

The Netherlands Climate Assistance Programme

Climate Change Vulnerability Reduction in Bolivia

MDG 7, Target: Achieve significant improvement in lives of at least half million slum dwellers in Bolivia by 2020

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BOLIVIA

This paper summarizes action – research carried out by the National Climate Change Programme in Bolivia in the context of the CCAT project of the Netherlands Climate Assistance Programme to mainstream climate change adaptation considerations in the context of MDG's and human settlements planning and achieve significant improvement in the lives of at least 0.5 Million People living in slums in Bolivia.

1. Summary

Cities are becoming the habitat of increasing amount of people and climate change will exacerbate the situation of vulnerable population living in urban areas. The increase in flood risk, heavy rains and drought situations is putting additional stress to the poverty reduction efforts in big and intermediate cities. Some quick growing cities like Trinidad in the eastern part of the country where about 80.000 people live are facing repeatedly challenges to cope with climate related risk and extreme events. Worsening flood and drought events are not only jeopardizing housing and generating increasing numbers of houseless, but also putting at risk progress achieved in health, education and employment generation activities.

From the other side the country institutions are increasingly struggling to cope with extreme events and disaster situations exacerbated by climate change, the country lack the financial and institutional capacities to ensure climate proofing of long term investments, principally to ensure the resistance of infrastructure, employment generation investments and public services. To be more effective climate change adaptation needs to be mainstreamed in the context of social, economic and environmental planning and urban areas are the living scenario for 62.4% of the population.

2. Introduction

Climate change is becoming a central issue within the international development debate. Mitigation and adaptation are the two sides of the same coin dealing with the maintenance of the carrying capacity of the planet and the insurance of a human civilization able to maintain and make progress in the well being of the people.

Developing countries and donor agencies are facing major challenges to fulfill the Millennium Development Goals and there is a general consensus that climate change will pose additional stress to the fulfillment of those targets.

Climate change adaptation and mitigation is perceived by the majority of countries as an additional burden they have to assume and as an additional cost.

This perception of the burden that humanity has to assume to mitigate and adapt to the consequences of climate change has changed the general perception of the issue and promoted the exploration of alternative solutions and paradigms. The exploration of a new framework to reduce 80% of the global emissions towards 2050 is reordering a new constellation of solutions that go beyond the formal context of the Rio Conventions and the UNFCCC towards the negotiation of major issues in the context of WTO, the inclusion of climate and environmental concerns into the reform of the UN system and the promotion of a more resilient development by ODA.

Building resilience will have to influence different variables of a particular country's development at different governance and institutional levels to make it more robust to the potential shocks of climate

change and variability. From the creative conjunction of institutional architecture, social capital and social learning theory, human adaptation occurs at the level of institutions, policy and learning.

Climate change and variability is putting additional stress for achieving poverty reduction targets in Bolivia, the cost of the “El Niño” event 1997/98 was of about 6% of GDP and the costs of Mamore river floods in the Beni provinces in year 2006/2007 (the worse in 40 years records) and 2007/2008 are estimated to exceed the 400 Million dollars.

Considering increasing urbanization rates in Bolivia, this case study looking in detail Bolivias Slums vulnerability to climate change will highlight possible entrances and methodological approaches to the target definition issue and therefore contribute to the general objective of CCAT Project in Bolivia to define a set of climate vulnerability reduction targets considering climate change trends as well as extreme events in vulnerable regions prioritized by the Territorial Ordering Plan of the Country.

Other specific objectives of this case study are:

- To consolidate a methodology and gain practical experience how to mainstream climate change into the efforts of the country to achieve the Millennium Development Goals
- To contribute to the articulation of other planning tools of the country like Territorial Ordering, Risk Management and Poverty Reduction.

Target definition is not a simple issue in Bolivia, due to continuous institutional and policy changes, but countries have already agreed on a certain set of targets in the context of the Millennium Development Goals than can be used to mainstream climate change considerations as noted by (Klein & Suarez 2006).

By making the complex interactions between climate change vulnerabilities and development explicit, this matrix (Table 1) serves to summarize a climate change and development country profile and for identifying alternative approaches to reducing sector and regional vulnerability now and in the future. The same approach can be used for defining Climate Change Adaptation (Vulnerability Reduction) Targets.

Table 1: Climate Change and Development Matrix

Development Indicators	What do we know from experience about climate?	What might be plausible future climate scenarios?
MDG, Poverty Reduction Strategy, Sector Vulnerability	Geography of impacts and vulnerabilities	Geography of impacts and vulnerabilities

Bolivia has defined different targets and indicators in relation to the MDG's. This case study focuses on Goal 7: To ensure environmental sustainability as shown in the following Figure 1.

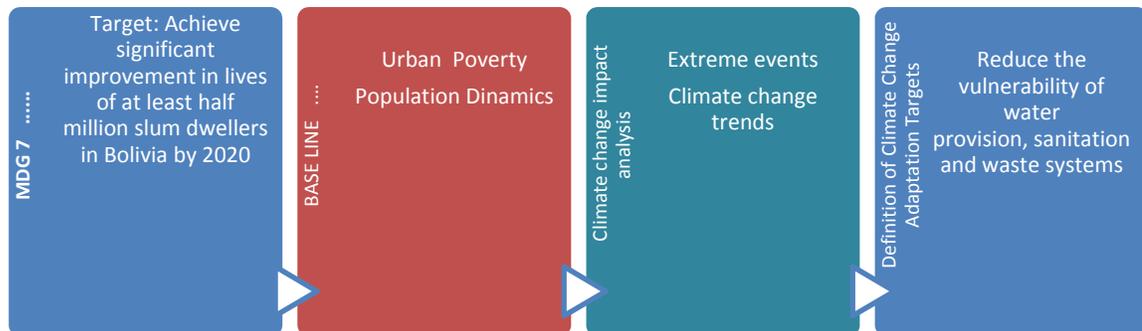


Figure 1: Steps for mainstreaming Climate Change Adaptation by MDG Targets

For carrying out this case study the CCAT project team pursued following activities:

- Interviews to key stakeholder (including UN Staff, NGO leaders and members of the research community).
- An in-depth review of Poverty Reduction and MDG's documentation.
- An examination of the existing literature and documentation on climate risks and sector trends.
- Three Workshops in the Beni provinces with principal stakeholders
- The CCAT project team participated and carried out consultations by the CCR (Ad hoc) Working Group.

In the next sections this paper will discuss why looking into more detail Bolivia's human settlements might highlight the critical path for reducing the vulnerability of human populations to climate change and the definition of vulnerability reduction targets.

3. Urbanization, slums and poverty reduction

Bolivia is still one of the countries with the highest levels of rural population in the continent (57.5%), however this portion is rapidly sinking. Poverty rates maintain high especially in rural areas. In urban areas poverty rates have fallen by about 10 percent over the past decade from slightly over 50 percent by the beginning of the 1990s to slightly under 50 percent in the late 1990s (World Bank 2000). Rural poverty rates, on the other hand, have fallen much less and were still above 80 percent in 1999 (Ibid). According to the (UN-Habitat 1999) 60% of the Bolivia's urban population lives in slums.

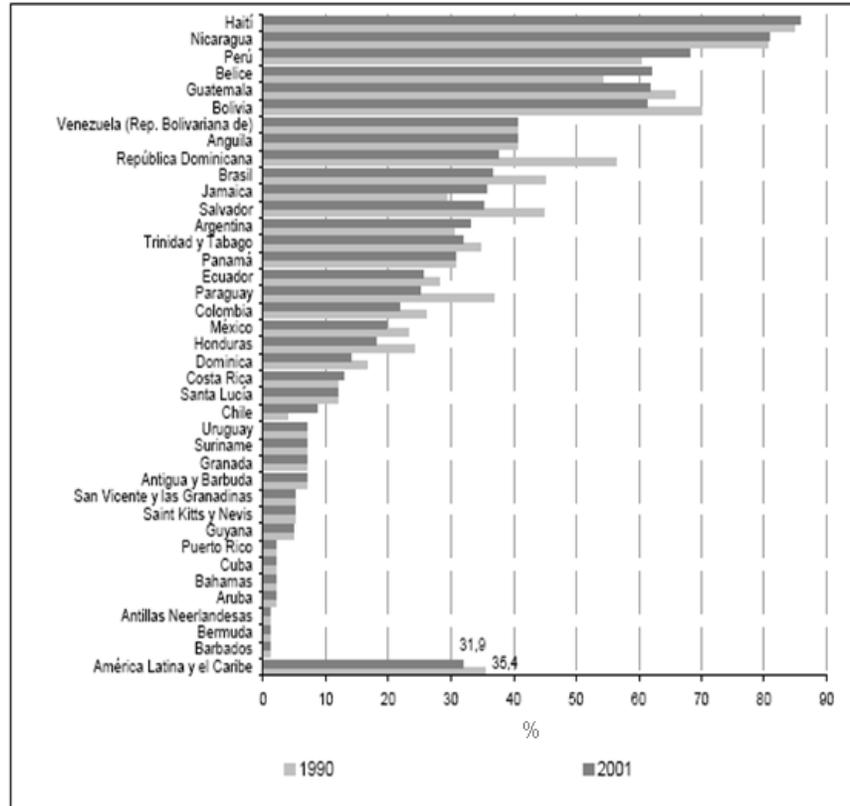


Figure 2: Percentage of slum dwellers in Latin-American countries (Source: UN Habitat 1999)

The human settlements network has been evolving in a decentralized way. Each of the three mayor regions of the country (the highlands, the valley region, and the lowlands) has a mayor urban center. El Alto and La Paz in the western part of the country concentrates people from the rural highlands. Cochabamba in the central valley's region provides an urban center almost as big as La Paz and Santa Cruz in the lowlands has been growing faster than any other city in Bolivia during the last 50 years (see Table 2).

Table 2: Bolivia's 7 largest cities and population by census year (thousands)

City	1950	1976	1992	2001	Average annual growth rate 1950-2001 (%)
La Paz – El Alto	267	635	1118	1487	3.4
Cochabamba	86	229	515	778	4.4
Oruro	58	124	183	202	2.5
Potosi	43	77	112	133	2.2
Santa Cruz	41	254	697	1114	6.7
Sucre	38	63	131	194	3.2
Tarija	16	38	90	135	4.2
	551	1423	2849	4045	4.0

Source: Urquiola et al. 2000 cited by Andersen 2002

As mentioned by (Henderson 2001 and Andersen 2002) the existence of various competing urban centers in Bolivia implies that no city has yet reached mega-city dimensions and compared to the generalized trend in developing countries the largest city in the country is losing its supremacy (see Figure 3). In 1950, La Paz - El Alto accounted for almost 40 percent of the urban population in Bolivia. By 2001 that percentage had dropped to 32 percent. Thus, as long as Bolivia keeps urbanizing in a decentralized manner, as it has been doing during the last 50 years; Bolivia is unlikely to suffer from excessive urban concentration and mega-city problems.

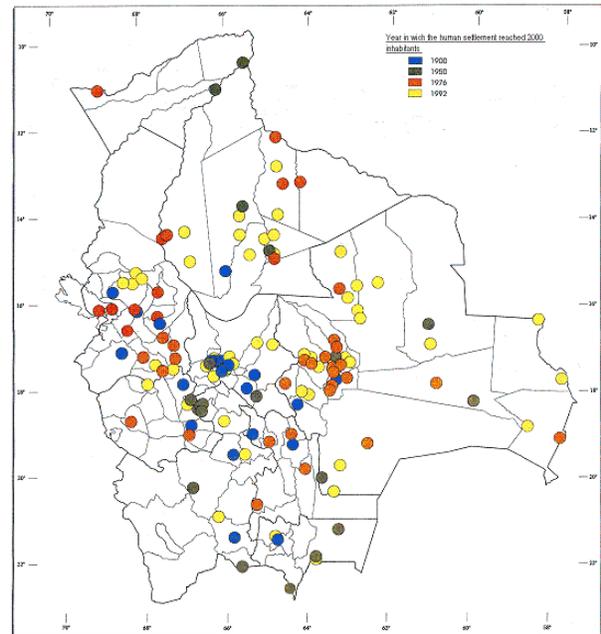
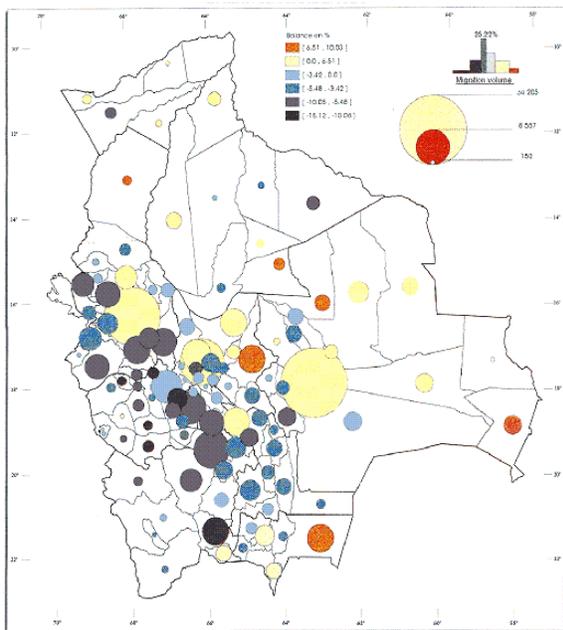
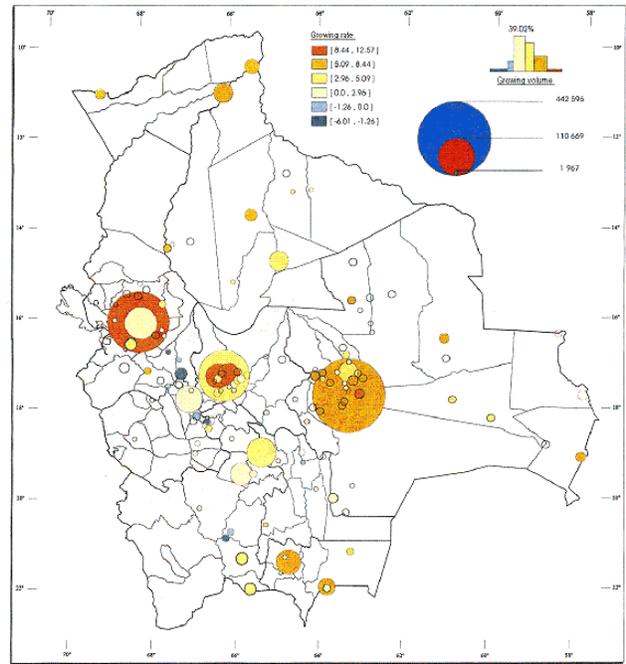
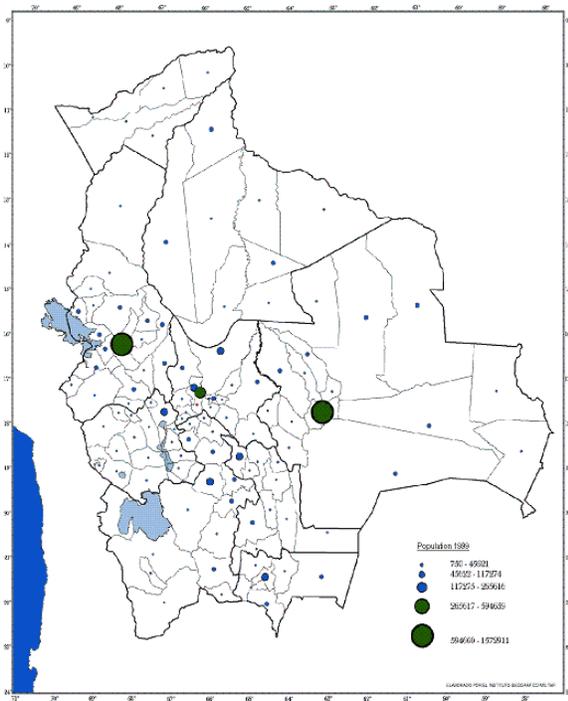


Figure 3: Populations dynamic (Sources: ORSTOM 1995, IGM 1999)

4. Climate change impacts and vulnerability perceptions

Despite the positive trend in Bolivia’s city network described in point 3, Bolivia is still facing difficulties to achieve better poverty reduction results due to the difficulty to provide services for disperse population living in rural areas and smaller cities. Andersen (2002) compares the level of basic services in the 10 major cities in Bolivia (the nine department capitals plus El Alto) with the situation in the remaining 301 municipalities and conclude that while more than 95 percent of the population in the 10 biggest cities have electricity installed in their houses and 84 percent have piped water, the remaining municipalities (55% of the population) are doing considerably worse.

Figure 4: Drinking water coverage in intermediate cities 1992 shows that cities bigger than 50.000 inhabitants are able to provide drinking water to more that 70% of the population in year 2001.

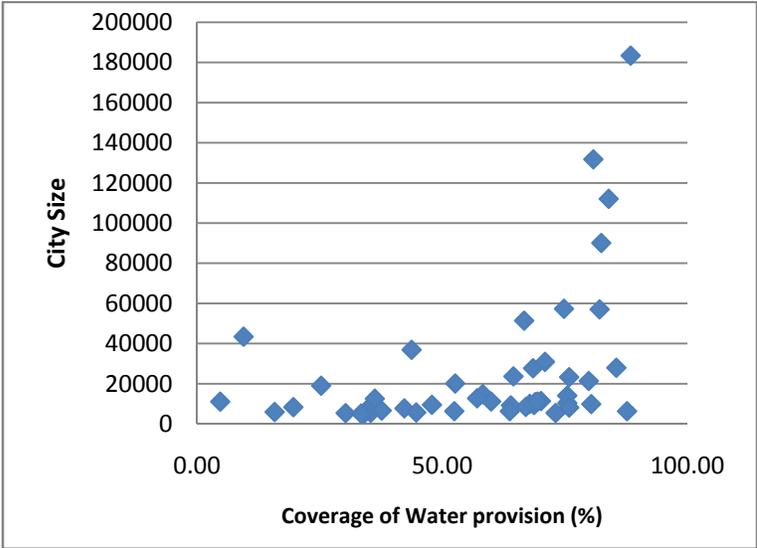


Figure 4: Drinking water coverage in intermediate cities 1992

In addition people are migrating from the western densely populated mountain regions towards the Amazonas lowlands. Almost 80% of the human settlements bigger than 5000 inhabitants in the lowlands have been created after 1976 (See Figure 3).

This migratory movement from west to east explain the mayor part of environmental challenges the country is currently facing. Between 1990 and 2006 about 3.2 Million hectares of rain forest have been deforested for the habilitation of new agricultural and livestock raising land (Superintendencia Agraria 2005) , reducing rainfall infiltration and enhancing soil erosion and thus exacerbating flooding, drought and forest fires. It is also acknowledge that climate change pose additional stress to this already challenging situation.

Civil defence 2005 summarized in a vulnerability map the occurrence of climate and geo tectonic extreme events in the country, this map highlight the important weigh of population densities in the perception of vulnerability and risk. According to this map (See Figure 5) the most vulnerable areas are

the highly populated centres of La Paz, Cochabamba and Santa Cruz. The gray zones also show regions with relative high population densities.

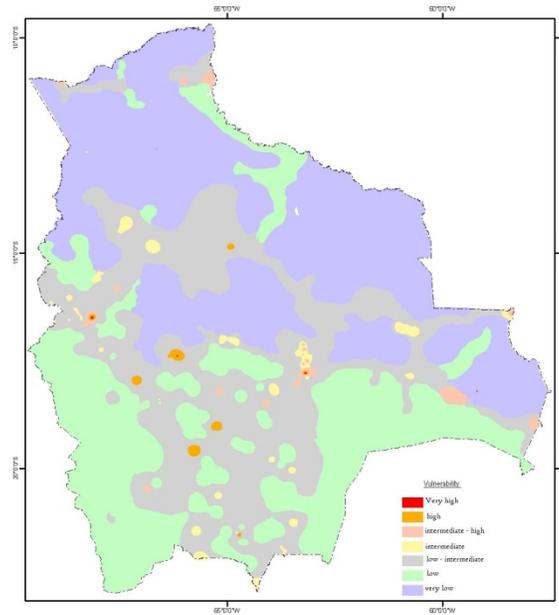


Figure 5: Vulnerability Map (Source: Civil Defence 2007)

Temperature rise

According to global circulation models, temperature will further increase in the coming years, due to the continued increase in global greenhouse gas emissions. By year 2010 GCMs already show an increase in mean temperature in the order of 0,5 to 1 °C over the whole continent. The increase of temperature will be more notorious in the Amazonas and in the Andes regions of Bolivia where for an optimistic policy scenario (450 ppm of CO₂ by year 2050)¹ the increase in annual mean temperature will be in the order of 1,5 to 2 °C.

Modelled changes in temperature increase faster at higher altitudes (Bradley et al. 2004), with enormous implications for water resources, montane ecosystems and high-altitude agricultural activities. Melting of glaciers might be one of the most notorious effects of climate change in Bolivia. Besides the fact that water contained in glacier reservoirs is used for agriculture and urban uses in the city of La Paz and El Alto, these reservoirs are integrated part of very particular ecosystems and contribute to regulate water runoff, this means higher risk of flash floods as well as substantially reduced river flows during the dry season.

Moreover as a result of temperature increases, malaria has expanded its incidence area, particularly with regards to high-altitude areas that used to be too cold for the survival of the mosquito vector.

¹ 450 ppm is the Europe target to maintain temperature increases below 2°C by 2100. This optimistic scenario has been chosen to show that even if the global community were able to achieve this substantial abatement of Greenhouse Gases possible (relative to the “business as usual” scenario”), adaptation to climate change would still be needed.

Floods, droughts and changes in precipitation patterns

There is considerable support for the idea that the frequency of extreme weather events will increase over the next century mostly because of the intensification and disruption of hydrological cycle (Trenberth, 1999), intense precipitation and drought situations are likely to occur more frequently, and consequently produce more flooding.

General Circulation Models show a slight increase in precipitation between 15 to 25% to 2100 for most of the Bolivian territory (See Figure 6).

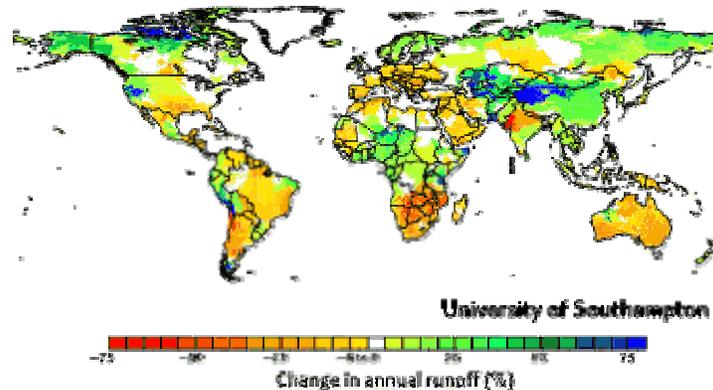


Figure 6: Change in annual runoff (%) (Source: Arnell 1999)

However precipitation will not increase on a regular basis during the year. By year 2050, according to Hadley Centre GCM, precipitation will increase in the order of 3 to 9 % during the rainy season (December-February) but decrease during the initiation of the spring and rainy season in the month of September in the order of 3 to 6 % over the major part of the Bolivian territory and until 9% in the Amazonas region. These outputs of GCM are in general consistent with the trends observed since 1990 and with the description of the further shortening and delay start of the rainy season described by farmers and agriculture extensionist in different parts of the territory.

Floods 2007 and 2008 in the Beni provinces

In March 2007 river Mamoré floods in the Beni provinces (the bigger reported in the last 60 years) affected more than 2.5 Million hectares of savannas, affecting livelihoods in 16 small cities, generating more than 30.000 evacuates and 200.000 livestock losses.

According to very conservative official reports floods produced an estimated economic damage between 200 and 400 Million US\$.

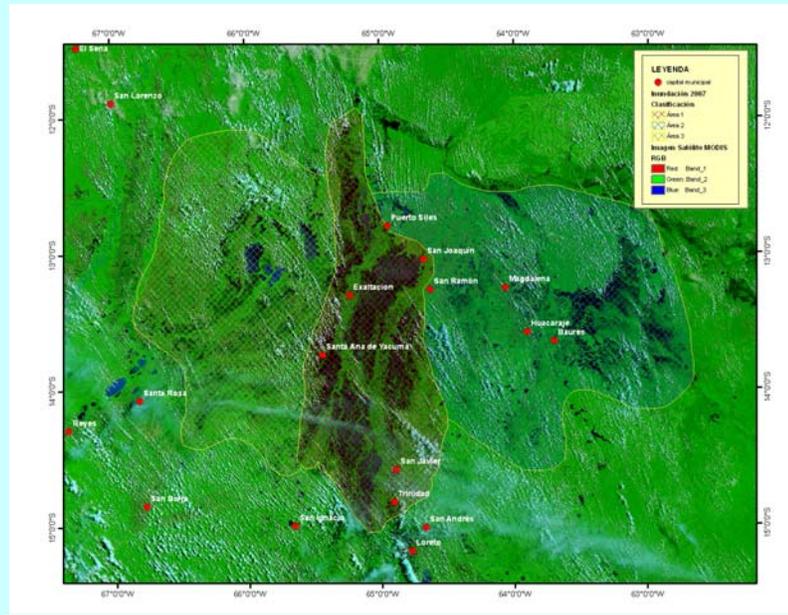


Figure 7: MODIS Satellite imagery of the flooding area (Source: PNCC)

Principal factors that exacerbate vulnerability

According to UN – ECLAC assessment of climate disturbances 2007 floods exacerbated due to four principal factors:

- Unplanned settlements in vulnerable floods prone areas
- Land habilitation and deforestation upstream
- Unsustainable soil management and erosion upstream
- Increase of the barrier effect and precarious drainage systems in roods

5. Climate change adaptation targets

About 5 Million people live in human settlements bigger than 5000 inhabitants and still almost 50% of them are below the poverty line (INE 2001). According to UDAPE 2006 the level of people with access to basic sanitation is 43.5% (2005) and will reach by best estimates 65% by year 2015. We estimate a number of 2.5 Million Slum dwellers living in 17 urban clusters and periurban regions throughout the Bolivian territory (See ANNEX 1) from which about half a million are highly vulnerable to extreme events like floods and droughts and the emergence of vector borne diseases.

Table 3: Climate change impacts and vulnerability of human settlements

Code of the urban cluster	City	Recurrence of extreme events between 1980 – 2008	Climate change impacts	Highly vulnerable slum dwellers
A	Metropolitan Area of La Paz	●●●	Heavy rains, landslides, glacier withdrawal will jeopardize water provision	About 50.000 families living in risky areas.
B	Metropolitan area of Cochabamba	●●	Drinking water stress, food supply jeopardize by extreme events	About 120.000 people and periurban farmers under water stress.
C	Metropolitan area of Santa Cruz	●●●	Heavy rains, floods, hot waves, vector borne and sanitary diseases	Less than 20% of 1.8 Million people have access to basic sanitation. Most vulnerable population children, mothers and the elderly (best estimate 60.000 people).
1	Cobija	●	Floods	≤ 100 people living in floods prone areas
2	Riberalta y Guayaramerin	●●	Floods, Forest fires	1000 people living in floods prone areas.
3	Rurrenabaque-Reyes-San Borja	●	Floods	≤ 100 people living in floods prone areas
4	Trinidad-Santa Ana de Yacuma – Baures – Marban	●●●	Floods and droughts, vector borne and sanitary diseases	Less than 5% of the population has access to basic sanitation. About 50000 families living in flooding areas
5	Yungas settlements	●	Heavy rains, landslides	About 10.000 people living in risky areas
6-7-8	San Ignacio de Velazco savannas settlements	●●●	Heavy rains, flooding, forest fires	About 4.000 people living in flooding areas, Most vulnerable population children, mothers and the elderly (best estimate 10.000 people).
9	Chapare settlements	●	Heavy rains Flash floods,	About 2000 people living in flooding areas
10	Potosi and other mining settlements	●	Droughts	≤ 10000 people with water stress
11	Central Valleys settlements	●●●	Hail, floods	About 1000 people living from agriculture in periurban areas

Code of the urban cluster	City	Recurrence of extreme events between 1980 – 2008	Climate change impacts	Highly vulnerable slum dwellers
12	Robore	●	Hot waves, heavy rains, flooding,	About 4.000 people living in flooding areas, Most vulnerable population children, mothers and the elderly (best estimate 5.000 people).
13	Patana settlements (Pto. Suarez)	●	Hot waves, heavy rains, flooding,	About 4.000 people living in flooding areas, Most vulnerable population children, mothers and the elderly (best estimate 5.000 people).
14	Sucre – Padilla – Monteagudo	● ●	Hail, flash floods	About 1000 families living from agriculture
15	Tupiza – Villazon	●	drought	About 40000 people living under water stress
16	Tarija-Bermejo	● ●	Hail, heavy rains, floods	15000 families periurban farmers
17	Camiri-Yacuiba	● ●	Flash floods, droughts	About 100.000 people under water stress risk, 3000 families living in flooding areas

Source: Civil defense reports (1980-2008)

Not only the lack of planning of human settlements is responsible for about two thirds of the economic and social losses vulnerable population has to assume² in relation to extreme events and climate change, but the lack of a clear employment generation and secure housing policy (including social incentives) in urban slums.

National policies to achieve the goal

Decentralization process in Bolivia and providing financial resources to local governments according to their populations helped to reduce the gaps in poverty alleviation between urban and rural areas. Between 1992 and 2005 the gap in water provision reduced from 60 to 33 percent points and in basic sanitation from 19 to 14 percent points (UDAPE 2005). Local governments are able to set priorities in consultations with the communities and thus able to attend the most urgent needs.

To be able to reach those targets additional efforts are needed to better plan human settlements and provide access to water and basic sanitation.

The current government has set in motion a process of consultations and discussions around territorial ordering and capacity building for disaster preparedness, rehabilitation and reconstruction of damages

² The mayor part of the costs of damages and rehabilitation from extreme events have to be assumed by vulnerable populations.

produced by extreme events, nevertheless the country haven't produce a clear disaster prevention or vulnerability reduction policy yet.

From the other side the current governmental water policy has put additional emphasis on three principal aspects:

- Water is of public domain
- Participation of social groups and legal security to ensure access to water
- Funding will be available from public sources

6. Conclusions

About 2.5 million people in Bolivia are living in Slums and about half million of people are highly vulnerable to the different impacts of climate change and extreme events. To achieve improvements in their lives a very concrete economic, social and environment set of policies and programmes are needed.

Decentralization process in Bolivia and providing financial resources to local governments according to their populations helped to reduce the gaps in poverty alleviation between urban and rural areas. Between 1992 and 2005 the gap in water provision reduced from 60 to 33 percent points and in basic sanitation from 19 to 14 percent points (UDAPE 2005).

Local governments are able to set priorities in consultations with the communities and thus able to attend the most urgent needs. Any strategy to reduce climate change vulnerability has to involve the local governments and motivate them to approach highly vulnerable population. MDG's can serve to advocate for financial resource allocation from governmental budgets and integrate MDG's in urban planning policies and local budgets.

Water and sanitation play a major role in improving the lives of vulnerable populations living in slums. For the case of Beni provinces the damages in the waste system during the floods (See ANNEX 3) was the principal threat to the health of the population.

Taking into account that the cost of damages and rehabilitation from extreme events have to be covered by vulnerable population itself. Urban planning has to explore sound strategies to compensate those losses by employment generation and secure housing programs.

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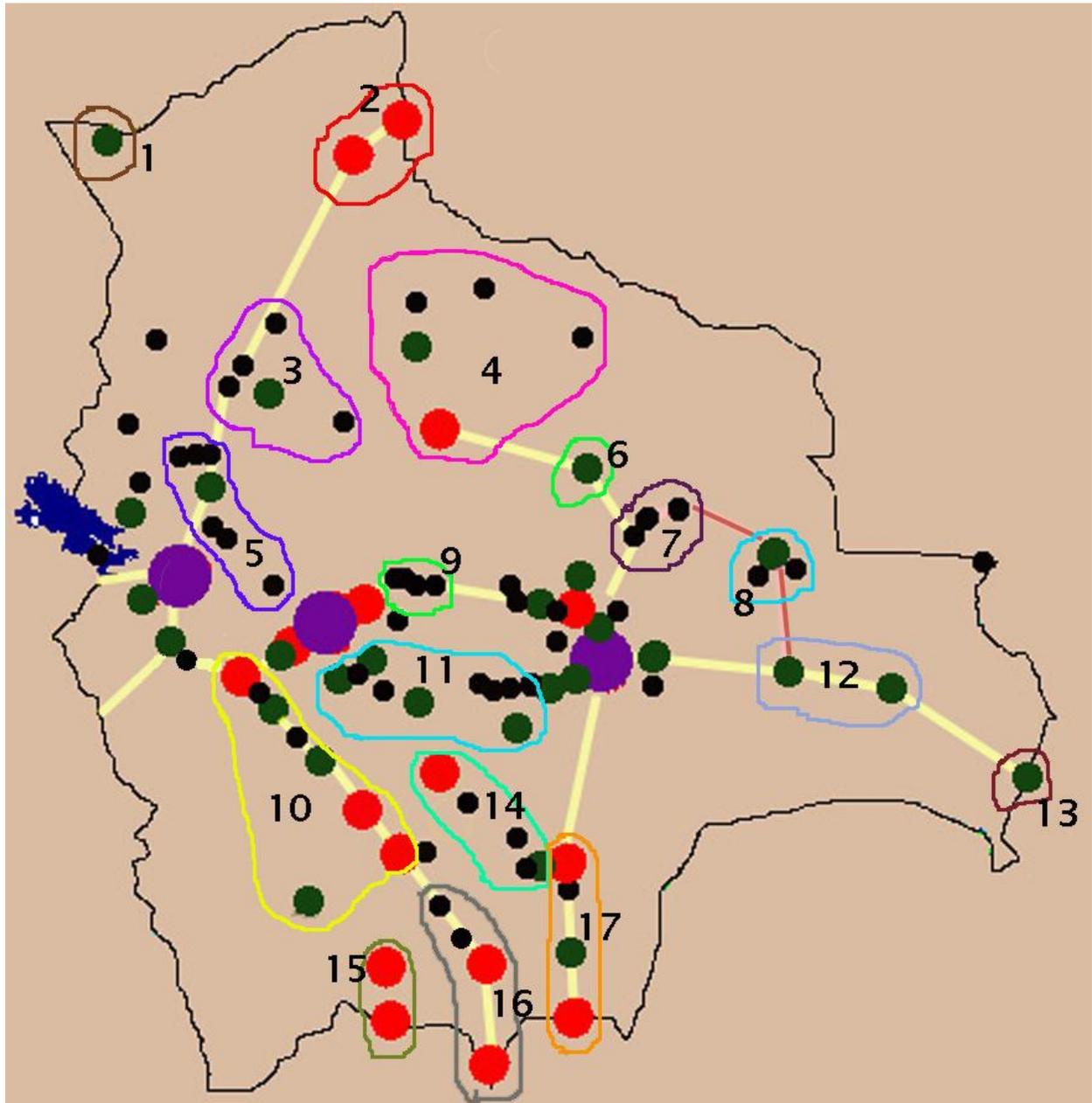
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LIST OF ACRONYMS

CCAT	Climate Change Adaptation Targets
CCR	Climate Change and Risk Working Group
CO ₂	Carbon Dioxid
GCM	Global Circulation Models
GDP	Gross Domestic Product
MDG's	Millenium Development Goals
NGO's	Non Governmental Organizations
ODA	Overseas Development Assistance
UN	United Nations
UNFCCC	United National Framework Convention on Climate Change
WTO	World Trade Organization

ANNEX 1: Urban settlements clusters (>5000 Inhabitants)



ANNEX 2: Access to water and basic sanitation in urban areas (1992)

Code of the urban cluster	City	% of people living below the poverty line	% of people without sustainable access to safe drinking water	% of people without access to basic sanitation	Municipal Population
A	Metropolitan Area of La Paz	59.01	87.58	39.15	1121392
B	Metropolitan area of Cochabamba	68.02	59.02	15.69	537285
C	Metropolitan area of Santa Cruz	66.54	74.13	6.02	777404
1	Cobija	50.93	67.86	4.52	11375
2	Riberalta y Guayaramerin	74.67	39.01	2.79	84651
3	Rurrenabaque-Reyes-San Borja	88.73	22.34	0.74	47420
4	Trinidad-Santa Ana de Yacuma – Baures – Marban	66.53	66.54	1.31	82054
5	Yungas settlements	90.73	52.70	6.01	148889
6-7-8	San Ignacio de Velazco	88.44	36.28	0.84	42929
9	Chapare settlements	90.98	29.89	4.94	228681
10	Potosi and other mining settlements	59.44	78.57	39.03	203161
11	Central Valleys settlements	71.34	52.46	19.55	16621
12	Robore	70.06	70.02	0.67	42519
13	Patanal settlements (Pto. Suarez)	66.95	63.02	0.61	36121
14	Sucre – Padilla – Monteagudo	78.94	42.23	20.44	211086
15	Tupiza – Villazon	67.28	66.57	19.42	84045
16	Tarija-Bermejo	65.25	66.35	27.95	154181
17	Camiri-Yacuiba	68.31	67.86	16.025	168626

ANNEX 3: Impact Assessment Matrix Beni Provinces Flooding

Sector	Group	Consequences	Economic Criteria	Social Criteria	Environmental criteria
Livestock Farming	Medium and small farmers	Loose of 300.000 livestock heads	Looses estimated in 180 MM	Principal economic activity about 50.000 employments	
Agriculture	Small farmers	Loose of perennial and seasonal crops	Not estimated	Many subsistence farmers lose their assets. Small farmers are in the majority indigenous populations	
Tourism	Tourism operators	Strong decrease in tourism operations during floods	Not estimated		
Human Health	Rural and periurban population	Increase in ERA's and IDA,s increase of the risk of Denge epidemics. 2 causalities (not confirmed Denge cases). Alerts	Not estimated, the sanitary situation is so far controlled in mayor cities.		
Waste and Sanitation	Waste system in mayor cities	Deterioration of waste systems, contamination of water, deterioration of water provision of more than 30.000 families.	3 MM best estimate for rehabilitation, 30 MM for reconstruction.		Contamination of water bodies might increase contamination of fish and drinking water and exacerbate the risk of infectious diseases.
Human settlements and housing	Periurban settlements	17.000 Houses destroyed ????	Looses estimated 85 MM	40.000 flooding refugees	
Infrastructure	Roads, electricity, gas and water pipelines	60% of the provincial road system damaged (good estimate) ????	80 MM in damages and loos of interprovincial roads ????		

Sector	Group	Consequences	Economic Criteria	Social Criteria	Environmental criteria
Transportation	Interprovincial transportation	3 months stop	Not estimated		
Households		Increase in the prices of water (100%), food (80%) and fuel (200%) ????? Difficulties of the children to attend the school. Loose of employment and income sources.	Not estimated	Increase in the prices of households (Canasta básica) Looses of the principal sources of employment	
Environment	Wild fauna	Strong decrease in some critical wild fauna populations. Increase of illegal hunting Strong decrease in fish stocks.	Not estimated	Indigenous population live from fishing and hunting.	There is the need to increase wild fauna refuges