the dry season, suddenly the rains appear... We don’t have irrigation systems, so the rain is very important for our crops.’

Clemente Salazar, community leader of Raquaypampa, Cochabamba, March 2009.

Bolivian NGOs who have been working with poor Quechua peasant farmers for several decades in the department of Cochabamba say the climate has changed almost beyond recognition in recent years. The director of Yachay Chhalaku, Antonio García, described it as ‘having gone mad’. For the villages which do not have access to irrigation systems, rain coming at the right part of the year and in sufficient quantity is crucial to a successful crop.

In particular, men and women farmers complain of the lack of predictability of when the rains will come, the shortening of the rain cycle, hotter temperatures, stronger winds, and more insects affecting the crops (see Eusebia’s testimony). A combination of all these factors is causing lower yields, and threatening food security. Water is the key issue in a department which has witnessed constant battles over access to a natural resource in short supply, including the Cochabamba ‘water wars’ in 2000 which caused widespread protests and several deaths.

Local men and women say it now rains between December and February, whereas previously the rainy season lasted from October or November to March or April. The

shortening of the season means that if farmers want to plant in months outside the rainy season, they have to rely more on irrigation schemes. Fears are rising that this can lead to more local disputes over access to water from lakes and reservoirs.

Official figures from SENAMHI, the national meteorological and hydrological office, confirm many of the perceptions of the farmers. Since 1978, the average maximum and minimum temperatures in the valleys have risen by between 0.8 and 1.5 degrees centigrade in the summer months, while in the winter the increase has been between 0.4 and 0.5 degrees centigrade. SENAMHI also states that the period of rains has shortened to fewer months, although it says the overall volume has remained constant. In 2009 however, there was significantly less precipitation.

For the farmers, the unpredictability of the weather and the lack of rains at certain times add another layer of problems to a whole range of already-existing difficulties facing agriculture in the region. However, for centuries Andean communities have followed multiple strategies for minimizing risk, including the risks associated with the frequent changes to the climate in the harsh terrain they live

in. They use sophisticated methods of social organisation, plant different varieties of seeds at different times of the year, and manage different types of microclimates and soil types.⁶²

In addition they have relied on a complex series of climate indicators to predict the weather and so determine when they should sow their crops. These include traditional observations of the behaviour of animals, birds, insects and plants, the position of the stars and the appearance of clouds which they use to forecast the intensity and timing of the rainy season. As Teodora Huanca from Aguirre in the province of Ayopaya explains, 'Our grandparents used to look at the signs from nature, particularly around the beginning of August. If the fox barked in one way, then they knew it was going to be a good year for rain. If it barked in another way, then it wouldn't be. They also looked at the clouds on the 1st August, and if there were clouds it would be a good year. If there was humidity under stones, then it was going to be a good year for rain, but if it was dry with no sweating, then it was going to be a dry year.'

Some of the older members of the community still retain this skill, although younger members who often migrate to cities for jobs do not. With the help of the NGO CENDA, some communities are looking at how they can recover the knowledge of their ancestors to forecast the weather. As Clemente Salazar, a community leader from Raquaypampa, says, 'What we need to do now is to research which natural weather indicators, such as the time of the blossoming of certain trees, still work and which new ones are appearing. And we, community leaders, need to work with the school teachers to make sure that this knowledge is taught to our children.'

Some observers doubt how accurately the traditional methods of predicting the weather will work in a context of more climate variability. But these methods have the advantage of drawing on local knowledge, particularly as micro-climates vary hugely from valley to valley and formal weather forecasts are often too general and not local enough. CENDA points out that local forecasting skills are just part of its support for indigenous communities trying to cope with climate change. It also works with indigenous technicians, and promotes family and community-level action and research to pool knowledge on soil, seed and land management techniques. It is hoping to help communities to use their inherited knowledge of different seed varieties to adapt to the different soil and weather conditions.

Moreover, as CENDA argues, indigenous communities can draw on other traditions such as Andean principles of solidarity, reciprocity and collective natural resource management which all help farmers to cope with adversity and may go some way in helping these communities adapt to climate change.

Remarkably, the community of Raquaypampa is accepting its own responsibility in combating climate change even though their contribution to greenhouse gas emissions is tiny. They are looking at storing water and planting trees. 'Even though we Bolivians aren't contaminating a lot, if we don't start with ourselves, we can't ask others to do things either', says Clemente Salazar. 'We need to look for alternatives so that Mother Earth doesn't get any sicker. We all need to put our hand to our heart, and question what we are doing, for the sake of the future generations.'

62 Regalsky and Hosse, *ibid*, chapter II.

Box 4.1

Eusebia Teramba de Ramos,
mother of three children, from Aguirre canton,
Tunari province, department of Cochabamba

"I tend our land as my husband goes off to work as a builder to earn some income. He helps at the time of sowing. We depend on our small plot of land for the food we eat. I grow potatoes but also wheat, beans, oca, *papa lisa* (a type of long, thin potato) and oats.

But we are short of water. When I was young there was plenty of water, now there isn't. There is a very little water in the river these days. There's no rain. It only rained from about February to March or April this year. There's much more variability in the rain. It used to come in October, but now it can come much later – in December or after.

When we were sowing last year, there was no rain so we had to use irrigation from the water canals. In the last three years the weather has been like this. It's also been hotter at times, and colder at times. There's also been more wind.

This year has been good for potatoes, but the problem has been the worms (*gusanos*) that get into the potatoes. Our elders say this is because of the drier weather and higher temperatures. There has also been a real problem with moths (*polilla*).

We have to put a type of mint (*muña*) on top of the potatoes so the worms don't get into them.

We have had potato worms before but the appearance of the moths is new, since 2004. The insects get into the potatoes through the stalks, so we have to cut off the tops of the plants to stop the blight spreading.

The lack of water has made it more difficult to sow my crops. You have to wait your turn to get water from the irrigation system. Last year we went on a prayer procession (*rogativa*), carrying a statue of the Virgin Mary to pray for rain. This year we didn't.

Our yields are down a lot in the last three years. This year we got twenty bags of about seven arrobas each (225 lbs) from the first harvest, 3-4 bags from the second harvest and none from the last. We used to get a total of about 50 bags.

Depending on the size of the family, twenty bags should be enough to last you until the next crop. But if the worms get in, then you might only have enough potatoes until December.

The shortage of water is causing more problems with other communities. We are currently fighting with our neighbours in another part of Aguirre over access to water nearby because we don't have enough water to sow our crops."



The lowlands, Rescuing the Past



'The ancient cultures in Beni did not try to fight against the flooding. They saw it not as an obstacle but as an opportunity, in the alternating cycles of seasonal drought and overabundance of water.'

Oscar Saavedra, executive director, Kenneth Lee Foundation.

The flooding that devastated the Amazonian department of Beni in 2008 was the worst in at least 50 years. In the previous two years there had been widespread damage from flooding too. But as one local resident of the capital Trinidad summed it up: '2006 was a bad year; 2007 was really bad; but 2008 was extraordinarily bad'.

At the end of January that year, several communities living on the outskirts of Trinidad began to be affected by rising water. The situation got a lot worse on 10 February when it started to rain heavily. The drainage system collapsed, causing almost all the neighbourhoods beyond the protection ring to be flooded, and some within it. Sanitation and sewage treatment facilities outside the protective ring also collapsed contaminating the flood water. A national disaster was officially declared on 12 February 2008.

According to a detailed report by CEPAL, 24,000 families, equivalent to 118,000 women and men, were affected across Beni.⁶³ This represented nearly 27 per cent of the population, the highest proportion of the population of any of Bolivia's nine departments.

According to Oxfam International, around three quarters of the total surface area of Beni was in some way affected by the floods. That is a huge area when you bear in mind that Beni is a department of about 215,000 square kilometres, not far short of the size of a country like Ecuador.

The CEPAL report calculated the economic damage caused by the 2008 flooding as US\$44 million in general damage to Beni's roads, US\$89 million in damage to the agricultural sector, and US\$71 million in damage to housing. In total, Beni suffered a staggering US\$220 million of loss and damages as a result of the flooding - the largest figure for any department.⁶⁴

As already mentioned, the cause of the flooding was linked to the La Niña weather cycle, which in Bolivia can cause intense rainfall in the east of the country.⁶⁵ However, the underlying problem was that of the widespread deforestation in the main river basins of the area. This had led to the silting and sedimentation of rivers and a reduced capacity to carry water.

63 Cepal, *ibid.*, p.25

64 Cepal, *ibid.*, p. 133

65 Cepal, *ibid.*, p.7

As was to be predicted, it was the poor and their families who suffered the most. Rural indigenous populations living alongside the rivers were particularly vulnerable. The human cost was widespread and heart-breaking. Dunia Rivero Mayaco, a 44-year-old mother of three from Puerto Almacén near Trinidad, lost everything in 2008. 'I had planted rice, maize, bananas and onions on my plot of land. But the water left nothing. I lost my house too. We had to live three months in temporary accommodation on the main road. The children got ill there. I didn't want to lose everything again.'

Maira Salas from the village of Copacabana, a 20 minute boat ride down the river Ibare from Trinidad, had a similar experience. 'It was terribly sad. We never thought there would be so much water. Our whole community was totally flooded. We all had to go to Trinidad and live under tents. Three months we were there, and when we eventually came back, all our land was completely clean of everything. Even the weeds were dead.'

The experience of the 2008 flooding acted as a major impetus for many of the women from different locations around Trinidad to enlist in a scheme known as the camellones ('raised fields') project, which is run by the Kenneth Lee Foundation and financed by Oxfam. Women from Puerto Almacén, Loma Suárez and Copacabana interviewed in July 2009 were unanimous in saying that the project offered the possibility of avoiding a repetition of the loss of crops caused by the 2008 flooding and thereby achieving greater food security in the future, particularly for their children.

The essential logic of the camellones project is that by building raised earth platforms of up to two metres high and surrounding each of them with canals, you can protect seeds and crops from being washed away as they are above the level of the flooding. You can also use the water surrounding them as a source of irrigation and nutrients during the dry season.

As Oscar Saavedra, director of the Kenneth Lee Foundation, expresses it, 'it's a harmonious relationship between the soil and the climate, and creates more of a balance between the rainy and dry seasons. The logic of managing the water is different. We cultivate the water.' Or as one of the villagers of Copacabana described it, 'the flooding is no longer a curse, but a blessing'. In short, from being victims of the floods, low-income women and men are becoming masters of turning the excess water to their advantage.

One of the many extraordinary aspects of the camellones project is that poor communities living in Beni today are using a similar technology to that developed by indigenous pre-Columbian civilisations centuries ago in the same region to solve a similar range of problems (see box 5.1) Agricultural production in Beni – then and now - is severely constrained by the annual cycle of floods and droughts. The land was always considered more suitable to slash-and-burn agriculture as the poor-quality soil is often exhausted after two to three years. In contrast, the complex system of water management used in the camellones can provide more nutrients to the soil.

Another attractive dimension to the camellones project is that it offers the possibility of adapting to climate change. If as predicted by many experts, the cycles of El Niño/La Niña are going to increase in intensity and frequency, then the project has the capacity to help poor families cope better with the extreme weather events that are to come.

The first experimental modern camellones were built in 2007. As of July 2009, there were 64 completed camellones in five different communities, all near Trinidad. According to the Kenneth Lee Foundation, 45 'champions' had been chosen to promote the scheme; 280 families were strongly committed to the project, whilst 400 were beneficiaries. The aim is to expand it to 1,000 families. Each camellón measures about 500 square metres, and the heights can vary to between 50 centimetres and

two metres depending on the estimate of the height of the flooding in a particular area and its capacity for water run-off.

In the five different areas, there are different experiences of working them. In Copacabana, the whole community of 34 families run six camellones collectively. In contrast, in Loma Suárez, where 30 families each have a camellon, they are run on an individual family basis. In Puerto Almacén, five families have a camellon each but the women and their children all help each other too.

Women are the main participants in the scheme, and usually have the leadership roles. This is partly because the men often have to work away from their communities, for example working as fishermen, sand collectors from the river banks (*areneros*), wood collectors or day workers on cattle ranches. The women's commitment is largely a reflection of their being primarily responsible for providing food for the family.

The essential characteristics and advantages of the camellones project are the following:

- The main idea of constructing the raised earth platforms is taken from the ancient cultures that inhabited the region centuries ago. However, the current-day camellones draw on modern scientific understanding of agro-hydrology. Whereas the ancient camellones were built by hand, the new ones have been constructed with tractors and earth-moving equipment.
- The camellones offer a sustainable solution to flooding and drought by managing the flood waters and preserving the water for times of drought. In addition, they are a good insurance against the unpredictability of the rains in the future. It should not matter when the rains come as the water can still be managed at whatever time of the year.
- The system should provide improved food security and diet as a result of better and more frequent yields. The more fertile soil



Camellones in Beni. Photos: Mark Chilvers / Oxfam

means that in some cases, the camellones are already producing three crops a year, and in others two. The Kenneth Lee Foundation says the yields (for example of cassava and maize) are one of the highest naturally produced anywhere in the world. The canals can also be used for fish farming to improve nutrition.

- The system uses natural fertilizers, and in particular an aquatic plant in the canals called *tarope* which both purifies the water and acts as a fertilizer when spread over the soil (see box 5.2). The canals can also provide fish stock, animal fodder and nutrients for the soil.
- The camellones can provide a natural seed bank which can survive the flooding. This is crucial as the farmers need to be able

to plant within as little as 15 days of the floodwaters receding to take advantage of the natural fertility of the soil at the right time. It also means they do not have to buy more seeds to replant their crops if they have been lost at the time of the floods.

- The camellones system, with its better soil quality, can reduce the need to cut down the forested areas around the communities. By contrast, in the individual plots belonging to families (*chaco*), the soil is exhausted after two to three years of growing maize and rice (cassava can be grown for much longer), which forces the farmers to clear more land by cutting down the forest to plant the newly-cleared new areas.

In the case of Copacabana, the communal experience of the camellones project helped to bring the community together after the

Camellones in Beni. Photo: Mark Chilvers / Oxfam



shattering experience of the 2008 flooding. Families from the same village got to know each other for the first time. The president of the project in Copacabana, Guido Gil Fernández said, 'We have all worked as a community on the project, including women and old people. It has helped to unite the community. People see the benefits, so they join up and start working.'

The project may sound almost too good to be true, but the initial signs are positive. The experimental camellones built in 2007 survived the 2008 flooding reasonably well (see photo). In 2009, there was little serious flooding so the system did not undergo a severe test. The engineers working with the project know that one of the real challenges to the system will come when severe flooding and/or drought takes place.

There are other huge challenges for the future. One is that farmers diversify their production into growing produce like tomatoes, cucumbers and lettuces (80 per cent of which are currently imported from outside Beni), which can provide good nutrition and an income from local sale. Another is to prove

that the seed banks can survive serious flooding. And yet another is to overcome initial scepticism from some local people about the time and physical effort needed to make the camellones work in comparison with other sources of employment.

The mayor of Trinidad, General Moisés Shiriqui, is sufficiently convinced by the efficacy of the camellones to incorporate them into local plans for coping with the extremes of weather in the future. 'We have been told that there will be more intense flooding and drought', he says. 'The camellones form part of our solution for helping campesinos living near river banks to have a source of food during the flooding season, a place to plant crops and an area to keep a seed bank.'

Oscar Saavedra for his part has a larger vision. 'We are enjoying success in a humid subtropical region in the Amazon where previous projects have failed. This process could be repeated in various parts of the world with similar characteristics like Bangladesh, India and China. It could help to reduce world hunger and combat climate change.'

Box 5.1 The 'hydraulic cultures' of the Bolivian Amazon

The pre-Columbian 'hydraulic cultures' spread out across a large area of the northern and central parts of South America. In the Bolivian Amazon they were active for two and half millennia between 1000 B.C. and 1400 A.D. approximately. They were responsible for managing a complex system of water and earth engineering. They built around 20,000 artificial man-made *lomas* (artificial hills) throughout Beni, some of which reached a height of 20 meters around a base of 30 hectares. In addition, they constructed 5,000 kilometres of dykes and one million hectares of *camellones* (raised earth platforms). It is thought that these civil works could have supported a population of between three million and ten million in Beni.

There were four different types of *camellones*, all built with manual labour, depending on the profile of the land and its vulnerability to flooding. During the rainy season, large expanses of land are under water for several months except for raised areas. When the water recedes

into the tributaries that run into the Amazon, it takes nutrients with it leaving a sandy brown soil where it is difficult to grow crops.

The brilliance of the *camellones* system was that it allowed the pre-Columbian cultures to harness the floods to bring fertility to the soil and to keep it humid during the dry season. According to Oscar Saavedra, the author of a study called 'hydraulic cultures of Beni', the floods were 'the basis for development and the flourishing of a great civilisation'.

The basic system of *camellones* was also used in different parts of Latin America, and in different types of ecology including the altiplano and coastal areas. They can be found in Peru, parts of the Pantanal in Brazil, Venezuela, Colombia, Ecuador, Surinam, the Guyanas and Argentina (see map).

Source: Oscar Saavedra, *Culturas hidráulicas de la Amazonia boliviana*, Oxfam 2009.



Box 5.2 'Working the camellones'

Maira Salas, 50-years-old, Copacabana, Beni.

'I am very proud to be from Moxos. We are learning from our culture from many years ago. We are only just now learning how our ancestors lived and survived. Before they lived from fishing, they didn't have cattle. They were so brave and strong to build their *lomas* (artificial hills). They did not have tractors to build them, and they lived for years with their *lomas*. It's incredible.

These *camellones* will now help us when the floods come. The crops like bananas that die easily will survive better. We can now plant fruits like lemons and oranges. I'd like to have a raised area in my *chaco* (plot of land) too. My husband works as a carpenter. We need both his income and the *chaco* to survive.'

Delvy Sánchez, 42-years-old, and Corina Yberne, 53-years-old, Loma Suárez

'We started planting in November last year. We are onto our second harvest. The first harvest of maize was pretty good. I got 980 maize cobs from half of my *camellon*. Our *chacos* are bigger than a *camellon*, sometimes more than a hectare. The *camellones* are not that big. But the great advantage is that the *camellones* will give you a crop during the time when the water is high. The canals should help the *camellones* not to dry out. We are still in the experimental phase, we don't know if they will dry out. During the rainy season, three of the *camellones* were too low and the waters came up to the top and they couldn't harvest the cassava.

The fish pond is working well. We are not eating the fish yet as we want them to grow bigger. Another advantage is that we have a

more secure place to grow seeds. We want to grow tomatoes, cucumbers, lettuce and cabbage to sell.

The men have to go out and earn an income. But we women are strong too, and don't want to get left behind the men. Of the 30 people working the *camellones* here, only six are men and the rest are women. We enjoy working in a group, and swapping experiences of what to grow.'

Oscar Peñaranda, 47-years-old, Copacabana.

'*Tarope* is an aquatic plant that grows in rivers and lagoons. It purifies the water so more fish can live in the water. We have seen that the *tarope* we collected from the river acts as a great fertiliser for the crops. When you spread it on the soil, it preserves the humidity of the earth and gives it more nutrients. This soil is really hard without the *tarope*. I did an experiment with cucumbers. Those without *tarope* were very small, and those where I put the *tarope* are growing well. *Tarope* is a fabulous plant for fertiliser. We have now planted 500 *tarope* plants in the canals.'

Erminia Guaji, 57-years-old, president of the camellones project, Loma Suárez.

'I am really happy. Now I have a place to work and a place to grow seeds where previously I had none. The water took away everything from my plot (*chaco*) in 2008, but now I am growing maize, cassava, tomatoes, peppers, bananas and papaya on my *camellon*. I cannot read or write but I do know how to work the land. I grew up helping my Dad on our plot of land. But this is much better than having just the *chaco*.'



The Platform of Social Organisations against Climate Change



'It could be that on individual issues we don't agree. But above and beyond the differences we may have, in general, I am sure that where we do agree is that the Earth is under risk, Pachamama is ill.'

Cristian Domínguez, peasant leader, CSUTCB

Bolivia is quite unusual among developing countries in having a well-organised alliance of social movements, national and international NGOs working together as a pressure group on climate change. Known as the Platform of Social Organisations against Climate Change, the coalition aims to be an interlocuter between citizens and the state, pressing for and helping formulate national climate change policies. It also seeks to give a voice on the international stage for poor and vulnerable Bolivians affected by climate change, as well as raise popular awareness.

Since its first meeting in December 2008, and its formal foundation in February 2009, the Platform has blossomed into a widely-supported initiative with more than 180 organisations involved. Its social movement members include Bolivia's main peasant federation, the CSUTCB, the women's peasant organisation, the CNMCIQB - BS, as well as other indigenous and social organisations such as CONAMAQ, CPESC, CIDOP and CSCIB. It also has representatives from urban areas,

such as home workers, and neighbourhood associations. Bolivian NGOs like CIPCA, Agua Sustentable and Fundación Solón are involved, as are international development agencies, Oxfam, Christian Aid and CAFOD.⁶⁶

The Platform has already become a powerful player in Bolivia on climate change and some of its members form part of official government delegations in international negotiations on climate change. The Platform's public positions centre on the pursuit of 'climate justice'. For instance, it argues that the harm caused by global warming should be repaid through recuperation programmes, potentially involving international compensation funds. The Platform has also been pushing for an International Tribunal on Climate Justice. Reflecting national politics, the Platform's public statements contain a critique of capitalism and multi-national corporations as a major cause of climate change, and emphasise the importance of indigenous culture and participation as a solution to the problem.

⁶⁶ For a full list of member organisations, see www.cambioclimatico.org.bo.



Members of the Climate Change Platform. Photo: Oxfam

In terms of national policy, the platform emphasises that Bolivia also has a responsibility to act on climate change and should put its own house in order. It has proposed a series of policies, which include⁶⁷:

- An immediate moratorium in forestry concessions and establishment of a legislative framework to regulate their sustainable exploitation and replacement.
- A new transport policy that protects the environment and minimises emissions.
- The rejection of large-scale infrastructure and other mega-projects (like dams and mining), due to their climate and social impacts.
- Measures to end excessive water use by industry, which limits human access.

- The introduction of early warning systems and risk management.
- Popular awareness on climate change, including via the education system.

Cristian Domínguez is one of the main spokespersons for the Platform. He is the Secretary of Natural Resources for the peasant organisation, CSUTCB and comes from the Amazonian department of Pando. He says he has been thinking of climate change for the last 20 years, and has been motivated in particular by the recent changes he has seen in the weather (see box 6.1). He blames capitalism for the way it has plundered Bolivia's natural resources. 'It has no feelings', he says. 'It turns us into selfish consumers. The search for gold contaminates us all. We need to get back to respecting nature and its resources.'

⁶⁷ The following points are loose, translated summaries of the 20 point Declaration of the Platform agreed in in March 2009. The declaration can be found at the Platform website under 'Documentos'.

Box 6.1

Cristian Domínguez,
secretary of natural resources, CSUTCB.

'I have been watching the weather closely since the 1980s. It's been changing but changing more quickly since the 1990s. For example, we used to sow our crops on 24 September before the rains come. Now we have to wait sometimes until November until the real rain comes. There's a two month de-



lay. We used to be able to harvest in January, but now we have to wait until March or April. The months are out of sync. And the weather is more extreme. In 2007 and 2008 we had unprecedented rains, and the dry periods seem a lot stronger. We are losing our variety of some crops too. We used to have 27 different types of banana seed where I am from (in Pando), but now we have only 5. It's the same with rice - we had about 50 types now we have 15. In some parts of the country, there are more plagues of insects due to the weather and even mosquitoes at high altitudes due to the warmer weather. Some farmers are able to grow different crops so it's not all bad. Climate change takes away some possibilities and it gives you others. Part of our culture has always been to manage climate risks. We don't call it 'adaptation' to climate change but 'evolution'. But it's becoming more difficult as the climate is becoming more extreme.'



Government perspectives on climate change and adaptation



'For us, what's been a disaster is the model of 'living better', of unlimited development, of industrialization without any boundaries, of modernity that undervalues history, of growing accumulation at the cost of other people and of Nature. That's why we are fighting for 'Living Well', in harmony with other human beings and with our Mother Earth.'

President Evo Morales, Open Letter: Salvemos al Planeta del Capitalismo, November 2008

For several years Bolivia's National Climate Change Programme (PNCC) has published a series of detailed studies on a wide variety of topics about climate change including impacts and adaptation.⁶⁸ However, the political profile of climate change received a major fillip when in February 2009 the PNCC came under the aegis of the Ministry for the Environment and Water, which had its remit extended to take responsibility for climate change (see box 7.1).

The government of President Evo Morales has enjoyed an increasingly high public profile on global warming at the UN and other international meetings. In these fora it has sought to strengthen the voice of vulnerable countries, indigenous groups and social movements, and to re-frame the debate in terms of climate justice. Key elements of the government's position⁶⁹ include that:

- Developed countries owe a 'climate debt' to developing countries. This includes, first, a 'mitigation debt', whereby developed countries need to compensate for their excessive emissions, which have used up three-quarters of the atmospheric space available and thereby constrained developing countries' opportunities for development. Second, developed countries owe an 'adaptation debt' as a result of the costly effects of climate change on Bolivia and other developing countries, who are least responsible for the problem but most impacted.
- Developed countries should pay this debt through very steep emissions cuts and the transfer of resources and technology, enabling developing countries to adapt to climate impacts and fulfil their right to develop, but without high emissions levels.

⁶⁸ See website, <http://www.pncc.gov.bo>, for full details.

⁶⁹ See following position papers for full details: a) "Carto de Evo: Salvemos al Planeta del Capitalismo", November 2008 b) *Submission by the Republic of Bolivia to the Ad Hoc Working Group on Long-term Cooperative Action under the UNFCCC*, April 2009 c) *Communication from the Plurinational State of Bolivia to the UNFCCC proposing an amendment to the Kyoto Protocol*, June 2009 d) President Evo Morales Speech to the UN General Assembly, 23rd September 2009.

- Developed countries should cut emissions by 49 per cent on 1990 levels between 2013 and 2017. The size of these cuts are calculated on the basis of developed countries' historic and current emissions, and share of global emissions needed by developing countries to meet their priorities for economic and social development, and poverty eradication.
- Developed countries should provide financing to the value of least 1 per cent of the developed countries' GDP. Funds should come under the auspices of the UN and be drawn from taxes on hydrocarbons, financial transactions, air and sea transport, and the profits of multinational companies.
- As climate change constitutes an extra burden on the development paths of poor countries, funds should be additional to official development aid.
- An international court for climate justice should be established, which holds to account countries that fail to meet their commitments and evaluates the environmental damage caused by heavy-polluting countries and companies.
- Biofuels are not an alternative as they prioritise producing crops for transport above producing crops to feed human beings.
- Climate change adaptation and mitigation technologies should be publicly owned, and not under patent, in order to ensure access for developing countries. The flexible intellectual property rights regime established for public health emergencies should be applied to climate change.
- Programmes to Reduce Deforestation and Degradation of Forests (REDD) should be based on a direct compensation mechanism from developed to developing countries



Khapi community, La Paz Bolivia. Photo: Mark Chilvers / Oxfam

that guarantees the full participation of local communities and indigenous peoples.

One of Bolivian government's particular contributions to the debate on how to address climate change has been the concept of 'living well' (Vivir Bien) or 'Suma Qamaña' in Aymara. Broadly speaking, the concept challenges what it calls the egotistical, individualistic and constantly accumulating nature of capitalism and instead promotes the idea of a communitarian socialism that lives in harmony with Mother Earth (the Pachamama).⁷⁰ It's called 'living well' and not 'living better' as the aim is not to progress at the cost of other people, but to complement each other and not compete. It is to think not just in terms of income per capita, but also of cultural identity, community, and harmony between ourselves and Mother Earth. The government has sought to promote this vision internationally, most recently through its call on the UN General Assembly to introduce a new UN Declaration on the Rights of Mother Earth⁷¹.

The changes in government and the focus on implementing a new constitution is an opportunity to move forward in developing national legislation and public policies to address climate change adaptation and mitigation. However, the government is still in the early stages of developing national policy and practical adaptation programmes and seeking funds from international sources to be able to implement them. There is a long way to go.

Amongst the government's initial priorities have been studies on the future availability of water to El Alto and La Paz, strengthening meteorological observation posts, experimenting with different potato varieties, small-scale irrigation and hydroelectricity schemes, and reforestation programmes.⁷² But in the coming years, these will need to be scaled up enormously, technical capacity will need to be enhanced, and the ability to absorb funds and execute them effectively will need to be made a priority.

70 See Evo Morales Ayma, *Los 10 mandamientos para salvar el planeta, la humanidad y la vida*, Ministerio de Relaciones Exteriores, La Paz, 2008.

71 President Evo Morales Ayma Speech to the UN General Assembly, 23rd September 2009. <http://www.un.org/ga/64/generaldebate/BO.shtml>

72 See PNCC, *Vulnerabilidad y adaptación al cambio climático en Bolivia*, La Paz, 2007, and presentation by PNCC, 'Logros institucionales', Climate Change day, La Paz, March 2009.



Social Movement Summit, Cochabamba. Photo: Sarah Best / Oxfam

Box 7.1

Rene Orellana, Minister for the Environment and Water

Multiple impacts

Our problem is that Bolivia is going to suffer multiple impacts from climate change: in the Amazonian region major flooding and drought, in the altiplano less water due to glacial retreat; and in the Chaco we already have three or four droughts every five years.

Water needs

Currently the supply from the reservoirs is roughly sufficient to match the demand from El Alto and La Paz. But we are going to have to double the supply in the next 10-15 years. This we are already doing by carrying out feasibility studies for three new dams, and then we will invest the money in constructing them. This way we can capture more of the precipitation to compensate for the loss of water from glacial retreat. But we are also pursuing more immediate solutions like drilling more water holes and constructing a new water purification plant.

Climate justice

We think it is tremendously unjust that Bolivia, one of the countries most affected by climate change, should have to pay the cost of adaptation when it is the developed countries which have harmed our climate and planet. That's why we are making a double demand on developed countries: first that they should reduce their greenhouse gas emissions and secondly, that they should create a worldwide adaptation fund for developing countries.

On the USA

They have to give strong indicators of what they are going to do about cutting their emissions. They are not going to solve the problem of glo-



bal warming with lovely-sounding speeches. Some of our social organisations are thinking of initiating legal action against multinational companies for violating their right to water. States should identify companies who caused global warming and they should be made to reduce their GHG emissions and contribute to the adaptation fund as a form of indemnity.

On 'Living Well'

Bolivia's contribution to the climate change debate is to join the international campaign to recognise the rights of the planet and of the Mother Earth. The indigenous cultures include the principle of thanking the earth and nature. We look at mother earth not just as the source of food but also of happiness and spirituality. Bolivia is a country that looks a lot towards the countryside. One of the central tenets of 'Living Well' is to ensure production of food that is good for you and in sufficient quantities to avoid the sort of disruption caused by flooding and other disasters in the last two years.



Conclusions and Recommendations

Bolivia is currently going through a period of unprecedented opportunity for positive social change, overturning deep-seated patterns of inequality, discrimination and poverty. However, because of its vulnerability to the impacts of climate change, the possibilities of implementing lasting change for poor, indigenous women and men will be severely constrained. This is a high price for a situation for which Bolivia has virtually no historical responsibility.

Local communities have shown how they are responding to the challenges of the changing climate, some drawing on centuries-old traditions of managing risk. These efforts should be supported. However, many communities are ill-equipped. There needs to be a step change in the approach to mitigating and adapting to climate change – in terms of international and national policy, technical and financial support, institutional capacity, as well as awareness and action amongst social movements and the public at large. Recommendations on key areas for action are set out below.

Recommendations for the international community:

- As the international community takes forward vital negotiations to agree and implement a post-2012 climate regime it is

critical that Climate Justice - the historical responsibility of rich countries for climate change and their obligation to transfer finance and technology for adaptation and mitigation in developing countries - is at the heart of the solutions. This involves deep emissions cuts by rich countries, and a major transfer of resources to poor countries.

- Oxfam International is calling for a fair and safe deal in which:
 - Global emissions are cut by 80 per cent from 1990 levels by 2050.
 - Rich countries cut emissions by 40 per cent below 1990 levels by 2020.
 - Rich countries provide at least US\$150 billion per year to help developing countries adapt to climate impacts and develop in a low-carbon way. This includes the immediate provision of at least \$50 billion per year for adaptation, with rich countries' contributions increasing in line with the latest economic and scientific estimates⁷³.
 - An adaptation financing mechanism is established, which generates a predictable flow of new funds, additional to existing aid targets of 0.7% of Gross National Income (GNI).

⁷³ There are a number of estimates of the additional adaptation costs that climate change is imposing on developing countries. In 2007, Oxfam International estimated adaptation costs in developing countries as being at least \$50bn per year. A recent study from the World Bank put this figure higher, at \$75 - \$100 billion each year from 2010 to 2050. See World Bank, *The Economics of Adaptation to Climate Change*, September 2009.

- Until such a fund exists, ongoing adaptation and mitigation projects being carried out by countries like Bolivia should be recognized and supported by the donor community.
 - Bolivia's vision for a more sustainable development path, epitomised by the concepts of *Vivir Bien* (Living Well) and *Pachamama* (Mother Earth), presents an important challenge to the resource-intensive, exploitative economic models, which have caused the climate crisis. As the international community seeks to shift to a low-carbon economic model, countries should engage seriously with, and learn from, Bolivia's experience and proposals for alternative development approaches.
 - Recent proposals from the Bolivian government for an International Tribunal on Climate Justice – targeted at polluting countries and companies – highlight the need for effective global governance and accountability mechanisms, which hold polluters to account and protect or compensate vulnerable countries. Social movements in Bolivia believe these types of ideas should be considered in international fora debating climate change.
- climate change policy at the highest level.
 - Secondly, the government should further develop and implement a national adaptation strategy, which is properly mainstreamed across the government's programmes for eradicating poverty, and adopted by and co-ordinated across all the key ministries. Such plans should also identify the most urgent adaptation activities and the cost of these, and secure international financing for their implementation
- Disaster Risk Reduction needs to be part of long-term planning at all levels of government, across all ministries, and particularly at the departmental and municipal level. Disaster preparedness has to be stepped up. For example, the civil defence vice ministry, VIDEICODI, needs more trained specialist staff, adequate equipment and additional financial resources.
 - Given the increased climatic risk and severe vulnerability of small agricultural producers, the development of an agricultural insurance scheme should be a priority. It should cover key food security crops such as quinoa, potatoes, soybeans, corn and rice and insure against different climatic extremes like drought, flooding, severe frost. The government should request funding for this from the international community.
 - Water storage and management should be made a major priority, particularly in urban areas where increased demand is generating water shortage problems. Given the high rate of water loss through poor infrastructure – which in cities like El Alto leads to loss rates of up to 40 per cent - the government should give as much focus to water conservation measures, as to building new infrastructure like dams for water storage. At the community level, existing rainfall must be captured, stored and used to the maximum capacity. Soil and water conservation measures at the headwaters

Recommendations for the Bolivian government:

- The Bolivian government has made an important and serious start in understanding and responding to climate change effects. However, Bolivia still needs to develop and implement effective policies, institutions and practices to adapt to the reality of severe climate risks.
- An overarching institutional and public policy framework for national policy on climate change adaptation and mitigation needs to be developed through a twin strategy:
 - Firstly, by integrating climate change measures into the new legislative framework which will implement Bolivia's new Constitution and thereby embed

of river basins are crucial. Reforestation can play a major role in improving water capture.

- Poor women are both particularly vulnerable to climate shocks, and – through their central role in the household economy - play a critical role in protecting families and communities from climate risks. As such, the government must ensure that, with its important emphasis on indigenous emancipation, it does not lose sight of the need for women to be at the center of national and international policies for adaptation and the reduction of poor families' vulnerabilities to disasters.
- The government needs to promote better access to the information from the early warning and climate observation systems that identify anomalous weather situations like drought, rainfall and flooding, in order for producers to plan or take preventive action.

Recommendations for Bolivian social movements and civil society

- It is Oxfam International's experience in more than 100 countries around the world that a combination of active citizens and effective states is the best way of securing development and poverty reduction. It is also the best way of preparing for climate

change. Civil society and social movement initiatives like the Bolivian Platform of Social Organisations against Climate Change should be further supported and strengthened.

- The Bolivian Platform of Social Organisations against Climate Change has made great progress in understanding and addressing climate change issues and in influencing the Bolivian government position. This platform should develop concrete proposals on the content and direction of national adaptation and mitigation policy. While close to government, social movements need to ensure they maintain their autonomy and independence from government in order to place new issues and perspectives on the climate agenda, and hold government accountable.
- Active citizenship is as much about collectively pressuring for change as it is about the choices and actions of individuals. There needs to be a concerted campaign, supported by both government and civil society movements, to broaden awareness beyond the sphere of experts and leaders of social movements to the public at large and to encourage changes in individual behaviour – such as sustainable energy and transport use, water conservation and household recycling.



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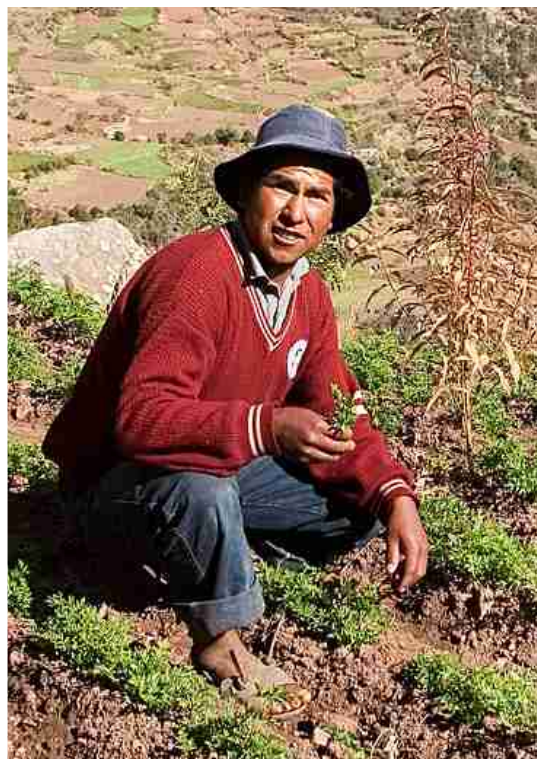
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