

# **Climate Change in Zambia: Impacts and Adaptation**

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## ***Abstract***

*This article summarizes the impacts of climate change in Zambia as well as Zambia's adaptation efforts, both of which are detailed in Zambia's National Adaptation Programme of Action (NAPA) of September 2007. The article provides also (1) a brief review of the Zambia-specific climate change literature and (2) some empirical background on Zambia's socio-economic status and Zambia's agriculture. Among others, the article comes to the conclusion that in addition to international assistance, the Zambian government needs to become more capable of providing some sort of security for its people.*

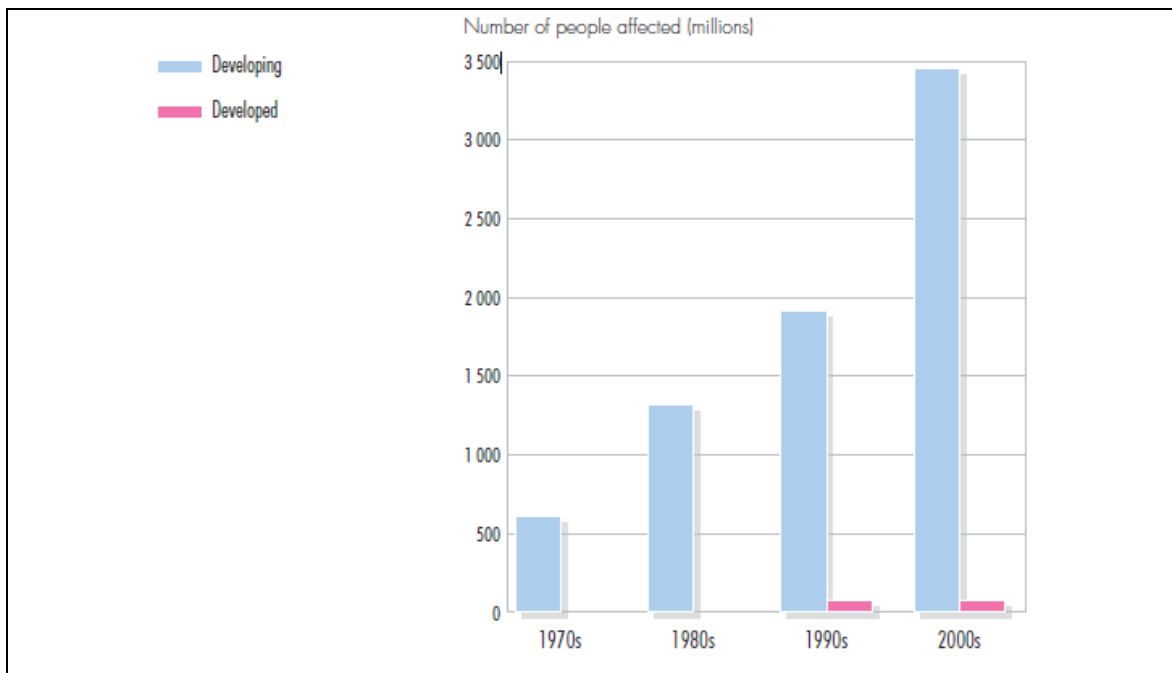
## **I. Introduction**

It is now clear that climate change, which is both an increase in long-term average temperatures as well as an increase in climate variability, is due to an increased concentration of greenhouse gases in the earth's atmosphere. As documented in the fourth assessment report of the Intergovernmental Panel on Climate Change (2007), the emissions of greenhouse gases have increased by 70 percent from 1970 to 2004, due to human activities. The increased greenhouse gas emissions have led to an increase in the greenhouse gas concentration in the earth's atmosphere, which traps some of the sun's heat. The well-observed impacts of this increased greenhouse gas concentration are (a) an increase in the earth's global average surface temperature, (b) an increase in sea levels, and (c) a melting of the Northern Hemisphere's snow cover.

As documented by the fourth Global Environment Outlook of the United Nations Environment Programme (2007), another critical observation has been an increase in the frequency and intensity of extreme climate-related disasters during the last four decades. While about 2 billion people were affected by such disasters in the 1990s, a combination of the observed and projected figures for the first decade of the 21<sup>st</sup> century shows more than 3.5 billion people affected by such disasters. Furthermore, while the climate-related

disasters of the 1990s affected 40 percent of the population in developing countries and only a few percent of the population in developed countries, the climate-related disasters of the first decade of the 21<sup>st</sup> century affected 80 percent of the population in developing countries while still only a few percent of the developed countries' population, see Figure 1 below. Given the South & East Asia's large population, South & East Asia was the worst affected region in absolute numbers; however, Africa was the worst affected region in terms of percentage of its population affected.

**Figure 1: Number of People Affected by Climate-Related Disasters in Developing and Developed Countries**



Source: UNEP (2007), Fourth Global Environment Outlook, Figure 8.5, p. 374 [based on data compiled from the Emergency Events Database (EM-DAT)].

This article summarizes the main impacts of climate change in the Republic of Zambia. These impacts include among others a huge decrease in agricultural productivity, a significant increase in the deaths of wild animals, a flooding of some parts of the country, a decrease in tourism, dried out rivers, the risk of Victoria Falls to dry out, and an increased spread of diseases such as malaria due to the increasing number of mosquitoes. The article explains also what Zambia has started doing to help itself overcome these challenges, and what is needed from the rest of the world to minimize the damage of climate change. This article is structured as follows. The next section (Section II) provides a brief review of Zambia-specific climate change literature. Section III provides some empirical background on Zambia, while Sections IV and V analyze, respectively, the main impacts of climate change in Zambia and Zambia's main adaptation efforts. Section VI provides some conclusions.

## II. Literature Review

There are by now various books and many articles which address problems that arise from climate change in Africa. One of the more famous books is the one edited by Pak Sum Low (2005). The literature addressing climate change specifically in Zambia is much thinner and focuses mostly on Zambia's climate change struggles, mainly in terms of negative impacts on Zambia's agriculture and food production. The most comprehensive report on climate change in Zambia is Zambia's National Adaptation Programme of Action (NAPA) of September 2007. The NAPA has been formulated by the Government of Zambia (2007), supported by the Global Environment Facility (GEF) and the United Nations Development Program (UNDP). As stated on the NAPA website of the United Nations Framework Convention on Climate Change (UNFCCC),<sup>1</sup> NAPAs provide a process to identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for which further delay would increase vulnerability and/or costs at a later stage.

Jain (2006) assessed the economic impacts of climate change on agriculture in Zambia, based on the Ricardian method which measures the effect of climate on the value of agricultural land, though the Ricardian method has been modified by replacing land value with net farm revenue as Zambia has an abundance of free farming land for subsistence farming. A multiple linear regression model with net farm revenue as response variable has been fitted with climate, hydrological, soil and socio-economic variables as explanatory variables. The results indicate that most socio-economic variables are not significant, whereas some climate variables and the corresponding quadratic variables are significant in the model. Further findings are that an increase in the November–December mean temperature and a decrease in the January–February mean rainfall have negative impacts on net farm revenue, whereas an increase in the January–February mean temperature and mean annual runoff has a positive impact.

Riché (2007) undertook a climate change vulnerability assessment based on community consultations in seven locations in Zambia and came to the conclusion that Zambia faces increased risks due to climate change due to a rise in the frequency and severity of extreme events, including droughts, floods and high temperatures, and a decrease in the length of the rainy season.

*“The rise in extreme climatic events is negatively affecting the natural, physical, financial, and human resources that are crucial for people’s livelihoods, and is leading to increased food insecurity and health issues. When facing climate hazards, small scale farmers (which are negatively affected by disruption of their normal farming cycles) rely heavily on access to alternative natural resources from forests and wetlands.”<sup>2</sup>*

OneWorld.net (2010) provides a briefing guide on climate change in Zambia, which summarizes the effects of climate change in Zambia and Zambia's adaptation measures. The guide also looks specifically at deforestation (which it considers to be a key agent in the linkages between poverty reduction, food security and climate change in Zambia) and

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<sup>1</sup> [http://unfccc.int/national\\_reports/napa/items/2719.php](http://unfccc.int/national_reports/napa/items/2719.php)

<sup>2</sup> Riché (2007), p. 31.

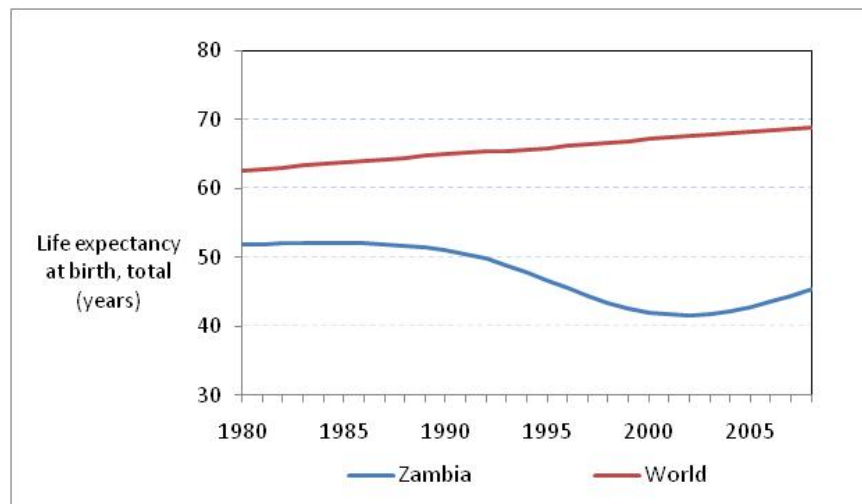
the prospects for future electricity access in Zambia (which amounts currently to about 49 percent for urban residents and only 3 percent for rural residents).

Finally, there are by now also many news reports documenting the negative impact of climate change in Zambia. One of the more recent such report has been provided by Smith (2009), who reports on the devastation brought on to Zambia as climate change brought on early flooding and that the Red Cross had warned that global warming will lead to more disasters along the Zambezi river basin. Another, even more recent news report on climate change in Zambia has been provided by the United Nations Development Program (UNDP),<sup>3</sup> which includes both a quick summary of climate change implications, and a video explaining them to increase awareness on the matter.

### III. Empirical Background

Zambia is a Sub-Saharan African country with a land area of 752,614 km<sup>2</sup>, though only 34 percent of the land is effectively used for agriculture. The country consists mostly of plateau with an elevation between 950 meters to 1500 meters above sea level.<sup>4</sup> It has a population of about 10 million people, of which 65 percent live in rural areas. Fertility rates remain with an average of 5.3 children per woman very high in Zambia. Child employment in agriculture (age 7-14) constitutes 95.3 percent for females and 96.5 percent for males. The country's life expectancy is with 41.7 years extremely low. As Figure 2 shows, life expectancy has been decreasing in Zambia for most of the last three decades, partly due to a high HIV/AIDS prevalence rate, which currently stands at about 17 percent.

**Figure 2: Life expectancy at birth, total (years), 1980-2008**



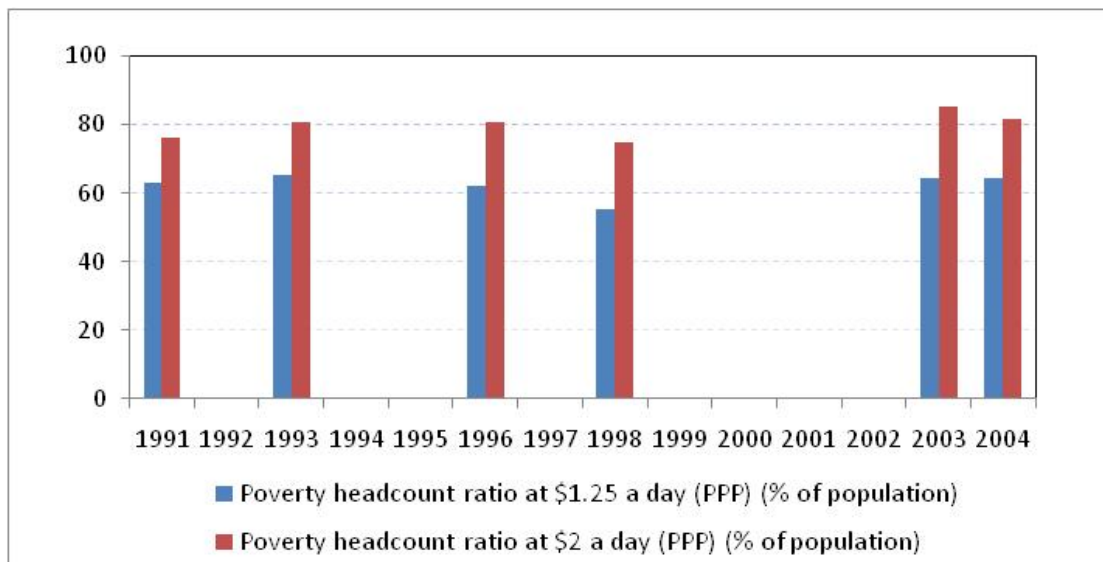
Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with *World Development Indicators* data as posted by the World Bank on May 2010; data for a few missing years was calculated by the author using simple averages.

<sup>3</sup> <http://content.undp.org/go/newsroom/2010/january/climate-change-the-zambia-story.en>

<sup>4</sup> See Jain (2006), p. 6.

Zambia is due to (a) its low income, (b) its low human development, and (c) its high economic vulnerability classified by the United Nations as one of the world's 49 least developed countries (LDC).<sup>5</sup> Zambia's latest Poverty Reduction Strategy Paper (PRSP) for 2002-2005 indicated that about 73 percent of Zambians are (based on Zambia's national poverty line) poor. Figure 3 shows the percentages of Zambia's population living below PPP\$1.25-a-day and PPP\$2-a day for all the years such data currently exists. It confirms the severe level of income poverty in Zambia and also shows that overall no progress has been made in reducing income poverty since 1991 (which is the first year for which such data is available).

**Figure 3: Poverty in Zambia, 1991-2004**



Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with *World Development Indicators* data as posted by the World Bank on May 2010.

Poverty is a multidimensional phenomenon, caused by many factors. Some of the more macroeconomic factors are low savings, low investment and unemployment. Being a Heavily Indebted Poor Country (HIPC), Zambia has recently qualified for debt relief under the Multilateral Debt Relief Initiative (MDRI).<sup>6</sup> Steps such as the *Fifth National Development Plan (FNDP)*<sup>7</sup> are being taken to contribute to the advancement of the Millennium Development Goals (MDGs) and Zambia's *National Long Term Vision 2030*.<sup>8</sup> However, as shown in Figure 3, these efforts are complicated by the fact that Zambia's dependence on agriculture has (despite a high volatility of agricultural production) grown in the past few decades. As will be shown in more details in the next section, this

<sup>5</sup> See United Nations Conference on Trade and Development (UNCTAD) (2009).

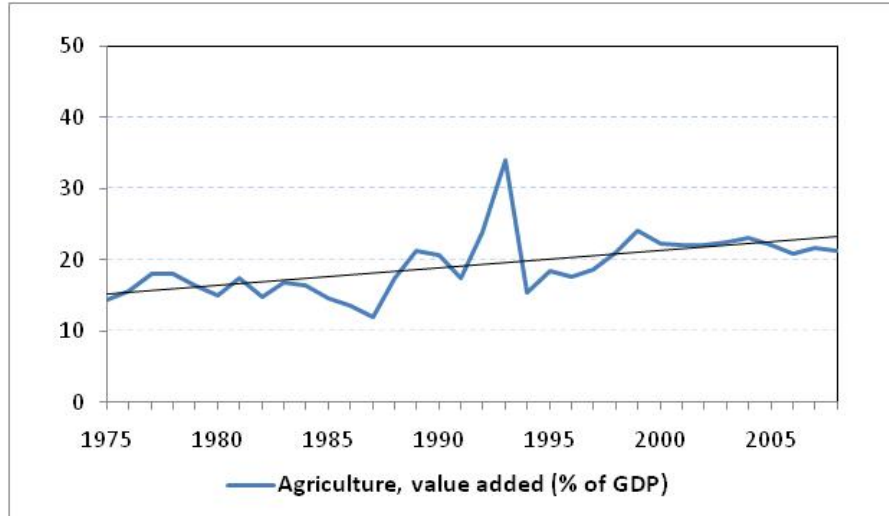
<sup>6</sup> See for example, <http://www.imf.org/external/np/exr/facts/mdri.htm>.

<sup>7</sup> See Government of Zambia (2006).

<sup>8</sup> See [http://www.mofnp.gov.zm/index.php?option=com\\_content&task=view&id=39&Itemid=57](http://www.mofnp.gov.zm/index.php?option=com_content&task=view&id=39&Itemid=57).

dependence on agriculture in the wake of climate change makes the Zambian people even more vulnerable to changes in weather conditions, which determine agricultural output.

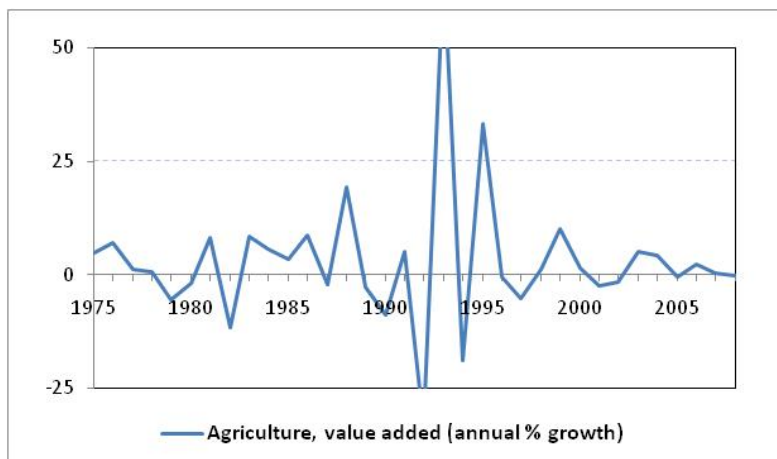
**Figure 3: Share of Agriculture (value added, % of GDP), 1975-2008**



Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with *World Development Indicators* data as posted by the World Bank on May 2010.

Despite the increased importance of agriculture within the Zambian economy, agricultural has not grown much over the last 30 years (averaging 3.0 percent per year from 1975-2008), largely due to frequent shocks, see Figure 4 below. Since 2000, the average annual growth rate of agriculture has been slightly below one percent.

**Figure 4: Annual Growth Rates of Agriculture (percent), 1975-2008**



Source: World Bank (2008) *World Development Indicators 2008*, CD-Rom, updated with *World Development Indicators* data as posted by the World Bank on May 2010.

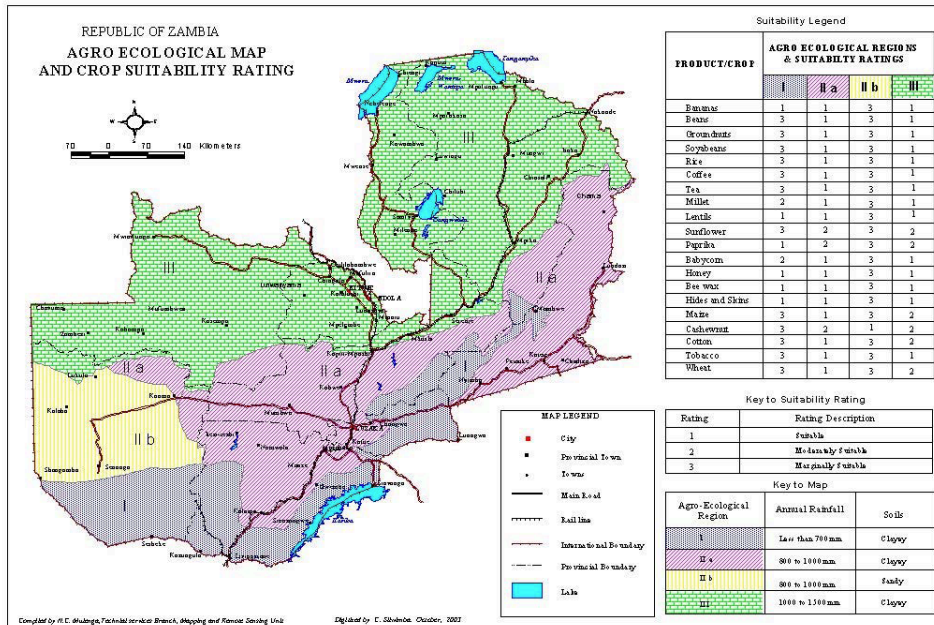
## IV. Climate Change Impacts

### IV.1. Impacts on Agriculture

The key climatic hazards Zambia is facing are droughts, floods, and—to some extent—extreme temperatures. All of them have negative effects on agriculture. Excessive precipitation in Zambia’s non-drought prone region, an increased frequency of droughts in the drought-prone regions, and a generally shortening of the growing season affect agricultural production and food security negatively, which then reduces the livelihoods as well as the adaptive capacity of individuals and communities.

- During the agricultural season of 2004/05, two thirds of the country lacked the much-needed rainfalls, creating 120,000 tons of food shortage and 1.2 million starving people until the subsequent year’s harvest. Cotton and tobacco fields, which typically resist drought seasons, have also been affected.
- Floods have also become more recurrent, and even started affecting areas that had never experienced flooding before. Based on Zambia’s NAPA of 2007 (see Government of Zambia, 2007) floods have affected 41 out of Zambia’s 72 districts. The magnitude and timing of the floods also caused problems, as the regions that are used to the floods were caught unprepared by earlier occurrences and higher magnitudes.

**Figure 5: Agro-Ecological Map and Crop Suitability Rating for Zambia**



Source: Government of Zambia (2007), Figure 1.1, p. 2.

As shown in Figure 5, Zambia has three agro-ecological regions, with Region II split into two sub-regions. Each region/sub-region comes with a different crop suitability rating.

Historical baseline data shows that Region I experienced the lowest rainfall over the last 30 years, followed by Regions II and III, respectively. Projections based on historical trends show that Regions I and II will experience lower average rainfalls in the future, while Region III is expected to have an increase in average rainfall. This will impact agricultural production negatively as the first two regions, especially Region I, are already now drought-prone regions.

#### **IV.2. Impacts on Human Health**

Beside the lack of food, which has had dreadful impacts on the Zambian population's health, other factors, enhanced by climate change, are also causing their health to be at risk. Climate changes are predicted to increase mortality levels associated with climate-sensitive diseases. Health in general will also be affected by stress/drought or death/injury due to floods or storms. Factors that contribute to water-borne diseases are also increasing. Those factors include water and air quality, temperatures, and the quality and quantity of food. Malaria, being the number one killing disease in Zambia, requires a constant assessment of its status. Floods are expected to have effects as water recedes and stagnates, causing favorable environments for mosquitoes, which will in turn transmit more diseases. Floods also became an important factor leading to water contamination, due to the increased pit-latrines collapses and other similar hazards.

#### **IV.3. Impacts on Wildlife**

Climatic situations have a direct effect on animal populations. Cattles, for instance, have reduced in numbers due to the increased temperatures and the lack of food and water. The reduced cattle population will also directly affect the farmers that depend on them for productivity. The increased droughts, which cause fires, soil degradation and fertility loss, have already started impacting forests. Miombo forest, which was known for its fast regeneration, is now at danger. Beside natural resources being threatened, wild animals have started showing changes in behaviors, migrating to other places, suffering from the lack of food, and getting more diseases. Elephants, for instance, are much skinnier than they used to be, and that makes them weaker, threatening their overall survival. The water shortage, as well as for having had a direct impact on fish stocks, has also had disturbing effects on the whole ecological system.

#### **IV.4. Impacts on Zambia's Economy**

It goes without saying that a country dependent on agriculture will suffer economically when its production levels fall low. Getting out of poverty only gets more difficult when the natural environment that the country is dependent on is affected negatively. On top of that, there is no system that provides the population with basic needs or protects them from the impacts of climate change. A large part of the Zambian population is therefore stuck in poverty, relies on international aid and the wealthier segments of the Zambian population to survive within the changing environment.



#### **IV.5. Projected Impacts of Climatic Hazards**

Looking to the future, Zambia's climate is expected to see an increase in temperatures in Regions I and II as well as an increase in alternating occurrences of drought and floods throughout the country. This will increase the risks of drowning, climate-sensitive diseases, outbreaks of infectious plant, zoonotic and human diseases, the destruction of agricultural crops, roads, housing, power and water supply infrastructure with the concomitant disruption of the accessibility and delivery of health services and relief assistance which will then result in food shortages and an increase in malnutrition or starvation. Climate change will likely also increase the displacement of Zambia's population and lead to anxiety, depression, and overcrowding.

All other sectors of the economy that depend on Zambian food resources are at risk. The maize industry, for instance, will see difficulties as most of its varieties will not mature because of too short growing seasons. Given that agriculture is such an important part of Zambia's economy, the resulting food shortages will greatly affect the whole country, as it has already started doing.

Studies have also shown that Zambia's fish are at danger. Water levels are predicted to lower down in rivers and lakes, consequently affecting the fishing industry. Some fish species such as the breams and sardines, which are the most vulnerable ones, might not survive the environmental change. Some communities also depend on various animals as a source of nutrition. For example, puku, lechwe and waterbucks will impact their surrounding communities when their migrating behaviors will alter due to the changes in rainfall frequencies. Also, higher temperatures and droughts will prevent the forests from regenerating properly. The miombo forest, which covers 60 percent of the territory, is the source of fuel and charcoal for over 80 percent of households. Its condition will therefore have high stakes for all the communities and animals that depend on it.

#### **V. Adaptation Measures**

There are many ways by which the people of Zambia have started adapting to climate change repercussions. As the NAPA report describes, many of the strategies used to adapt are alike between different villages. That is simply because most of the problems they are faced with are the same. For instance, they deal with the increase in diseases by boiling their water, treating it with chlorine, using traditional medicinal plants and going to medical clinics. To deal with the declining crops and fish stocks, the communities try to diversify by relying on other natural resources. These diversifications depend on the resources available, the level of education, expertise, coordination, and institutional support, which can be different from one community to another. Typical income diversification include charcoal making, fishing, honey and beer production, selling grass and livestock, crafts making, depending on the situations and resources available. To acquire food, villagers often need to trade commodities.

To deal with drought, selling fewer crops to keep more for household consumption becomes common. Furthermore, shifting agricultural production from highlands to lower lands, planting crops earlier, incorporating crop residues instead of burning them, growing more drought resistant crops, crop rotating, intercropping, cover cropping, irrigating,

sinking wells, and walking longer distances to get water are all adaptation strategies that are taking place in Zambia.

When faced with floods, adaptation measures include gathering and selling wild food, as well as the shifting of agricultural production, livestock and houses to higher lands, burying ditches to prevent waterborne diseases, evacuating early when water levels are known to increase, improving drainage around houses, putting plastic on top of houses, and building shelters to compensate for destroyed houses

When rainy seasons are shorter, coping strategies such as using bed-nets and repellents for mosquitoes, working earlier in the morning, buying medicines for cattle, using zero-grazing for some animals, as well as other adaptation strategies applicable to drought and floods situations are put into place.

All of these coping strategies are basic ways to deal with each of the issues to some extent. But there is only so much that individuals or communities can do to adapt to climate change. There is a strong need for national and global strategies to take place to reduce further damages. By sorting each region by their needs, national plans can be made to more effectively adapt to the imminent changes, and help agriculture, fishery, livestock production, human health, and natural resources. The NAPA made a list of options that would all help the different issues Zambia is facing. From those options, the most prioritized ones are:

- Strengthening of early warning systems to improve services to preparedness and adaptation to climate change in all the sectors (agriculture, health, natural resource, and energy).
- Promotion of alternatives sources of livelihoods.
- Adaptation of the effects of drought in the context of climate change in Zambia's agro-ecological region I.
- Management of critical habitats.
- Promote natural regeneration of indigenous forests.
- Adaptation of land use practices (crops, fish and livestock) in light of climate change.
- Maintenance and provision of water infrastructure to communities to reduce human-wildlife conflict.
- Eradication of invasive alien species.
- Capacity building for improved environmental health in rural areas.
- Climate-proofing sanitation in urban areas.

## **VI. Conclusion**

Zambia is one of the most affected countries by climate change. Drought, floods, and higher temperatures are all environmental factors that are extremely difficult to deal with,

especially in a poor country like Zambia. Despite ambitious policy statements, Zambia has virtually no hope of getting out of poverty on its own. Though the international community is willing to provide some support, there are many issues that need to be addressed in order to improve the living standards of the Zambian population. Ideally, apart from the adaptation measures listed above, the Zambian government needs to become more capable of providing some sort of security for its people. There needs to be some kind of safety net, securing the people from what would otherwise lead to diseases and death. It is obvious from the many issues related to climate change adaptation and poverty reduction that there is no single solution. It is rather a long list of issues that need to be addressed, in order to address the country's needs from many angles and would then synergistically improve Zambia's dire situation.

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