



## Ensuring Sustainable Development within a Changing Climate

Trærup, Sara Lærke Meltofte; Laursen, Nethe Veje

*Published in:*  
Proceedings (online)

*Publication date:*  
2009

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Trærup, S. L. M., & Laursen, N. V. (2009). Ensuring Sustainable Development within a Changing Climate. In *Proceedings (online)* International Human Dimensions Programme on Global Environmental Change.

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## Ensuring Sustainable Development within a Changing Climate

Sara L. M. Trærup<sup>1, 2, \*</sup> and Nethe Veje Laursen<sup>3</sup>

<sup>1</sup> UNEP Risø Centre, Risø DTU National Laboratory for Sustainable Energy

<sup>2</sup> Department of Geography & Geology, University of Copenhagen

<sup>3</sup> DTU Climate Centre, Risø DTU, National Laboratory for Sustainable Energy

\*slmt@risoe.dtu.dk

### Abstract

In year 2000, the international community agreed on the Millennium Development Goals, goals that aim at reducing poverty with 50 percent by 2015, and reach to improve on other social and development indicators. For many countries the MDGs are quite ambitious and require intensive efforts in order to be achieved by 2015. To half poverty through economic growth implies a sustainable development path that takes into account the possible adverse impacts from climate change.

This paper builds on the experiences from a climate change Action Programme and illustrates how national development plans can be vulnerable to adverse climate change impacts. It is suggested how climate change considerations can be strengthened in national planning to minimize vulnerabilities and simultaneously enhance adaptive capacity at the national level in order to contribute to sustainable economic growth and development. Vulnerable sectors and main vulnerabilities are identified on the background of natural disaster data and projected climate change impacts. The sustainability of respective national planning efforts in the light of climate change will be assessed by a review of selected national development plans and

strategies. Thereafter, examples are given on how to strengthen ongoing efforts in integrating climate considerations into existing national development plans.

The countries in focus are Bangladesh, Bolivia and Mozambique. The intention with this selection is to include different aspects of climate change impacts and adaptation options – there is no ‘one size fits all’ though a lot of similarities across countries do exist.

## 1 Introduction

The extent, to which the vulnerability of a country will increase with climate change, depends on its adaptive capacity. This in turn depends in large parts on the socio-economic and technological development, and on the strategies and planning processes the country will put in place in the coming 5-10 years. Decisions made now will directly affect to what degree a country will be able to cope with the impacts of climate change by 2030 and beyond.

This paper builds on the experiences the authors of this paper gained during the Danish “Climate and Development Action Programme”<sup>1</sup>, hereafter referred to as the Action Programme, where country missions were carried out from 2005 – 2008. The Action Programme included missions to selected countries in order to evaluate climate change vulnerabilities, national studies and experiences from local development planning, research and projects. The paper analyzes and reflects upon the experiences gained by the authors on the potential for integrating climate change as an element in development planning and activities in selected case countries will be demonstrated.

A main development challenge is to accelerate or maintain robust economic growth despite impacts from climate change. Poor countries with economies based on primary production are common in the most disaster prone areas. In year 2000, the international community agreed on the Millennium Development Goals (MDGs), goals that aim at reducing poverty with 50 percent by 2015, and strive for improvements on other social and development indicators. For many countries the goals are quite ambitious and require resolute efforts in order to be reached before

---

<sup>1</sup> The Danish Climate and Development Action Programme can be found at <http://amg.um.dk/en/menu/PoliciesAndStrategies/Climate+and+Development/>

2015. In order to half poverty through economic growth it will be necessary to aim for a sustainable development path, which requires that some essentials are in place. These are, for example, access to basic infrastructure, water, energy, education, as well as functional institutions, education and health care, which are also defined as development indicators in the MDGs and are important aspects for sustainable development and thus climate resilient development.

Approximately three quarters of the world's poor live in rural areas (WRI 2008; Ravallion and others 2007) and their livelihoods rely on natural resources, agriculture and other land use, and are therefore extremely vulnerable to the depreciation of natural resources.

Due to the importance of the agricultural sector, changes in climate that affect the agricultural sector may affect other aims such as economic growth, health, and education, directly or indirectly. Climate change also directly impacts other sectors, which are essentials for development, including water, energy, infrastructure, health, and education.

On the basis of this reality, it is therefore crucial to acknowledge impacts from climate change on national development strategies and plans in order to secure sustainable development. Integrating climate considerations into development planning is vital for enhancing resilience, as well as for reducing vulnerability at the various levels in societies.

Broadly, the literature on the linkages between development and climate change focus on how to mainstream climate change into development planning. Within this sphere mainstreaming is an aim for ensuring long term sustainability of ongoing activities and investments and for reducing the present and future climate vulnerability of development activities. This is perceived in relation to underperformance (e.g. shortening of the life time of a road with increase in flood return periods), and 'mal-adaptation' (e.g policies that inadvertently increase vulnerability). Mainstreaming is therefore understood as the integration of climate change issues and responses into general development planning, sectoral decision-making, and budgeting processes.

Existing efforts on climate change and development linkages include activities on mainstreaming climate change and on disaster risk reduction undertaken by the International Institute for Environment and Development (IIED), (Yamin and Huq 2005; Huq and others

2006). Moreover, the World Resources Institute has addressed - in a recent methodological case study analysis - how adaptation can be framed in the context of development (McGray and others 2007). OECD is similarly in the process of developing guidelines for how development assistance can take climate change into consideration, and this work has been supported by several technical adaptation studies (Agrawal 2005).

This paper is not an attempt to outline an analytical approach on how to mainstream climate change into development aid or planning nor is it trying to develop a methodology to portfolio screening for climate change or alike. As a complementary to these increasing efforts, the paper is analyzing and reflecting upon practical experiences on climate change and development issues gained during country visits including information gathering and discussions with national stakeholders.

The next section introduces the approach of the paper, before moving to section 3 on the analysis of countries' development and climate change linkages. Lastly, suggestions are given on how to strengthen on-going efforts in the area of climate change and national planning processes, which may enhance adaptive capacity at the national level.

## 2 Analytical framework

The approach of the Action Programme is to emphasize sustainable development as a framework to address climate change vulnerability and adaptation, rather than from a strictly environmental perspective, which has often been the case in past international programmes. Some general development impacts on a sectoral basis are illustrated in Table 1. The identification of these key vulnerabilities can provide policy guidance for national policy makers on key climate linkages to national development policies and plans.

The paper follows the IPCC (IPCC 2007) definition of vulnerability as “the degree to which geophysical, biological and socio-economic systems are susceptible to and unable to cope with, adverse impacts from climate change”. Implicitly, human wellbeing and social aspects are affected by potential changes and risks associated with climate change impacts on land-use activities, water, ecosystems, infrastructure, energy systems, human settlements, and health.

Human and social vulnerability to climate change is considered in relation to expected climate changes, variability, and extremes in terms of precipitation, temperature, floods, and typhoon patterns.

As a first step of the case country analyses in this paper, the projected climate changes are reviewed and key natural disasters are identified on the background of disaster data. This is used to illustrate and indicate climate change exposure to development planning. This improves the ability to identify vulnerable sectors in the next step. The second step is aiming to identify vulnerable sectors in the country and to assess direct and indirect sector impacts. Clearly, climate change is much more than natural disasters, but using disasters as indicators of climate change impacts is justified by a rationale of simplification of the analysis and to make illustrative examples.

<b>Sector</b>	<b>Disaster linkage</b>	<b>Development impacts</b>
Agriculture	<ul style="list-style-type: none"> <li>▪ Drought</li> <li>▪ Flood</li> <li>▪ Earthquake</li> <li>▪ Storm</li> <li>▪ Extreme temperature</li> <li>▪ Epidemics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Lack of rain, or extreme precipitation will damage the harvest</li> <li>▪ Sea level rise can threaten agricultural areas, especially in low-lying areas.</li> </ul>
Water	<ul style="list-style-type: none"> <li>▪ Drought</li> <li>▪ Flood</li> <li>▪ Extreme temperature</li> </ul>	<ul style="list-style-type: none"> <li>▪ Lack of water</li> <li>▪ Too much water</li> <li>▪ increased water logging in coastal zones</li> </ul>
Planning	<ul style="list-style-type: none"> <li>▪ flood</li> <li>▪ drought</li> <li>▪ earthquake</li> <li>▪ storm</li> <li>▪</li> </ul>	<ul style="list-style-type: none"> <li>▪ Planning efforts will be lost – including investments and potential development improvements</li> </ul>
Infrastructure (roads & bridges)	<ul style="list-style-type: none"> <li>▪ Flood</li> <li>▪ Storm</li> </ul>	<ul style="list-style-type: none"> <li>▪ Damage to existing infrastructure</li> <li>▪ Need to incorporate new extremes in new infrastructure</li> </ul>
Disaster preparedness	<ul style="list-style-type: none"> <li>▪ Drought</li> <li>▪ Flood</li> <li>▪ Storm</li> </ul>	<ul style="list-style-type: none"> <li>▪ More disasters cause more damage.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Earthquake</li> <li>▪ Mass movement</li> </ul>	
Health	<ul style="list-style-type: none"> <li>▪ Flood</li> <li>▪ Epidemics</li> <li>▪ Extreme temperature</li> <li>▪</li> </ul>	<ul style="list-style-type: none"> <li>▪ New health challenges</li> <li>▪ New of more frequent outbreak of diseases</li> </ul>
Energy	<ul style="list-style-type: none"> <li>▪ Flood</li> <li>▪ Storm</li> <li>▪ Earthquake</li> </ul>	<ul style="list-style-type: none"> <li>▪ Climate change can hamper the development of energy net</li> <li>▪ Or damage existing energy net</li> <li>▪ Might hurt renewable energy sources like e.g. hydropower.</li> </ul>
Coastal zones	<ul style="list-style-type: none"> <li>▪ Flood</li> <li>▪ Storm</li> </ul>	<ul style="list-style-type: none"> <li>▪ increased water logging in coastal zones</li> <li>▪ coastal erosion</li> </ul>

**Table 1: Overview of selected sector linkages to disasters and related vulnerabilities**

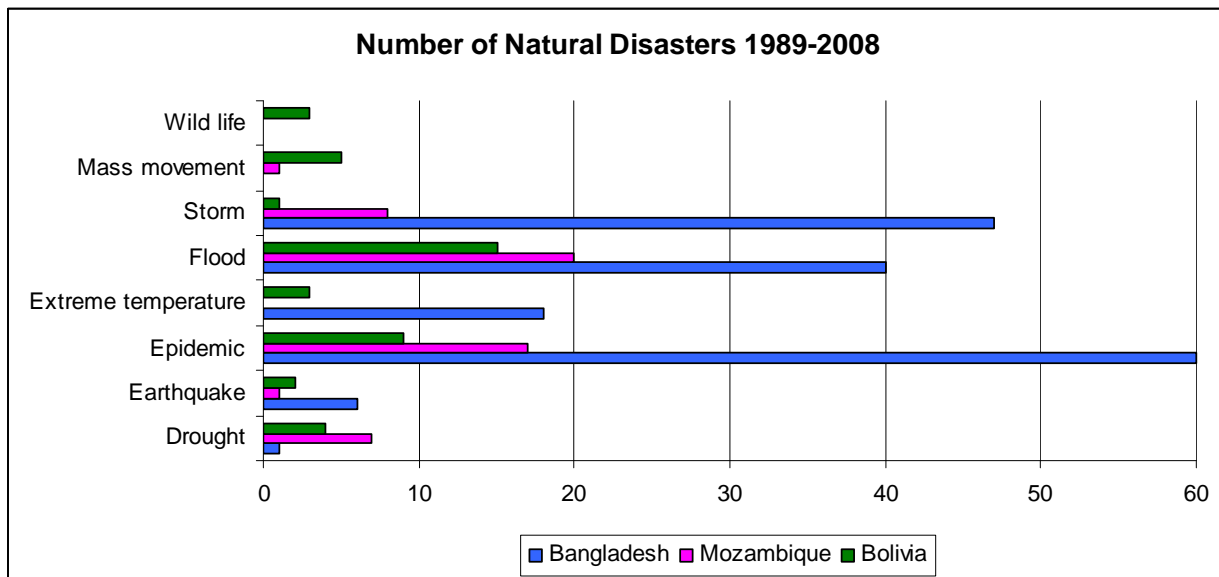
The analysis of country development plans, is aiming to assess the current adaptive capacity of the specific country and sectors. This assessment is based on existing national development plans, such as Poverty Reduction Strategy Papers (PRSPs), and in this paper also on experiences gained from the Danish Action Programme. Lastly, the analysis discusses further efforts to strengthen the climate change efforts in the selected countries.

### 3 Country cases

The countries used as case examples are Mozambique, Bangladesh and Bolivia; all have been participating in the Action Programme.

The three countries are different but still share some similarities. They are all poor and to some extent disaster prone countries, with the poorest part of the population being dependent on natural resources, and thus clearly vulnerable to climate change. According to Figure 1, Bangladesh is the most affected country in terms of actual number of natural disasters, while Bolivia has the widest range of disasters. Flood is rather important to all of the three countries, as is epidemics. Storms are frequent events in Bangladesh and Mozambique. Conversely Bolivia

has experienced some incidence of drought, which is also the case for Mozambique, while extreme temperatures are seen in both Bolivia and Bangladesh. The total number of natural disasters<sup>2</sup> in Bangladesh, Bolivia and Mozambique in the last 20 years is shown in Figure 1. The most distinct feature is the extremely large number of natural disasters in Bangladesh. Bangladesh has the highest number of both epidemic disasters, floods, storms, extreme temperatures and earthquakes. This highlight how extremely vulnerable Bangladesh is to natural disasters already and this will only worsen as climate becomes more extreme.



**Figure 1: Number of total disasters 1989 – 2008 in Mozambique, Bolivia and Bangladesh.** Source: EM-Dat (2008).

### 3.1 Mozambique

Mozambique’s economic development indicators have been steadily increasing during the last decade, and absolute poverty has been reduced from 70 percent at the national level in 1997 to 56 percent in 2003 (World Bank 2008). Current population is about 20.5 million with an annual growth rate of 2.1. The economy in Mozambique is diversified, and agriculture, transport, manufacturing, energy, fisheries, and tourism make important contributions to the economy. Mozambique has a weak infrastructure and high dependence on natural resources, with about 80

<sup>2</sup> Criterias for being included in the Emdat database – at least one of the following criterias must be fulfilled: Ten (10) or more people reported killed, Hundred (100) people reported affected, Declaration of a state of emergency, Call for international assistance



percent of the population living from agriculture. Most agriculture is subsistence and rain fed and therefore production relies heavily on the climate.

### *3.1.1 Climate Change Impacts*

Climate change is likely to alter the frequency and severity of natural disasters in Mozambique, including the prevalence of droughts, floods, and storms. Mozambique is at the downstream of major river basins from neighboring countries. These river basins are projected diminishing run-off of 25-40 percent (Arnell 2003, 2004) and the availability of surface water and river run-off is expected to decline as a consequence of decreasing rainfall for South eastern Africa (IPCC 2007; Tadross and others 2005). Cyclone activity is expected to intensify as a result of increased surface temperatures (McDonald and others 2005) and in addition lead to increased risk of flooding.

According to the data on natural disasters, Mozambique is especially exposed to floods, droughts, storms (tropical cyclones) and epidemics, with especially floods and epidemics as the major issues. Epidemics include diseases such as malaria, cholera, pest infestations and diarrhea and are often a natural consequence of flood. Based on above climatic changes, the frequency and intensity of these events are all expected to increase with climate change.

### *3.1.2 Direct and indirect sector impacts*

The sectors in Mozambique which are most vulnerable to climate change impacts are agriculture, water resources, coastal resources, human health, and infrastructure.

The agricultural sector is a core sector in Mozambique, accounting for almost 30 percent of GDP (World Bank 2008). The occurrence of natural disasters such as floods, droughts and tropical cyclones has negatively affected the agriculture sector, through the disruption of routine practices, infrastructures and the erosion of the soils. Increase in droughts will further pose

constraints to agriculture which are mainly rain-fed. Overall in Mozambique, agricultural productivity is expected to decrease as a consequence of climate change.

The impacts from climate change to water resources will be observable through irregularities in distribution of rainfall and through the increase of the temperature and solar radiation, which in turn will increase evaporation levels. Human health is affected by the epidemics following floods. The sanitation infrastructure in Mozambique is poor and consequently resulting in a 45 percent increased rate of diarrheal diseases after floods compared to a scenario with proper sanitation infrastructure (Reacher 2004; Wade and others 2004). Existing infrastructure such as roads and bridges is generally not resilient to increased frequency and intensity of for example flood events and the lifetime of current investments are consequently shortened. Coastal areas are vulnerable due to sea level rise and storms (tropical cyclones) with especially the low-lying areas facing problems in relation to sea-level rise, storm surge and coastal erosion.

Sea-level rise will have a considerable impact on Mozambique's second largest city Beira including the highly important harbor in Beira which is the closest harbor for neighboring landlocked countries, and therefore a large economic asset for Mozambique. Furthermore, sea level rise, coastal erosion and increasing intensity and frequency of storms will have a negative impact on coastal communities as well as on the resources and ecosystems people depend upon for their livelihoods.

### *3.1.3 Analysis of development plans*

At present in Mozambique there is a focus on natural disasters as one of the main risks to poverty reduction along the line of HIV Aids and food insecurity. The National Poverty Reduction Plan (PARPA) in Mozambique recognizes that “natural disasters resulting from climate changes and seismic activities can aggravate a situation of absolute poverty because of their destructive impact on the human dimension and socioeconomic infrastructures“ (GoM 2006). The PARPA identifies natural disasters as a crosscutting issue and it is the intention to integrate disaster impacts into its three development pillars; governance, human capital, and economic development. At present, there is emphasis on disaster prevention, such as advanced

warning systems for floods, droughts and cyclones, and much effort is made in mapping areas at risk of such disasters. Therefore, Mozambique is well advanced in anticipation of reducing disaster impacts. However, as identified during the Action Programme, there was not, at the current time, systematic institutional focus on climate change and there did not seem to be efforts to formulate means to integrate climate change considerations into general planning processes and strategies.

The responsibility of climate change lies within the Ministry of Environment and there remains uncertainty whether ministries which have key roles in development planning such as the ministries of health, agriculture, transport, and energy understand the magnitude and timing of climate change impacts in Mozambique and the implications for their own activities. As a result, climate change is currently taken into consideration in budget planning and there is a general absence of engagement in the development of adaptation implementation strategies.

#### *3.1.4 Integration of Climate Change into Development Planning*

During the Action Programme it appeared that existing knowledge about climate change impacts in Mozambique still needs to be seen in a wider context by the various stakeholders and to be integrated in general development policies and planning, instead of being viewed as isolated environmental problems or issues. Through the Action Programme, it was suggested to strengthen awareness raising among stakeholders, including capacity building, and to generate improved information on climate change vulnerabilities and coping strategies. A need to expand the knowledge base on how climate change impacts on development plans, such as the PARPA, was also identified. This includes both general awareness raising and specific activities that aim at generating better climate change impact data, and more general capacity for integrated analysis of climate change and development impacts and issues.

The rationale for awareness raising and capacity building is that the general information level on climate change and its impacts on general development issues, such as economic growth, are limited. Furthermore, the available information is spread out among many institutions and stakeholders and there seem to be inadequate knowledge sharing and collaboration in between

ministries, as well as organizations. In addition to raising awareness among stakeholders at the national level in Mozambique, the sustainable development path of the country could benefit from awareness creation also at a more decentralized level in such a way that climate change becomes an integral part of planning throughout all municipalities.

## **3.2 Bangladesh**

Bangladesh is one of the poorest countries in the world, and ranks low on almost all measures of economic development. This, coupled with extremely high population density and the low-lying land where it is situated, leaves the population extremely vulnerable to natural disasters and climate events. Growth rates have been positive during the last decade, but 50 percent of the population are still poor (GoB 2005a). Due to poverty, many people live in the lowest lying, and most disaster prone areas where there are economic possibilities e.g. in relation to fishery. The main sectors include the service sector, agriculture, fisheries, infrastructure and planning.

### *3.2.1 Climate Change Impacts*

Projected climate change include stronger monsoon rainfall and thus higher frequency of floods, increased mean temperature, change in precipitation pattern– a decrease in average rainfall but increase in extremes, and sea level rise (IPCC 2007; GoB 2005c). The sea level projections foresee a rise of 45 cm around 2050, and this will lead to a potential loss of 15,668 km<sup>2</sup> land, which is expected to expose 11 percent of the population or 5.5 million people. If the sea level rise goes up to 1 meter the implications will be 20.7 percent of the land lost, exposing 14.8 million people. The direct and indirect consequences of sea level rise include saltwater intrusion into surface and groundwater systems, drainage congestion, decreased water logging potential, and devastating effects on mangroves e.g. in the Sundarbans (GoB 2002).

Climate change will exacerbate present conditions in land and environment, and could lead to land degradation due to malpractice, which again result in shortages in food production. As shown in Figure 1 major natural disasters in Bangladesh are storms, floods and cyclones, and

epidemics. Especially, the coastal zones will be severely affected by climate change. Within the last two decades, Bangladesh has experienced several devastating floods, providing an early indication of increasing vulnerability to climate change impacts.

### *3.2.2 Direct and indirect sector impacts*

The most vulnerable sectors to climate change impacts in Bangladesh include agriculture, coastal zones, water resources, forestry, fishery, infrastructure and health.

With 19 percent of GDP from agriculture and more than 60 percent of the population relying on agriculture as their main source of income, the entire economy is extremely vulnerable to climate change and natural disasters (World Bank 2008). The sector will suffer not only from increased mean temperatures but also from a rise in inundation frequency and the destruction of crops due to storms, floods and sea level rise. At the same time, a growing population number calls for more production. Due to the high population density, also in the coastal cities, floods can quickly cause severe damage. Epidemics and waterborne diseases will rise as a consequence of other disasters if no measures are taken.

The capital of Bangladesh, Dhaka, which is one of the most densely populated cities in the world, is also extremely exposed to climate changes. This is not only due to extremes like storms, tsunamis, and cyclones, but also to gradual sea level rise, coupled with deficiency in planning. (UN-Habitat 2008).

Given the number of storms and floods, infrastructure becomes increasingly important. Not only will roads and sewage systems be at risk and important to maintain, housing for the vast number of people living close to the waters and floods will also have to be either secured, or rebuilt every time a disaster occurs.

### *3.2.3 Analysis of development plans*

As one of the most disaster prone countries in the world, Bangladesh is familiar to dealing with climate extremes and is therefore already well advanced in climate change issues. Disaster preparedness is of major importance in Bangladesh, and the disaster sector is already reasonably well developed so that the country, instead of reacting after the occurrence of e.g. a storm, has taken preventive measures and increased resilience to such climate events. The country seems much aware of the high costs of inaction.

Most elements of climate change are henceforth integrated in the most recent Poverty Reduction Strategy Paper (PRSP) (IMF 2005) and in the PRSP document “Unlocking the Potential”(GoB 2005b) climate change and adaptation measures are briefly mentioned where the strategic goal has been set to integrate climate change issues with other policies, programmes and projects. Despite that most of the elements of climate change are mentioned in numerous plans, there is limited progress in implementing the stated goals and targets with the completion of the National Adaptation Programme of Action (NAPA) as an exception. The mentioning of climate change often remains in the environmental section, and may therefore lead to the conclusion that climate change is well considered in environmental issues, as it traditionally has been a part of.

There is a need for more general integration of climate change in more capital intensive sectors like infrastructure, where large investments risk being lost due to floods and storms, where it could have been avoided had other materials been used.

Despite this, there are good examples of sustainable development practice in Bangladesh, where climate change is integrated into the planning processes. The National Water Management Plan (GoB 2005d) is one example. Here, sea level rise and saltwater intrusion is addressed in e.g. building of coastal embankments, and use of alternative crops and water filters. Also road projects in Bangladesh note the potential damage from disasters in the design phase (World Bank 2006).

#### *3.1.4 Integration of Climate Change into Development Planning*

From the Action Programme mission in Bangladesh, it was clear that, there is potential for initiating several activities in Bangladesh, both as integrals of sector programme support and as

separate intervention. Even though climate is more integrated into development processes, than in the two other case countries in this paper, the inclusion of climate change issues could still be addressed in a more proactive way.

There are some obvious entry points for including climate change and new climate extremes into for example infrastructure projects. Some examples are

- Development of an approach for integrating disaster risk and future climate projections in the planning of rural road projects. This includes assessment of data needs involved in projections of risks related to cyclones and floods in the short term (5 years), medium term (up to 20 years), and in the longer term (50 years and ahead) as well as formalized risk assessment procedures to be applied to the projects.
- Development and test of road construction designs that take disaster risks and climate change into consideration.
- Development of a plan for maintenance of already established roads as well as for new roads that take disasters and climate change into account.
- Dissemination of experiences to the engineering department in the different ministries, and to local private sector engineering companies involved in consulting work on road design.

This of course requires that proper construction design is identified, and is feasible in specific situations (or in a specific situation). Here, the first bullet is important: identification, handling and managing the data needed to make the right investments is crucial. As much as adaptation is necessary, it should also be a focus not to overinvest in costly infrastructure – it is a fine balance to find the optimal level of adaptation

In relation to management of water resources, rainwater harvesting in Bangladesh could be further exploited, and used not only for drinking or cooking, but also in agricultural production. In Bangladesh, there seem to be somehow mistrusting towards the use of rainwater and therefore this will require some awareness raising before it could be implemented. It could however be an important tool to get access to water in times with either lack of water (require storage facility) or after storms and flooding, when well water is contaminated.

Tubewells could also be secured as many shallow wells are inundated during serious flooding. A design to prevent this has been developed to avoid being flooded, e.g. adjusting pump height. However, the different possibilities should be assessed, and the best options identified and installed in flood prone areas.

All of the above examples are very pragmatic and this is true for many adaptation issues – it is necessary to include an extra dimension in the planning process, to include new extremes or more/less water, higher maximum temperatures etc., and add that to traditional construction plans. It is also necessary to take a more macroeconomic approach, and systematically include designs as the ones mentioned above in general national development planning.

### **3.3 Bolivia**

Bolivia is the poorest country in South America with 65 percent of the population living in poverty. Especially the large indigenous population, who lives in secluded areas, and rely their main source of income on natural resources, suffers particularly from poverty (World Bank 2006a). 14 percent of the county's GDP stems from agriculture (World Bank 2008). There has been immense political and institutional instability, with six presidents since 2001 (Ríbando 2007) making sound economic development difficult.

Fragile ecosystems combined with an unstable economy and the high dependence on natural resources makes the population vulnerable to changes in the resource base and thus to climate change. Bolivia is also extremely vulnerable to changes in relation to water access and availability, because large parts of the country depend on glaciers as main source of water and these glaciers are melting (World Bank 2007).

#### *3.3.1 Climate Change Impacts*

Generally, climate change scenarios for Bolivia are limited as exact projections are extremely difficult to estimate because of the diverse topography of the country creating large differences



in temperature and precipitation. It is, however, anticipated that a number of changes will occur: changed in precipitation patterns, increase in temperatures, increase in occurrence of extreme events and changed seasonality of the seasons (IPCC 2007; RoB 2000)

With regards to natural disasters, Bolivia has the widest range of natural events among the three case countries. The main disasters are flood, epidemics and mass movements, but also drought. These events are all expected to be intensified by climate change.

### *3.3.2 Direct and indirect sector impacts*

The most vulnerable sectors in relation to climate change impacts were in the Action Programme identified as transport, health, agriculture and water, sectors which all affect the productive capacity and the food security of the country. Climate change affects Bolivia mostly in the form of disappearance of water sources, crucial for agricultural and human development as well as for industrial development.

With regards to agricultural impacts, an increase in rainfall in some parts of the country will impact water availability for land use and hence negatively affect crop yields. Also the increasing temperatures have led to acceleration in disappearance of the glaciers, the main source of water. In relation to health issues, the main concerns are heat stress, flooding and polluted water, and malaria epidemics.

Transport and thus market access is important for development, and it is necessary to have roads that can resist floods and mass movements.

Water is a major issue in Bolivian development and access to water is of great concern for industries as well as for livelihoods. The economic consequences of glacier retreat are enormous; the amount is counted in billions of dollars for the power sector, and affect water supply for mountain urban areas, agriculture, and ecosystem integrity (World Bank 2007b) - One of the important functions of glaciers is the capacity to regulate water supply through runoffs during dry and warmer period while storing water in the form of ice during wet and colder periods. Most areas in the highland depend on the glaciers for water provision. As they

are melting, water scarcity may become a problem in the near future. Water shortage will create a situation where choices have to be made between using water for production and using it for human consumption, stimulating the increase of social conflicts due to different interests. Thus, it can become a matter of choice between economic development and poverty reduction and survival.

### *3.3.3 Analysis of development plans*

In line with most countries, Bolivia has a National Development Plan (MDP 2006). The core objective of this Development Plan goes beyond merely poverty alleviation as the main aim. It states to suppress the causes that produce pervasive poverty, inequalities and social exclusion by addressing the long-standing needs of the Bolivian people, in particular the most excluded and impoverished sectors of society.

On this background and in the preparation of NAPA, the National Clean Development Office developed a National Adaptation Mechanism (“Mecanismo de adaptacion al cambio climatico” – MACC) in 2007, in tune with national development principles and priorities. The strategic objective of the mechanism is to make key local and national stakeholders aware of the country’s vulnerability to climate change; to adopt ownership of the problem and acknowledge the need for and usefulness of adaptation. This should facilitate the prioritization of actions oriented to reduce climate change vulnerability of different regions and sectors, to promote preventive measures for negative climate change impacts and to generate opportunities from the positive impacts, if any. The preventive measures are focused on climate change risk management within each sector.

Health issues are already being addressed as isolated initiatives; some activities in vector control and medical surveillance have been initiated aiming at community participation and local health education.

The Action Programme mission in Bolivia, 2007, found that the focus is not so much on climate in Bolivia but rather on equity and inclusion of all population groups, and equal rights for indigenous people. To avoid losing valuable work, and progression, climate change should not

be overlooked. When relocating indigenous groups, climate change should be an equal important factor as is the wish of giving all population groups equal access in terms of land/housing/possibilities.

#### *3.1.4 Integration of Climate Change into Development Planning*

Climate change impacts are not explicitly considered in current development planning, despite that the objectives and the activities face important climate risks. Most of the public funds that generate resources are highly climate sensitive. Therefore, risks associated with climate change need to be considered as a threat to economic development.

There is a slowly growing awareness among policymakers in Bolivia of the importance of including climate change considerations into general development plans, though the knowledge of climate change is mainly limited to the climate change focal point and collaborating organizations as well as some ministries that are dealing with areas directly affected by climate change and natural disasters.

Knowledge on climate change is of great importance among people involved in policy design, and therefore this knowledge should be enhanced among policymakers dealing with development policy. Many sensitive elements of the current Development Plan are likely to be affected by negative effects of climate change. Clear guidance and policies are needed to address climate risks in the process of implementing development plans to ensure development sustainability under climate change conditions.

One major obstacle to including future climate change in the development planning processes in Bolivia is the lack of data and predictions. The National Meteorological and Hydrological Service in Bolivian do not have sufficient infrastructure and resources to process and handle data. Despite these difficulties in exact predictions, climate is visibly causing changes so it is undoubtedly that adaptive capacity has to be developed and hence resilience to climate changes to be increased.

## 4 Conclusions

The extent to which decision makers make use of improved scientific understanding to achieve sustainable development goals in the face of climate change depends in large part on the coherence of the science base and effective channels of communication of new knowledge to policy makers in feasible and applicable terms.

It is critical that ministries who play a key role in development, such as the ministries of transport, public works, energy, trade, water, agriculture, health, state administration and planning and finance, understand the magnitude and timing of climate change impacts, and implications for their own ministries, their own role and responsibilities, and the funding options available. Ministerial stakeholders must take climate change into consideration in their budget planning and actively engage in involving climate change considerations into the development of plans. This requires a coherent, organized science base and effective channels of communication. It is also extremely important that the individual ministries understand the broadness of climate change and the importance of communicating across ministries to avoid causing harm to other ministries work or maladaptation.

While understanding the increasing importance of climate change impacts, the governments currently have limited capacity and restricted financial resources to ensure organized and consistent implementation of integrated climate change measures. Until this is in place, the integration of climate change impacts is likely to be ad hoc and slow. Development agencies, non-governmental organizations and the private sector, i.e. companies who are committed to invest in sustainable development while doing business with the countries, therefore have a crucial role to play in facilitating these processes. It is vital to understand and eliminate the perceived and real barriers to attracting investments in the countries and to emphasize climate change linkages.

## 5 Acknowledgements

The authors of this paper have been contracted by the Danish Ministry of Foreign Affairs to assist in the implementation of the Danish Climate and Development Action

Programme/Danida. This paper is inspired by the experiences gained by the authors through implementation of the Action Programme and do not represent the official views of the Danish Ministry of Foreign Affairs/Danida.

## 5 References

- Agrawal, S. (ed.) (2005), *Bridge Over Troubled Waters: Linking Climate Change and Development*. Organisation for Economic Cooperation and Development (OECD), Paris
- Arnell, N. (2003), Effects of IPCC's SRES scenarios on river run-off: a global perspective. *Hydrology and Earth System Sciences*. Vol 7(5)
- Arnell, N. (2004), Climate change and global water resources: SRES emissions and socio-economic scenarios. *Global Environmental Change*. Vol.14
- EM-DAT (2008), The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, Accessible at: [www.em-dat.net](http://www.em-dat.net), Last accessed 13 January 2008
- Government of Bangladesh (GoB) (2002), Initial National Communication under the UNFCCC. Ministry of Environment and Forest Government of the People's Republic of Bangladesh.
- Government of Bangladesh (GoB) (2005a), Government of Bangladesh and UN: Millennium Development Goals Bangladesh Progress Report, 2005. Accessed March 2009  
[http://www.mdgbangla.org/report\\_publication/Bangladesh%20MDG%20Progress%20Report%202005.pdf](http://www.mdgbangla.org/report_publication/Bangladesh%20MDG%20Progress%20Report%202005.pdf)
- Government of Bangladesh (GoB) (2005b), Planning Commission, Government of People's Republic of Bangladesh: Unlocking the potential. National Strategy for accelerated Poverty Reduction.
- Government of Bangladesh (GoB) (2005c), Government of Bangladesh: National Adaptation Plan of Action. Ministry of Environment and Forest Government of the People's Republic of Bangladesh
- Government of Bangladesh (GoB) (2005d), National Water Policy Highlights. Ministry of Water Resources Government of the People's Republic of Bangladesh
- Government of Mozambique (GoM) (2006), Plano de Acção para a Redução da Pobreza Absoluta 2006-2009. PARPA II (Second Poverty Reduction Strategy Paper). República de Moçambique, Maputo
- Huq, S., H. Reid and L. A. Murray (2006), *Climate Change and Development Links*. Gatekeeper Series 123. IIED, London, UK.
- IMF (2005), Bangladesh: Poverty Reduction Strategy Paper. IMF Country Report No. 05/410, November 2005.

- IPCC (2007) Climate change 2007: impacts, adaptation and vulnerability. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds). Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, 976 pp
- McDonald, R.E., D. G. Bleaken, D. R. Cresswell, V. D. Pope, and C. A. Senior (2005), Tropical storms: representation and diagnosis in climate models and the impacts of climate change. *Climate Dynamics* 25(1): 19-36.
- McGray, H., A., R. Hammill, E. Bradley, L. Schipper and J. Parry (2007), *Weathering the Storm: Options for Framing Adaptation and Development*. World Resources Institute.
- MDP (2006), Ministry of Development Planning (2006): *Plan Nacional de Desarrollo 2006-2010*, Available (March 2009)
- MICOA (2003), *Mozambique's Initial National Communication to the UNFCCC*. Government of Mozambique, 116 pp
- Ravallion , M., C. Shaohua and P. Sangraula (2007), *New Evidence og the Urbanization of Global Poverty*. World Bank Policy Research Working Paper 4199, April 2007
- Reacher, M., K. McKenzie, C. Lane, T. Nichols, I. Kedge, A. Iverson, P. Hepple, T. Walter, C. Laxton, and J. Simpson (2004), Health impacts of flooding in Lewes: a comparison of reported gastrointestinal and other illness and mental health in flooded and non flooded households. *Communicable Disease and Public Health*, 7(1), pp. 1-8
- Republic of Bolivia (RoB) (2000), *First National Communication to the UNFCCC*. Ministry of Sustainable Development and Planning. Vice-Ministry of Environment, Natural Resources and Forestry Development
- Ribando, C. M (2007), *Bolivia: Political and Economic Developments and Relations with the United States*. CRS Report for Congress, 2007.
- Tadross, M., C. Jack, and B. Hewitson (2005), On RCM-based projections of change in southern African summer climate, *Geophys. Res. Lett.* ,32, L23713, Doi:10.1029/2005GL024460.
- UN-Habitat (2008), *State of the World's cities 2008/9 – Harmonious cities*
- Wade, T.J., S.K. Sandhu, D. Levy, S. Lee, M.W. LeChevallier, L. Katz, and J.M. Colford, (2004), Did a severe flood in the midwest cause an increase in the incidence of gastrointestinal symptoms? *American Journal of Epidemiology*, 159(4), pp. 398-405.

World Bank (2006), Implementation completion report: third road rehabilitation and maintenance project

World Bank (2006a): En Breve, May 2006 No. 89.

<http://siteresources.worldbank.org/INTENBREVE/Newsletters/20943040/89-MAY06-BoliviaPA.pdf>

World Bank (2008), World Development Indicators 2008

World Bank (2007) Latin America and Caribbean Region Sustainable Development Working Paper 30 Visualizing Future Climate in Latin America: Results from the application of the Earth Simulator, November 2007

World Resources Institute (WRI) in collaboration with United Nations Development Programme, United Nations Environment Programme, and World Bank (2008), World Resources 2008: Roots of Resilience—Growing the Wealth of the Poor. Washington, DC: WRI.

Yamin, F. and S. Huq(ed.) (2005), Vulnerability, Adaptation and Climate Disasters. *IDS Bulletin* Vol. 36 No 4