

Impact of Climate Change on the Poor in Bolivia

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Abstract

Bolivia is one of the poorest countries in South America and as a result is particularly vulnerable to climate change, which poses a threat to both the urban and rural poor. The changing weather patterns and rapid melting of glaciers in the Andes can cause both drought and flooding. That in turn will have an adverse impact on agriculture and the livelihoods of the poor. The economically vulnerable will suffer the most because of their limited ability to adapt. This article will examine the impacts of climate change in detail and will explore some of the options currently available to mitigate those impacts.

I. Introduction

In the heart of South America sits Bolivia, nestled between the soaring peaks of the Andes (on its west) and the Amazonian jungle (on its east). Given this location, Bolivia has a diverse geography with varied climates. It is the people in these diversities that are facing the specter of climate change in ways that not many would expect. In contradistinction with the trend of rising temperatures in the rest of the world, Bolivia's overall temperatures have dropped, especially in the highlands. Bolivia's changing climate is also characterized by unexpected impacts mainly on reduced cloud cover and precipitation in the highlands.

It is the effect of climate change on people, specifically Bolivia's poor and indigent, which is of capital concern. Any sudden change in the quantity of a given resource has an economic cost. Infrastructure must be rearranged to accommodate changes. The economic cost is undeniable. That the poor are inordinately affected by increasing scarcity cannot be denied either. Indeed, climate change in Bolivia has led to glacial melt, droughts, floods, forest fires, erosion, and many other ills that have plagued the poorest people the most. It has damaged Bolivia's economy and created many problems for the poor in both rural and urban areas.

This article examines the effects of climate change on Bolivia's poor. Following this introduction, the next section will provide an overview of the literature specific to climate change and its economic impact in Bolivia. Section III will provide some empirical background on Bolivia's economy, carbon dioxide emissions, geology and climate. Section IV will then discuss in more

details how climate change affects poverty in Bolivia. The final section offers a summary of the issues Bolivia faces and some options to mitigate problems in the future.

II. Literature Review

Given the severity of the climate change implications on Bolivia's poor, there has been a growing literature in the last few years.

- The most in depth research specifically on the impact of climate change on Bolivia's poor has been provided in a 2009 *World Bank Policy Research Working Paper* written by Lykke Andersen (who is working at the Institute for Advanced Development Studies in La Paz, Bolivia) and Dorte Verner (who is working at the World Bank in Washington, DC). Their paper, entitled "Social Impacts of Climate Change in Bolivia: A Municipal Level Analysis of the Effects of Recent Climate Change on Life Expectancy, Consumption, Poverty and Inequality" is an invaluable asset.
- A second main source is a paper by Greg O'Hare and Sara Rivas (2007), which clarifies the distinction between climate change in urban and rural areas and explains how these differences will affect the poor.
- Another major source is a report by Oxfam International (2009), which explains specific aspects of climate change on the environment and the people within those environments.
- There also are various other reports that touch on the subject but in a less comprehensive way. Elisabeth Rosenthal's (2009) news article in the *New York Times* and Bill Weinberg's (2010) review article offer insights into the specific though important topic of water supply and glacial melt in Bolivia. Both were written to look not only at the loss of glaciers from an environmental perspective but also at the effect on people affected.
- Finally, the Inter-American Development Bank's (2011) country strategy for 2011-2015 provides helpful background on Bolivia's current economic situation and also contains a section specifically on the situation of Bolivia's climate.

There are few disagreements among researchers on the impact climate change has had and will have in Bolivia. The consensus is that temperatures overall in Bolivia have fallen and this is due mostly to falling temperatures in higher altitude regions that offset increases in temperatures seen in lower regions. There is also no dissent that the impact of climate change on the poor is negative.

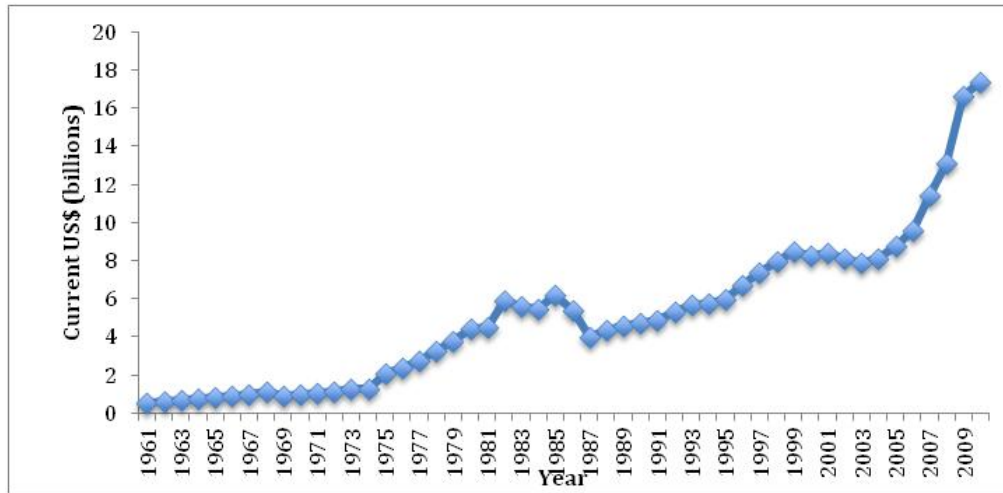
III. Empirical Background

III.1. Bolivia's Economy

Bolivia is one of the poorest countries in Latin America and the poorest in South America. Its gross domestic product (GDP) in 2009 was \$17 billion and its GDP per capita was \$1,758. Income has increased dramatically over the past 50 years in both the national level as well as per capita (see Figure 1 and Figure 2). However, taking inflation and differences in purchasing power parity (PPP) into account, Bolivia's GDP per capita increased far less, from \$3,604 in 1980 to only \$4,013 in 2009. Furthermore, in 2007, roughly a quarter of the population (24.7 percent) lived under PPP-\$2 a day and 14 percent lived below PPP-\$1.25 (which is the latest available data for Bolivia's poverty headcounts). In 2010, Bolivia's population was with 9.86 million just shy of ten million, of which 59 percent were between the ages of 15 and 65.¹

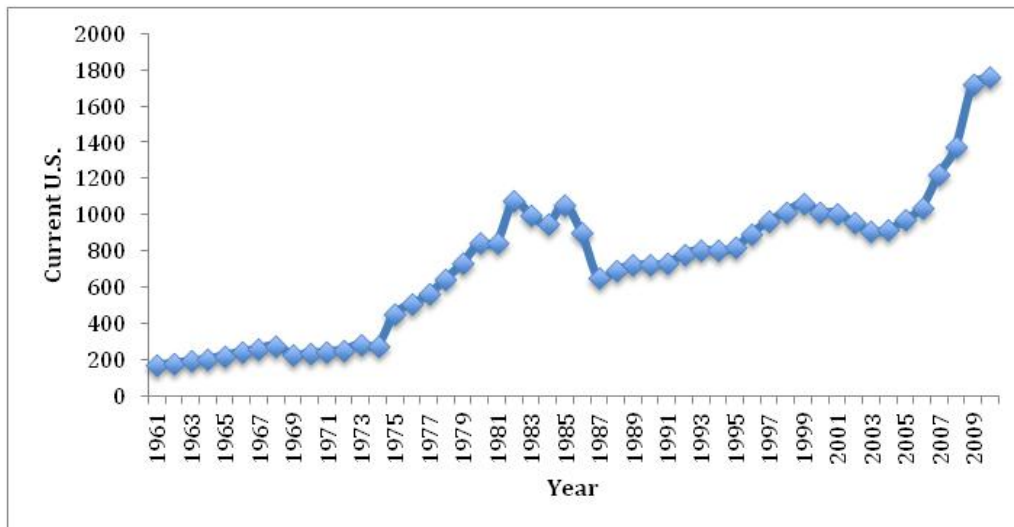
¹ World Bank (2011).

Figure 1: GDP in current U.S. dollar, 1961-2009



Source: Created by author based on World Bank (2011) *World Development Indicators* (as posted on the World Bank website; downloaded on June 7, 2011).

Figure 2: GDP per capita in current U.S. dollar, 1961-2009



Source: Created by author based on World Bank (2011) *World Development Indicators* (as posted on the World Bank website; downloaded on June 7, 2011).

It is imperative to understand the distribution of the poor and the reasons for their poverty before attempting to understand the impacts of climate change. As of 2010, 34 percent of Bolivia's people live in rural communities (which is a drastic decrease compared to the 63 percent living in rural communities in 1960). Still, it remains to be true that poverty in Bolivia is most significant in rural areas. In rural areas, the poverty rate was 77 percent on average in 2007, meaning that roughly a quarter of Bolivia's people are rural poor. This fact is important because climate change affects the poor in different ways in rural areas and in cities. Urban areas comprise 66 percent of the

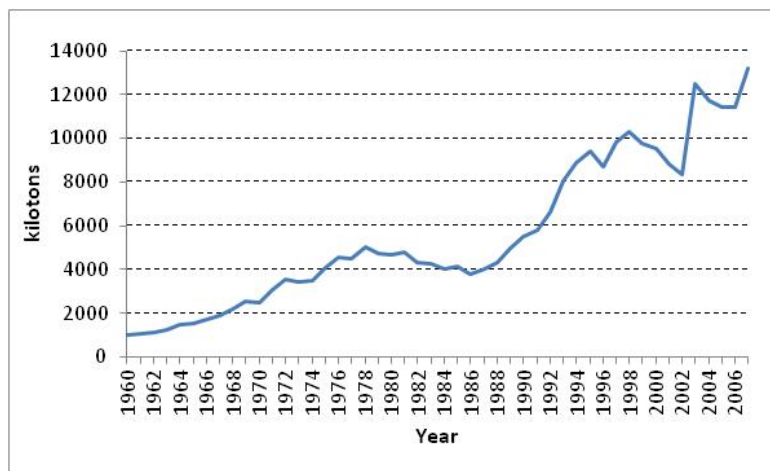
Bolivian population of which 50 percent are poor (in 2007), meaning that the urban poor amount to one third of Bolivia’s population and around 60 percent of the country lives in poverty.²

The rural areas are spread out among Bolivia’s different geographic regions. “Of the poor rural population, 31 percent live on the altiplano where the most intense poverty is found, 47 percent live in the high-Andean valleys (of the altiplano) and the remaining 22 percent live in the lowlands of eastern Bolivia and Chaco.”³ The “extreme poverty and destitution are quantitatively worse in the rural areas (1.8 million) than in the cities (1.6 million).”⁴

III.2. Bolivia’s Carbon Dioxide Emissions

Bolivia is not a large contributor of global emissions and therefore climate change. “In 2004 Bolivia was responsible for just 0.04 per cent of world emissions of greenhouse gases.”⁵ However, the amount of emissions does increase when changes in land use such as deforestation are added in. “If these emissions are included, in 2000 Bolivia was responsible for 0.35 per cent of world GHG emissions... 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.”⁶

Figure 3: CO₂ Emissions, 1961-2007 (in thousands of tons)



Source: Created by author based on World Bank (2011) *World Development Indicators* (as posted on the World Bank website; downloaded on June 7, 2011).

Furthermore, Bolivia’s carbon dioxide emissions have grown over time, largely following the global trend and reflecting fluctuations in Bolivia’s GDP (see Figure 3). Bolivia is inordinately impacted by climate change despite not being a large contributor to it. Unfortunately Bolivia will have to suffer the consequences for a mistake that others have made. But just what those consequences will be remains to be seen.

² World Bank (2011).

³ O’Hare and Rivas (2007), p. 314.

⁴ O’Hare and Rivas (2007), p. 323.

⁵ Oxfam International (2009), p. 12.

⁶ Oxfam International (2009), p. 12.

III.3. Bolivia's Geology and Climate

To understand the impact of climate change on Bolivia it is first necessary to understand Bolivia's geology and current climate. "Although Bolivia is located entirely within the tropics, the large altitude variations within the country imply that it has almost every conceivable type of climate ranging from Andean glaciers, via salt deserts, to steaming rainforest."⁷ O'Hare and Rivas (2007) suggest that the country can be divided into three distinct regions by altitude: "(1) the Andes (4,000–6,000 m) with their cold elevated mountains, valleys and interior plains, e.g. the altiplano at 3,000–4,000 m; (2) the extensive eastern lowlands lying below 1,000 m and covered in lowland moist tropical forest, although large tracts have been cleared especially in the west; (3) the smaller central valley (1,000–3,000 m) between the Andean highlands and the eastern tropical lowlands with a cooler and less humid climate."⁸

These differences are important to note because as will be explained in more details in section IV, the effects of climate change on poverty changes drastically depending on the conditions in each region. In this article, only the first two larger areas mentioned by O'Hare and Rivas (2007) will be observed because the central valley is a grey area when it comes to judging climate change impacts. Bolivia's heterogeneous geology impacts its climate heavily. As O'Hare and Rivas (2007) note the temperatures differ heavily depending on the altitude.

Climate change will have very disparate effects on different regions of the country. "The patterns of warming/cooling show a distinct geographical distribution, with the highland stations in the southwestern part of Bolivia showing consistent cooling, and the lowland areas to the north and east showing slight warming (...). This is consistent with data from neighboring countries, which show cooling in many parts of Peru and Chile but warming in Brazil."⁹

Oddly enough climate change overall has not led to an increase in temperatures in Bolivia. The temperature in the lowlands has increased to a degree but this is offset by a decrease in temperatures in the highlands.¹⁰ This however does not mean that climate change hasn't had a negative impact. Glaciers for example have still been melting rapidly which has a cost that will be explained later. Andersen and Verner (2009) note the reasons for the seeming inconsistency of glacial melting despite cooler temperatures:

"First of all, the glaciers have been melting continuously since the Little Ice Age (about 1550 to 1850), with only a brief slowdown during the relatively cool period of 1950-1980, and it is normal for melting to accelerate towards the end (just like a small ice cube melts faster than a big ice cube)... The reduction in precipitation is likely associated with the general reduction in cloud cover over the tropics since measurements began in the early 1980s, and less clouds means more intense solar irradiation, which accelerates glacial melt. Decreased cloud cover at this altitude also works to amplify the diurnal temperature range, increasing daytime temperatures (which would cause increased melting), but reducing night-time temperatures even more (because of the missing cloud-blanket), which explains the reduction in average temperatures."¹¹

⁷ Andersen and Verner (2009), p. 2.

⁸ O'Hare and Rivas (2007), pp. 310-311.

⁹ Andersen and Verner (2009), p. 10.

¹⁰ Andersen and Verner (2009), p. 11.

¹¹ Andersen and Verner (2009), p. 11.

Glacial melt arises from a far more rapid decline toward the end of a glaciers time and is compounded by decreased cloud cover caused by climate change.

The change in Bolivia's climate can be summarized as a decrease in overall temperatures in Bolivia due to lower temperatures in the Andes and an increase in temperatures in the lower areas. Glacial melt in the Andes is still occurring rapidly despite overall higher temperatures and this is due to reduced cloud cover as a result of climate change.

IV. Discussion

Climate change will impact the poor in various ways because of the demographic distribution across different geographic regions. Andersen and Verner (2009) suggest that as a general rule in each region “warm and wet is good, while cold and dry is bad for human development.”¹² It is difficult to enumerate every different way that climate change will affect the poor. Categorizing them is therefore also a difficult task but the main points highlighted by researchers will be discussed herein.

IV.1. Increase in Natural Disasters

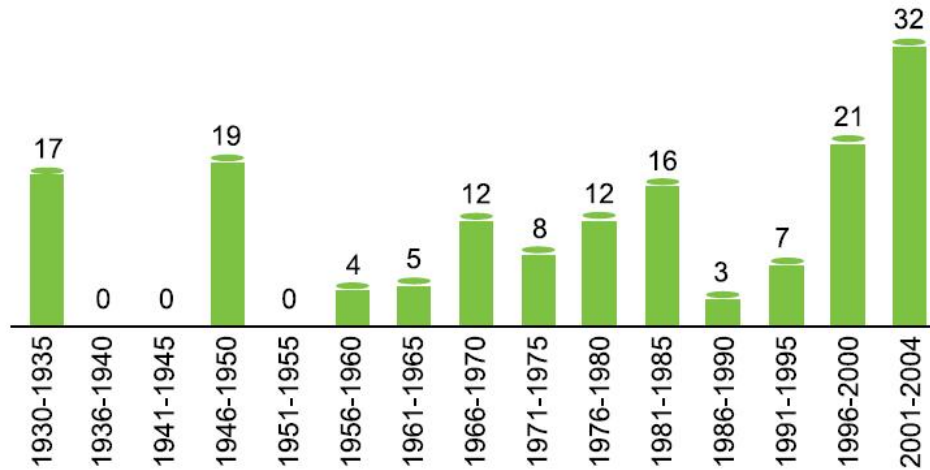
Climate change has increased the amount of natural disasters Bolivia has seen. Natural disasters inordinately impact the poor because they have less ability to react to them and tend to live in more hostile environments than the wealthy do. The charity Oxfam points out that “Bolivia experiences a wide variety of ‘natural’ disasters. These include drought in Chaco, flooding in the Amazon and ferocious hailstorms in the highlands. In 2007 — for the first time — Bolivia was among the top ten countries most affected by disasters. In 2007 and 2008 it faced the worst emergencies of the past 25 years.” Oxfam International (2009, p. 20) points out several revealing statistics on the subject:

- The period from 2001 to 2004 saw the highest number of emergencies declared in the last 70 years (see Figure 4).
- In the period from 1997-2007, flooding was the most common extreme weather event, followed by landslides, epidemics and droughts. Around 420,000 Bolivians were affected by flooding over this ten-year period.
- The three years of 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, the equivalent of approximately 6 per cent of the country's population.
- In 2006/7, the total cost (direct and indirect) was estimated at US\$443 million, and in 2007/8 at US\$547 million — the equivalent of 3 to 4 percent of Bolivia's annual GDP, a huge sum of money for a poor country.

It goes without saying that natural disasters cause deaths and injuries and that poorer areas are affected more. As Oxfam International (2009, p. 17) has pointed out: “Those living in rural areas are very likely to be the ones even more exposed to the more frequent and more extreme weather events.”

¹² Andersen and Verner (2009), p. 6.

Figure 4: Emergency Situations Declared by the Bolivian Government, 1930-2004



Source: Oxfam International (2009), Box 2-1, p. 20.

IV.2. Impact of Climate Change on Forests

When coupled with deforestation, climate change can have a harsh impact on the environment. The two in conjunction can cause rapid degradation of land through increased erosion. This is particularly true for Bolivia in the Amazon. As stated by Oxfam International (2009, p. 10), since 1990, deforestation has been increasing to currently about 300,000 hectares per year and in addition to adding to greenhouse gas emissions, this “also increases the devastation caused by flooding as natural forms of protection have been removed.”

The impact of deforestation on the poor coupled with climate change is not very clear. It is important to note that most of the land that has been deforested has been used for agricultural production, mainly of soya or for grazing, but whether or not the adverse effects of flooding and erosion outweigh the benefits of larger areas of agricultural production remain to be seen.

Climate change also has been considered the cause of an increase in the amount of forest fires. In 2005, 500,000 hectares of forest burned down because of uncontrolled fires during a time of drought. “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.”¹³ This was during one of the worst drought the Amazon has ever seen caused by higher sea surface temperatures in the North Atlantic. Furthermore, “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”.¹⁴

When climate change is coupled with deforestation and changing natural habitats the result is environmental degradation such as erosion and forest fires. These both adversely affect the poor. Moreover, it is important to note that both conditions release carbon dioxide into the air resulting in a vicious cycle where climate change causes environmental degradation which in turn causes

¹³ Paz Rada (2008), p. 546, as referred to in Oxfam International (2009), p. 32.

¹⁴ Oxfam International (2009), p. 32.

more climate change. For the poor of Bolivia it is necessary to break this cycle through more regulation and protection of the environment.

IV.3. Damage to Agriculture

In 2008, Bolivia's agricultural land comprised 34 percent of the whole country.¹⁵ Rural areas can be extremely susceptible to climate change because unexpected extremes cause a lack of security. "Bolivians do considerably better in hot areas than in cold areas, even when controlling for other factors such as education attainment and urbanization levels. Inhabitants in the hottest regions are able to consume almost twice as much as inhabitants in the coldest regions."¹⁶ On the face of it then one would think that warmer temperatures would be good for the country. The problem is that changes especially rapid changes come with a cost.

In warmer areas that cost has been an increase in various new ills that damage agriculture, which as noted before is what many of the poor rely on. "In the last few years, Bolivian lives have also been buffeted by an almost biblical array of extreme weather events, many of which scientists believe are probably linked to climate change. This year brought scorching temperatures and intense sun. A drought killed 7,000 farm animals and sickened nearly 100,000."¹⁷ In addition, "[s]evere storms normally associated with El Nino periods, every seventh year, now occur regularly. Warmer temperatures mean new crop pests -- crickets and worms -- as well as diseases like malaria and dengue fever."¹⁸

In regions that are now colder the adverse change has been more extreme weather that will be the main economic cost of climate change. "The colder winters in the already cold highlands could potentially have an adverse effect on the predominantly poor and indigenous population who inhabit the Bolivian highlands, since one of their main worries and limitations on agricultural productivity is frost"¹⁹ The colder winters in the Andes will indubitably adversely affect the poor.

IV.4. Glacial Melt and Water Supply

Another problem of climate change is the impact it has on water supply. This impacts urban areas more than rural areas because demand is increasing due to a high birthrate and immigration from rural areas to cities meaning all while supply is decreasing. Weinberg (2010) notes that the country will likely soon face dire water shortages. He reports that:

- in 2009, the 18,000-year-old Chacaltaya glacier overlooking La Paz (Bolivia's capital) vanished, threatening water supplies to the Bolivian capital;
- in the same year, water levels in Lake Titicaca (which some 2.6 million people depend upon) dropped 2.6 feet, reaching its lowest level since 1949; and
- in recent years, the rainy season in the Altiplano (which is the arid tableland near La Paz) has contracted from six to three months in recent years, prompting water rationing in some Altiplano towns and cities.

¹⁵ World Bank (2011).

¹⁶ Andersen and Verner (2009), p. 8

¹⁷ Rosenthal (2009).

¹⁸ Rosenthal (2009).

¹⁹ Andersen and Verner (2009), p. 12.

The rapid decline in glaciers is attributed to climate change by most scientists meaning that climate change has caused yet another burden on the poor of Bolivia.²⁰ Both rural and urban areas will be affected. “Irrigation schemes are used in only 10 per cent of Bolivia’s cultivated land (...). The remaining 90 per cent depends on a regular supply from precipitation, underground aquifers and glaciers.”²¹ That is to say that the vast majority of rural farms depend on supplies of water that will be reduced as a result of climate change.

Urban areas also suffer because demand for water is higher where populations are more concentrated. In addition, as pointed out in the Inter-American Development Bank (IDB) (2011) report, the burgeoning urbanization process will mean greater demand for water in the country’s urban areas. It is estimated that by 2050, the demand for water for irrigation and industrial purposes will increase by 150 percent and 250 percent, respectively.

IV.5. Damage to the Economy as a Whole

The increases in demand for water, coupled with the rapid degradation of the water supply, will certainly have economic consequences. Forty percent of Bolivia’s electricity comes from hydroelectric dams that run on water from glacial melt and precipitation.²² A lack of water in cities could disincentivize urbanization meaning that the rural poor would stay. The problem with this is that urban settings offer more opportunities such as education and more skilled labor. More people with more human capital are better for the economy as a whole so water shortages can have enormous consequences.

The method to gauge the cost of climate change on an economy is to see the direct impact it has on the economy as a whole. Economists agree that when the economy as a whole is well off, the poor are better off than if it is not. Andersen and Verner (2009) note “at the national level, the model estimates that climate change during the last 50 years has caused a reduction in consumption of about 1.3 percent.”²³ This suggests that climate change has a direct impact on GDP because it has reduced Bolivia’s purchasing power. That is to say that the Bolivian economy would be larger were it not for climate change. Clearly, the economy of the country as a whole has suffered from climate change

Andersen and Verner (2009) also point out that there is a “statistically significant positive relationship ($\rho = 0.28$) between initial level of consumption and the estimated effects of past climate change. This suggests that it is generally the poorest municipalities which have experienced the most negative effects of recent climate change, implying that recent climate change has contributed to an increase in both poverty and inequality.”²⁴

V. Conclusion

Bolivia faces many challenges in dealing with climate change and its many impacts. Mostly they involve adjusting to the inevitable changes from natural disasters to glacial melt, forest problems, agricultural degradation and overall damage to the economy that will occur. Bolivia’s GDP has been negatively affected, the poor have become poorer, and inequality has risen. The quality of

²⁰ Rosenthal (2009).

²¹ Oxfam International (2009), p. 23.

²² Oxfam International (2009), p. 24.

²³ Andersen and Verner (2009), p. 14.

²⁴ Andersen and Verner (2009), p. 15.

life of poor Bolivians has decreased and that decrease has been caused by something the poor themselves have a little part in and no control over: climate change.

Bolivia has also in recent times become an outspoken nation on the topic. Evo Morales, the current president, spearheaded a movement in the United Nations to proclaim April 22nd Mother Earth Day, saying “We are strangling the planet, strangling ourselves.”²⁵ He might be speaking from Bolivia’s experience as climate change there has become a stranglehold indeed.

Bolivia is left with the burden of attempting to seize control of a situation that it is the least complicit in. Bolivia has a duty to itself to overcome the problem of climate change but the rich countries that caused most of climate change have an even bigger duty to Bolivia. These countries should provide aid to Bolivia to relieve some of the ills they have caused. It is a travesty indeed that one of the world poorest countries has been left with a problem caused by the world’s richest ones. Climate change is rightfully seen as a tragedy of the commons however the impacts to all are unequal in this instance because Bolivia bears a greater burden. In this poor country the impoverished will be most affected.

The most obvious solution to the problem is to focus on environmental regulation and programs to reduce poverty. These are very obvious solutions but they are all the more germane given that the problems associated with climate change have been revealed. “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.”²⁶ What the future holds remains to be seen. But unless something changes soon, the future for Bolivia looks bleak indeed.

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²⁵ As quoted in Balita (2009).

²⁶ Oxfam International (2009), p. 17.

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