

Climate Change and Disaster Risks in Uganda

Climate Change and Disaster Risk Guide



Which climate and disaster risks affect Uganda?

How do climate change and disaster risks affect
Uganda?

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Picture Front Side

Farmer is watering crops with water from an irrigation project in Uganda. Photo by Simon Rawles. Accessed on Sept. 13. 2018 via <http://climatetracker.org/ugandas-agriculture-cant-thrive-beyond-1-5-degree-global-warming/>

Text

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Bread for All is the development organization of the Swiss Protestant Community of Churches. The organization supports 400 development projects and programs in 57 countries in Africa, Asia, and Latin America. In addition, its development policy has the goal of creating fairer international socioeconomic structures, maintaining creation, and bringing peace.

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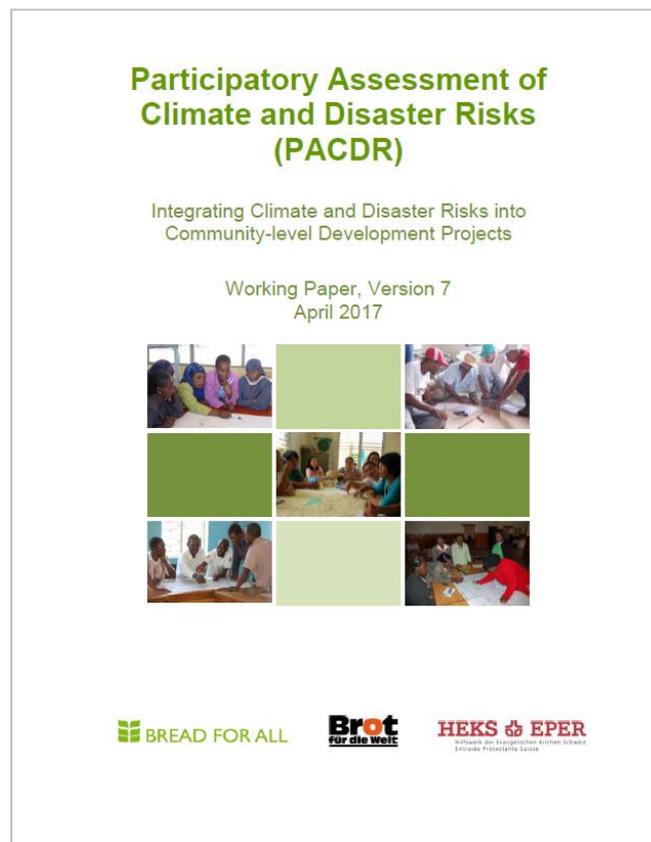
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1. Introduction

Climate change is one of the largest challenges, humanity faces today. Communities in Uganda are especially affected by the impacts of this global phenomenon, even though people in Uganda have contributed little to causing climate change.

The first step to cope with the adverse effects of climatic changes is to know about climate change and its impacts. Thus, this guide aims to provide basic information on climate change, its causes, and how it affects humans. Furthermore, this guide can also be used to analyze the climate context with the *Participatory Assessment of Climate and Disaster Risks (PACDR)* developed by HEKS, *Bread for all* and *Bread for the World*.



An introduction to the terminology on climate change and disaster risk reduction can be found in the PACDR tool on page 7 which can be downloaded here:

https://brotfueralle.ch/content/uploads/2014/04/PACDR_E_Ver7-April-2017.pdf

2. Climate Change and Disaster Risks in Uganda

As climate is a long-term phenomenon, it is not easy to identify changes. In order to be able to distinguish between “natural” climate variations and man-made influences and long-term trends of climate change, it is necessary to know what Uganda’s “general” or “normal” climatic conditions are. On this basis, trends can be identified. When working on climate change in a specific region, it is advisable to find out about local climate conditions first.

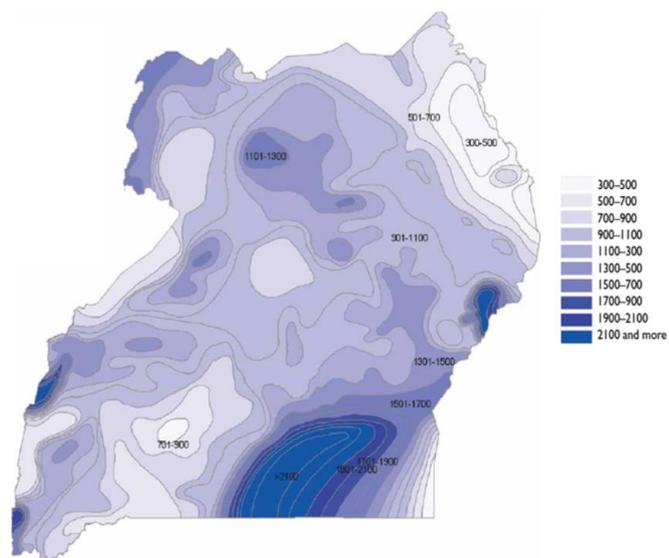
2.1 General Climate in Uganda

Uganda is located on the East African plateau and lies almost completely within the Nile basin. Situated along the equator, its climate is mainly tropical. Nevertheless, it has diverse climate patterns due to the country’s geographic features such as topography (mountain ranges), prevailing winds, lakes and rivers (Tetra Tech ARD 2013, Hepworth 2010).

Precipitation

Generally, the country has two well-defined rainy seasons (March to May, September to November) and two dry seasons (December to February, June to August), progressively merging into one rainy season. Most of the territory receives an annual rainfall of at least 1000 mm and is, therefore, relatively humid. Precipitation levels vary considerably between different regions. Generally, conditions are drier in the western part of the country whereas the northeastern Karamoja region has the driest climate (see Figure 1) (Tetra Tech ARD 2013, Hepworth 2010).

Figure 1: Average annual precipitation in Uganda, in mm/year



Source: Tetra Tech ARD 2013.

The region’s climate is naturally dynamic with high temporal and spatial rainfall variability. A part of this variability can be explained by large scale oscillations in atmospheric and ocean circulations, such as the El Niño Southern Oscillation (ENSO). During ENSO, sea-surface temperatures of the Pacific Ocean rise and tend to lead to more rain, especially during the latter part of the September to November season. Partly due to such phenomena, extreme events like droughts or floods occur regularly (Tetra Tech ARD 2013, Hepworth 2010).

Temperatures

Although Uganda is situated on the equator, its climate is rather warm than hot. Average temperatures vary little throughout the year but generally by altitude. For instance, on Lake Albert, the mean annual maximum temperature is 29°C and the mean annual minimum temperature is 22°C. In Kabale in the southwest, 1,250 m higher, the mean annual maximum temperature is 23°C and the mean annual minimum temperature is 10°C. In Kampala, mean temperatures range between 27°C and 17°C. Generally, average temperatures increase in the south of the country as the elevation decreases towards the Sudanese plain (Hepworth 2010; Kyoheirwe, Kabones and Muhanguzi 2012; McSweeney et al. 2012).

Climatic zones

Uganda's climate can be broadly subdivided into

- the highland climate with cool temperatures and moderate rainfall,
- the savanna tropical climate (including the lake basin climate) with moderate annual temperatures and high mean annual rainfall and
- the semi-arid climate with relatively high average temperatures and relatively low mean annual rainfall.

2.2 Past Trends of Climate Change and Disaster Risks in Uganda

Climate change is already happening in Uganda, as well as around the world. Please have a look at the PACDR tool on global trends, which explain the reality of man-made climate change (https://brotfueralle.ch/content/uploads/2014/04/PACDR_E_Ver7-April-2017.pdf).

Past and present changes help to indicate possible future developments, so it makes sense to have a look at climate changes during the last decades.

In general, the East African region is not known for a strong variability of its climate. Whereas there has been a significant increase in average annual temperatures over the last 60 years, developments of precipitation levels are less clear. The overall trend points to a gradual wetting trend, while seasonally, there has been a decrease of rainfall at the regional scale (Hepworth 2010, Tetra Tech ARD 2013).

Temperature

Analyzing data produced by 16 representative weather stations over the last 60 years (1951-1980 and 1981-2010) a recent study (Tetra Tech ARD 2013) found a significant overall increase of average annual temperatures in Uganda. Whereas the minimum temperature rose by 0.5-1.2 °C, maximum temperatures increased by 0.6-0.9 °C. Other studies recorded even higher overall increases by about 1.3 °C since 1960, an average rate of 0.28 °C per decade. Daily temperature observations showed significantly increasing trends in the frequency of hot¹ days and nights (McSweeney et al. 2012).

Rainfall

In contrast to the raising temperatures, different studies are not consistent regarding the development of precipitation levels over the last decades. Overall trends seem to point to a small increase in annual precipitation in Uganda.

The finding of no strong long-term changes in precipitations in Uganda does not exclude shorter-term changes in rainfall and its variability. For instance, researchers recently identified a decline in rainfall during the March to May season at a regional scale, persisting since 1999. There is also evidence for a shift in timing of peak seasons and in the magnitude and intensity of precipitation (Kyoheirwe et al. 2012). The inter-annual variability regarding the onset, cessation, and the length of the rainy seasons is significant but, here again, no overall (long-term) trend, or spatial pattern, has been detected (Tetra Tech ARD 2013).

Extreme events

In Uganda, rainfall is the most sensitive climate variable that affects social and economic activities. Although there has been no significant overall trend in precipitation levels over the last decades, the population has been increasingly affected by extreme events induced by climate change. In many regions other than the central region (Kampala and Entebbe) there is evidence of an increased frequency of droughts in recent years. In general, the incidences were more pronounced in western and north eastern parts of Uganda (Government of Uganda 2002). The northeastern Karamoja region has been most affected by this

¹ 'Hot' day or 'hot' night is defined by the temperature exceeded on 10% of days or nights in current climate of that region and season.

phenomenon, experiencing not less than six severe droughts since the late 1980s, according to the International Disaster Database (EM-DAT 2014). Floods have even been far more frequent, occurring almost every year in the last decades, but generally affecting significantly less people than droughts. Landslides are of raising concern as well, like the 2010 incident resulting in at least 388 deaths, according to EM-DAT.

Other risks

In addition to the hydrometeorological hazards, the most frequent disaster risks in Uganda are health risks, such as human and animal epidemics and diseases. Bacterial and viral infectious diseases occur regularly, leading to dozens to hundreds of deaths every year. Although Uganda is not very prone to earthquakes, parts of Western and Central Uganda are considered as seismically vulnerable. Increasing over the past years were several anthropogenic hazards in urban settings, such as traffic accidents or high-risk industrial installations (UNDP Uganda 2015). Studies show that other disasters in Uganda include pest infestations, crop and animal diseases resulting in yield losses and food insecurity (The Republic of Uganda & UNDP 2014).

2.3 Projected Trends of Climate Change and Disaster Risks in Uganda

The International Panel on Climate Change (IPCC) consists of a large number of climate scientists from around the world and its task is to model future climate change and its impacts. With the help of very complex computer models which have been “filled” with huge amounts of data from the present and the past, those scientists try to forecast climate change for the next decades. Of course, the future is always uncertain. However, by using different scenarios and by cross-checking the models with the past, fairly good projections for the future can be made.

Temperature

Different models and scenarios from several studies agree on the continuation of the already observed increasing trend in temperatures. Annual average temperatures in Uganda are predicted to increase on the order of 0.8-1.5 °C until 2030 (Tetra Tech ARD 2013; Zinyengere et al. 2016), 0.9-3.3 °C until 2060 (Zinyengere et al. 2016) and, 1.4-4.9 °C for a 2090 horizon (McSweeney et al. 2012) (see Figure 2).

Figure 2: Climate projections of the 2060s in Uganda

		Annual			January to February			March to May			June to September			October to December		
		Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Temperature (°C)	High	1.9	2.5	3.1	1.5	2.3	3.3	1.8	2.5	2.9	2.0	2.6	3.2	1.8	2.2	3.1
	low	1.0	1.8	2.2	1.0	1.5	2.3	1.1	1.7	2.2	0.9	1.9	2.4	0.9	1.6	2.1
Hot days % Frequency	High	19	29	43	23	32	62	19	35	50	31	45	58	17	29	52
	low	16	22	30	17	29	32	15	27	34	20	33	43	16	23	38

Future climate change projections for Uganda (2060s), across the different seasons.

The light blue blocks indicate increases. Min, Med and Max represent the minimum, median, and maximum values of the data range.

Source: Zinyengere et al. 2016.

A more recent review of several studies on climate change by the Directorate of Applied Data and Climate Services Uganda National Meteorological Authority (UNMA, 2018), indicates an increase in maximum and minimum temperatures of 1-3 C° by 2065 with minimum temperatures increasing more rapidly (UNMA 2018).

Projections indicate significant increases in the frequency of days and nights considered ‘hot’ in current climate. By the 2060s, 16-43% of the days will be ‘hot’ (Zinyengere et al. 2016), and 18-73% of the days by 2090. ‘Hot’ nights are projected to increase even faster, occurring on 31-84% of the nights by the 2060s and 35-97% of the nights by the 2090s. The occurrence of days and nights considered ‘cold’ in current climate is expected to become exceedingly rare. For a 2090 horizon and under the highest emissions scenarios, they don’t occur at all (McSweeney et al. 2012).

Precipitation

Developments of future precipitation levels are less certain than the increasing temperatures. Some studies point to a small, but not significant, increase in annual rainfall totals by the 2030s (Tetra Tech ARD 2013). Others indicate a significant increase in annual rainfall up to 43%. All together the studies show an average slight increase in mean rainfall for Uganda (Zinyengere et al. 2016) (See Figure 3).

Figure 3: Precipitation projection for the 2060s in Uganda

		Annual			January to February			March to May			June to September			October to December		
		Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Rainfall (%)	High	-2	6	21	-16	5	42	-10	7	19	-8	0	43	-4	7	21
	low	-5	4	13	-12	4	34	-9	3	21	-12	1	21	-8	5	11
Heavy rain events (%)	High	1	4	8	-6	4	12	0	3	8	-1	2	14	0	5	9
	low	0	3	5	-1	2	9	0	3	6	-5	1	8	0	2	6

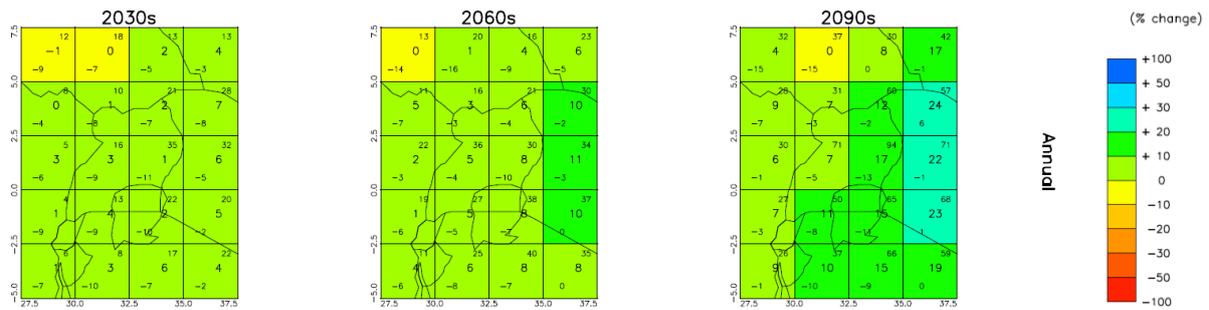
Future climate change projections for Uganda (2060s), across the different seasons. The light blue blocks indicate increases, as the dark blue blocks indicate decreases. Min, Med and Max represent the minimum, median, and maximum values of the data range.
Source: Zinyengere et al. 2016.

Figure 3 shows the significant variability across the different months and seasons as some of them indicate increases and others indicate decreases in rainfall. Studies show that most of the increases in rainfall will be at the western shores of Lake Victoria and the Mount Elgon region in the central western part and to the zone extending from Rwenzori to the southern parts of Lake Kioga (Zinyengere et al. 2016).

Through the recent review of several studies on climate change by UNMA, an attempt was also made to investigate the sensitivity of water resources to climate change. An example is the Lake Kyoga catchment area, where climate change has already affected water resources with continuous reduction in water levels of 6%. The results of the study revealed that climate change is likely to increase precipitation in the area by 10-20% received during the wet seasons, resulting in higher stream flow, and a reduction of 20-40% of precipitation during the dry seasons (UNMA 2018).

Increases in rainfall are predicted to be highest from December to February, which is historically the driest season. This development could lead to a change of seasonality of rainfall in the future, with the March to May rainy season shifting forwards in time or the September to November rains extending into, what's today, the dry season. Spatial patterns (see Figure 4) suggest stronger increases of annual rainfall in the eastern part of Uganda. Although long term projections point in an upward direction, precipitation could decrease for a 2030 horizon, depending on the season and the geographical region (McSweeney et al. 2012).

Figure 4: Spatial patterns of projected change in monthly precipitation until 2090s



Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are percentage anomalies relative to the mean climate of 1970-1999. Source: McSweeney et al. 2012.

Extreme events

Projections indicate an increase of the proportion of rain falling in heavy events, with the largest increases being seen in the rainy seasons. Rainfall maxima could increase by 27 mm in one-day events and up to 37 mm in five-day events (McSweeney et al. 2012). Heavy rain events are projected to increase up to 14% until the 2060s by some models (see Figure 3). Connected to this is the increasing runoff, where the Upper Nile Basin region of Uganda could already see an increase in runoff in the early 2030s (Zinyengere et al. 2016). In other words, climate variability will increase further and will result in more frequent and intense extreme weather and climate events such as droughts, floods, landslides and heat waves. Therefore, climate change is predicted to increase the frequency of climatic extremes that can lead to loss of life and property (UNMA 2018).

2.4 Impacts of Climate Change and Disaster Risks in Uganda

Ongoing changes of Uganda's climate have had severe adverse impacts on different environmental and social resources and sectors, as they increased extreme weather and climate events. Floods like those which occurred in 1997/98 or 2007 resulted in enormous losses of agricultural land, crops and livestock and lead to infrastructural damage and displacement. In a period of ten years (from 1991 to 2000) Uganda experienced seven droughts which caused severe water shortage, leading to loss of animals, low production of milk, food insecurity, increased food prices and generally negative effects on the economy. The highlands, which were previously malaria-free, are now invaded by the disease, because of the temperatures rising over the last decades. These impacts will increase in the future, as climate change increases.

Some sectors are particularly vulnerable to these adverse effects of climate change, such as health, agriculture, pastoralism, biodiversity, eco systems, and water resources.

Health

Increased temperatures and heavy rainfall can result in shifts in the spread of diseases like malaria or sleeping sickness. In originally malaria-free belts, particularly in the higher altitude regions the populations are newly exposed to high infection rates, morbidity and mortality.

Indeed, malaria has been identified as the most serious killer disease accounting for about 50% of out-patient visits (Zinyengere et al. 2016).

Floods pose serious pollution problems to sources of drinking water, with the potential danger of outbreaks of cholera and other waterborne diseases such as diarrhea, typhoid and dysentery. These diseases will then affect especially areas with poor sanitation (Zinyengere et al. 2016). Longer dry seasons could increase the incidence and severity of respiratory diseases. Increased workloads in coping with climate change impacts could cause stress and ill health. Furthermore, extreme weather and climate events can weaken the infrastructure of health services and lead to a decrease in quality of medical care (Government of Uganda 2007; McSweeney et al. 2012). Additionally, extreme weather events as floods and droughts are leading to food crop losses and food insecurity, resulting in malnutrition and famine (Zinyengere et al. 2016).

Agriculture and food security

Agriculture is the backbone of the Ugandan economy. It employs over 70% of the workforce and accounts for almost 25% of Uganda's GDP. The main export crops, coffee, tobacco and fish, account for approximately 37% of export earnings (Index Mundi 2018b). Most of Uganda's agriculture is rain-fed and there are mostly food crops grown for subsistence and the local market.

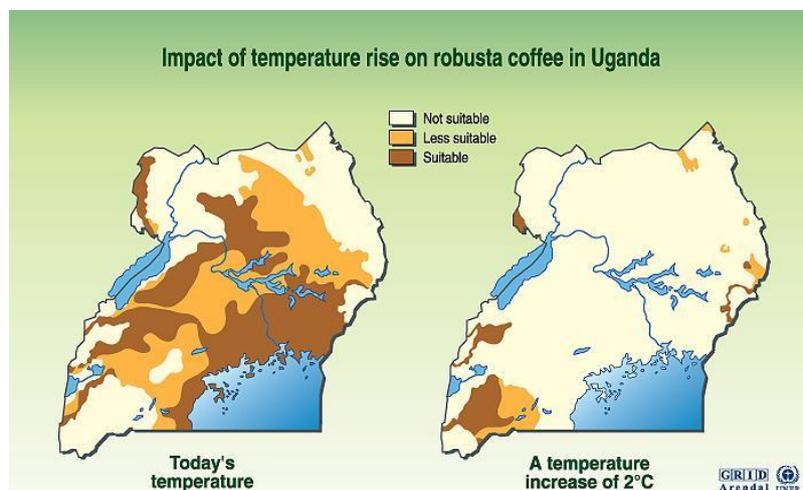
Climate change affects agricultural production in a diverse and complex

manner. More intense rainfall, higher temperatures, droughts and soil erosion can cause losses in yields and livestock. The changes in average rainfall may increase or decrease yields and expand areas suitable for livestock (Zinyengere et al. 2016).

While crops such as cassava, which did not do well so far in the cold zones of the mountains, are now grown in higher altitudes, others such as coffee are endangered by the rising temperatures induced by climate change. According to UNEP's analysis, in a conservative scenario with a 2°C rise in temperature, conditions for Robusta coffee will become unsuitable across most of Uganda's coffee growing area (see Figure 5). As the nation's leading export commodity, the loss of coffee within 30 to 70 years could lead to the loss of US \$266 million in exports, which is 40% of export revenue and 3% of Uganda's GDP (Hepworth 2010). Further, this could have implications for other commercial crops that are grown, such as paddy rice and cotton.

But it is not only cash crops that are affected by rising temperatures, increasing rainfall and more frequent extreme events. Food crops like matooke, maize, beans or rice which are essential for Uganda's food security are also vulnerable to adverse effects of climate change, even if not to the same extent. Table 1 summarizes the vulnerability of the most frequently grown crops in Uganda to adverse effects of climate change. Coffee is to be seen as the most important cash crop while maize is the most important subsistence crop.

Figure 5: Impact of temperature rise on robusta coffee in Uganda



Source: Simonett 1969.

Table 1: Comparison of the extent of climate related vulnerability by crop

Vulnerability	Coffee*	Matooke	Maize	Beans	Rice	Sorghum	Sweet Potatoes	Cassava
Rising temperature threatens suitability for production	+++	++	++	+	+	+	+	0
Falling soil fertility reduces yields and makes crop more vulnerable to climatic stresses	+++	+++	+++	++	++	++	+	+
Poor moisture retention capacity of soils increases vulnerability to precipitation variability	+++	+++	++	++	++	+	+	+
Pests and diseases increasing with rising temperatures	+++	+++	+	++	++	+	+	-
International prices increasingly volatile as a result of climate change impacts on supply	++	0	++	0	0	0	0	0
High temperatures and unseasonable rain promote rapid spoilage and threaten quality	+++	+++	++	+	0	0	+	+
Rising international concern over carbon footprint may threaten demand for exports	+++	++	0	0	0	0	0	0
Shortages of disease-free planting materials, exacerbated by unreliable precipitation	+++	+++	0	0	0	0	+++	+++
Crop is perishable. Extreme precipitation and flooding make transport more costly & difficult	++	++	+	+	+	+	++	++
Increasing variability of precipitation and extreme events threatens suitability for production	++	++	+++	+++	+++	+	+	+

Key: Relative impact of climate change on various aspects of vulnerability by crop:

- +++ Highly Vulnerable
- ++ Moderately Vulnerable
- + Limited Vulnerability
- 0 Not Affected

**Note: Threat of rising temperatures is much more acute for Arabica coffee than for Robusta*

Source: Tetra Tech ARD 2013.

Furthermore, heavy rains can lead to landslides, land degradation and soil erosion. The latter accounts for over 80% of the annual cost of environmental degradation representing 4-10% of Gross National Product (GNP) and estimated at about US \$625 million per year (Government of Uganda 2007). The problem is exacerbated by deforestation through increased demand for firewood, charcoal and arable land.

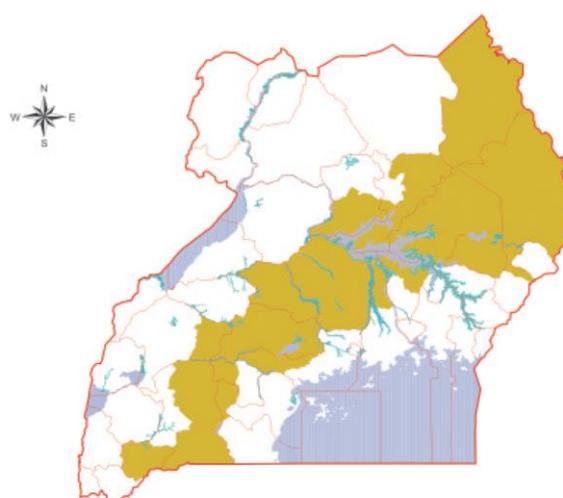
Another key sector in the Ugandan economy and an important source for food is fishery. It is estimated that over 1.2 million people are involved in the fishing industry (Zinyengere et al. 2016) and fishing is the second largest export earner, bringing revenue of US \$125 million in 2007 (Hepworth 2010, Government of Uganda 2007). High temperatures and prolonged droughts result in lower water levels in Uganda’s lakes which can lead to lower fish yields and reduced spawning, potentially leading to severe food shortages (Zinyengere et al. 2016).

Pastoralism

The semi-arid areas that form the cattle corridor (see Figure) are supplying most of Uganda’s livestock and meat products. Stretching from the northeast to the southwest it is a fragile ecosystem and depends on rainwater for human consumption and production. Prolonged and frequent droughts in these areas have led to loss of animals, poor quality of meat, low production of milk and dependency on food aid (Government of Uganda 2007).

In the longer run, increasing rainfall could increase grazing areas for livestock in the cattle corridor. However, increased temperatures, seasonal shifts and possible reduced rainfall in the dry season will lead to even scarcer water resources for human

Figure 6: The cattle corridor in Uganda



Source: NAPA 2011.

and livestock consumption, even though overall rainfall is increased. Participatory research revealed that lack of water accounts for 72% of livestock production problems. For every kilogram of dry-matter intake, three kilograms of water must be available to the animal. Shortage of water escalates infertility and lowers growth and milk production. During the dry season, forage for livestock is scarce and there has been a reported increase in livestock diseases. According to Uganda's National Adaption Program of Action (NAPA) research, malnutrition and worm infections account for 41% of livestock health issues in Uganda.

Biodiversity and eco systems

Uganda, with a convergence of seven major biogeographic regions, is extremely rich in biodiversity, having over 1,000 bird species (over 11% of the world total). There are at least 345 known mammal species, 165 reptile species, 43 amphibian species, 49 fish species and 4900 known species of higher plants. Climate change induced changes are likely to affect wildlife in various ways. The impacts manifest through a number of extrinsic and intrinsic reactions. In wildlife, extrinsic behavior involves movement to hostile environment in search of food and water. Intrinsic manifestations involve imbalance in physiology leading to phenomena, such as reduced immunity and hormonal imbalance giving rise to disruption in reproduction. Also, the drought-induced movement contributes to increased tendency of wild animals to hide, thus making the affected protected areas less attractive to tourists (Government of Uganda 2007). According to the National Biodiversity Data Bank (NBDB), Uganda's biodiversity index shows an alarmingly and steadily decreasing trend, reaching roughly 70% of the 1960-level in 2010 (NBDB 2014).

Forest products (timber, poles, rattan, bamboo, food, fodder, medicine, firewood, etc.) and services (biodiversity habitat, moderating of micro climate, shade and wind breaks for enhancing agricultural productivity) play a very important role in the social and economic development of Uganda. Forests are especially pivotal to the rural communities' livelihoods. For example, over 99% of Uganda's rural people use wood or charcoal as fuel. Forests also play an important role in moderating climate, particularly microclimate (Government of Uganda 2007).

Today, deforestation is the main threat confronting Uganda's forests, Savannah woodlands and bush land. Deforestation is caused by a number of factors, including population increase and poor agricultural practices. But climate change is also an issue because the distribution of plants and animals is determined by temperature and moisture patterns. Therefore, species response to warming temperatures can result in an altitudinally or latitudinally shift. According to Hopkins bioclimatic law, for every three degrees Celsius rise in temperature, there is a northward shift in vegetation of 250 km (MacArthur 1972). The disappearance of medicinal plant species has already been reported. This is serious because a large proportion of the rural population depends on direct herbal medicine to treat a wide range of ailments (Government of Uganda 2007). Also, dry conditions and prolonged droughts frequently lead to outbreaks of fire that degrade forests resulting in serious environmental consequences and reduced livelihood options (Zinyengere et al. 2016).

Water resources

Uganda has abundant water resources although their distribution is not even, particularly in the semi-arid areas of the country. The rainfall in "good years" offsets the water distribution problems particularly during the rainy season. Streams, on which a large proportion of the population depends, tend to dry up during droughts causing serious stress for a large proportion of the rural communities. The scarcity of water in such areas has resulted in movements into neighboring districts in search for pasture and water. These movements have frequently led to ethnic conflicts and disruption of production, affecting the development of these communities. The water scarcity in the dry land areas is likely to worsen with climate change (Government of Uganda 2007; Zinyengere et al. 2016).

Although precipitation is projected to increase, additional recharge and run-off may be offset by the greater evaporative losses brought by higher temperatures (Hepworth 2010,

McSweeney et al. 2012). In addition, heavy rainfall, leading to floods and landslides, complicates water management and is likely to affect the availability and the quality of water, as well as the life, property and infrastructure of people (Zinyengere et al. 2016). Prolonged and severe droughts can lead to low water levels in lakes, rivers, underground aquifers and reservoirs, impacting on the hydrology, the water supply and the potential for hydropower generation (Government of Uganda 2007).

3. Uganda's Contribution to Climate Change

Uganda is one of the countries with the lowest greenhouse gas emissions in the world, ranking 180th with per capita carbon dioxide (CO₂) emissions of 0.13 tons in 2014. Neighboring countries Kenya and Tanzania had yearly emissions of 0.31 and 0.22 tons respectively in the same year. The United States of America, as an industrialized country and ranking 9th, emitted 16.49 tons of CO₂ per person in 2014 (Index Mundi 2018a).

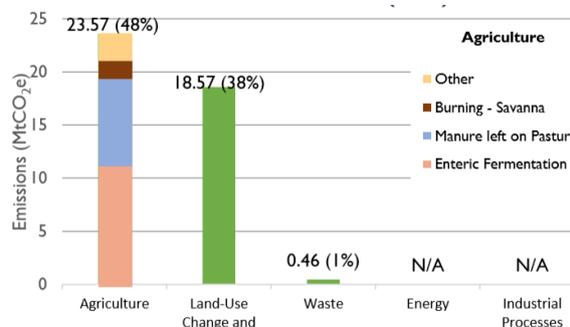
The available data of the greenhouse gas inventory for Uganda are reported for 1994 and 2000 (UNFCCC 2018f). Newer data from the CAIT Climate Data Explorer² shows, that agriculture is by far the most important producer of greenhouse gas emissions in Uganda,

with roughly 50% of total emissions. Other important amounts result from land-use change and forestry (38%) as well as waste (0.46%) (see Figure 7) (US AID 2015).

The **energy sector** is predominantly dependent on wood fuel, which accounts for up to 93% of the country's total energy consumption³. The other sources of energy in Uganda are petroleum and hydroelectricity accounting for 5% and 1.5% respectively. Uganda has one of the lowest per capita energy consumptions in the world with commercial energy consumption accounting for about 10% of the total energy consumption. The transport sector is the major consumer of fossil fuels. It is also the single most important import commodity responsible for the high-energy import bills. Over 75% of the petroleum fuels are used in the transport sector (Government of Uganda 2002).

Access to electricity in Uganda is limited for most of the population. The Ugandan census of 2014 reported that 20.4% of households used electricity for lighting (51.4% of urban households and 10.3% of rural households). Compared to older data, there has been an increase of electricity use for lighting of more than 10% since 2002. This increase correlates with the government programme on rural electrification that has increased coverage of electricity in rural and urban areas (Uganda Bureau of Statistics 2016). Until 2002, all of Uganda's electricity came from hydroelectricity generated by the Nalubaale Power Station at Owens Dam (built 1949-54) at the outlet of Lake Victoria and the beginning of Victoria Nile. Since 2005, Uganda has rapidly opened three new thermal power plants running on diesel which account for roughly 50% of the country's power supply. Other sources of electric

Figure 7: Uganda's GHG emissions by sector and percent of total emissions (2012)



Source: US AID 2015.

Table 2 : Uganda's greenhouse gas inventory 1994

Sector	Emission Totals Gg CO ₂ equivalent
Energy	3,905.12
Industry	43.50
Solvent use	-
Agriculture	37,500.51
Land-use change and forestry	8,252.70
Waste	95.05
Total	49,796.88

Source: UNFCCC Greenhouse Gas Inventory Data (<http://unfccc.int/di/DetailedByParty/Event.do?event=go>).

² Compare <http://cait.wri.org/>

³ Note: Consumption of biomass energy (wood fuel, charcoal, etc.) is not considered in the greenhouse gas inventory.

energy are smaller hydroelectric plants on Mubuku River or projects using biomass by-products from the sugar industry (The encyclopaedia of earth 2013).

For **industrial processes** and solvents, only three industrial processes were considered due to Uganda's narrow industrial base. These are cement, lime and foam production. From cement, a total of 15.4 Gg of CO₂ was emitted while lime and foam emitted 28.0 and 0.1 Gg of CO₂ respectively (Government of Uganda 2002).

In **agriculture**, emissions were estimated from livestock, livestock manure, rice production, fertilizer use and burning of agricultural wastes. The vast majority of greenhouse gas emissions resulting from agricultural activities is due to savannah burning (approx. 32,500 Gg CO₂-equivalent or 87%) followed by enteric fermentation. Accordingly, methane (CH₄) and nitrous oxide (N₂O) amount for nearly all the emitted greenhouse gases in this category, with roughly 66% and 33% respectively. Emissions resulting from fertilizer use were minimal in Uganda in 1994 but might be significantly higher today due to important efforts to modernize the country's agricultural system.

Land-use changes were linked with agricultural cultivation, livestock grazing, and various types of forest clearance and managed forests (sinks and removals) (Government of Uganda 2002). Statistics about deforestation vary greatly because degradation and deforestation are invariably pinned on guesswork. Available information suggests that at the start of the 20th century, both forests and woodlands covered over 50% of the land and now the coverage is about 24% (Government of Uganda 2007).

4. Climate Change and Disaster Risk Management Policy

4.1 Climate Change Policy

International Climate Change Policy – UNFCCC conferences and outcomes

UNFCCC in 1992: The international political response to climate change began with the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. The UNFCCC sets out a framework for action aimed at stabilizing atmospheric concentrations of greenhouse gases to avoid “dangerous anthropogenic interference” with the climate system (IISD 2012). The Convention, which entered into force on 21 March 1994, now has 198 parties (UNFCCC 2018d).

Kyoto Protocol in 1997: In December 1997 in Kyoto in Japan, delegates to the third session of the Conference of the Parties (COP) agreed to a Protocol to the UNFCCC that commits industrialized countries and countries in transition to a market economy to achieve emission reduction targets. These countries agreed to reduce their overall emissions of six greenhouse gases by an average of 5.2% below 1990 levels between 2008 and 2012 (the first commitment period), with specific targets varying from country to country (IISD 2012). The Kyoto Protocol entered into force on 16 February 2005 and now has 193 parties (UNFCCC 2018d).

Cancun, 2010: By the end of the conference, parties had finalized the Cancun Agreements. The parties recognized the need for deep cuts in global emissions in order to limit global average temperature rise to 2°C. On finance, parties created the Green Climate Fund (GCF) and recognized the commitment by developed countries to provide US \$30 billion of fast-start finance in 2010-2012, and to jointly mobilize US \$100 billion per year by 2020 (IISD 2012).

Doha, 2012: The Conference produced a package of documents collectively titled The Doha Climate Gateway over objections from Russia and other countries at the session. The documents contained: (1) An eight year extension of the Kyoto Protocol until 2020 limited in scope to only 15% of the global carbon dioxide emissions due to the lack of participation of Canada, Japan, Russia, Belarus, Ukraine, New Zealand and the United States and due to the fact that developing countries like China (the world's largest emitter), India and Uganda are not subject to any emissions reductions under the Kyoto Protocol. (2) Language on loss and damage, formalized for the first time in the conference documents. (3) The conference made little progress towards the funding of the Green Climate Fund (Wikipedia 2014).

Warsaw 2013: Officially, the Warsaw Climate Conference concluded successfully (UNFCCC 2013). However, this is seen much more critically by NGOs and independent observers (Greenpeace 2013). The media titles that the conference produced very little agreements (Washington Post). Negotiations in Warsaw focused predominantly on the implementation of agreements reached at previous meetings. The meeting adopted a decision that invites parties to initiate or intensify domestic preparations for their country mitigation contributions and resolves to accelerate the full implementation of the Bali Action Plan and pre-2020 ambition. Parties also adopted the “Warsaw REDD+ framework” (IISD 2014). With regard to finance for helping poorer countries cope with climate change, Warsaw was a disappointment: Even though the Green Climate Fund was established as an independent institution and arrangements between the COP and the Green Climate Fund were settled, the developed nations did not keep their promise to set any concrete financial targets. Instead, it was only agreed that developed nations should set “increasing levels” of aid.

Paris 2015: The United Nations Climate Change Conference, COP21 was held in Paris, France in 2015. The conference’s objective was to achieve a binding and universal agreement on climate, from all the nations of the world. The Paris Agreement builds upon the convention and for the first time brings all nations into a common cause to undertake

ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort. The Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below two degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Paris Agreement entered into force on 4 November 2016 and up to this date, 180 Parties have ratified of 197 Parties to the Convention (UNFCCC 2018a).

The Paris Agreement requires all Parties to put forward their best efforts through nationally determined contributions (NDCs) (and intended nationally determined contributions (INDCs)) and to strengthen these efforts in the years ahead. This includes requirements that all parties report regularly on their emissions and on their implementation efforts.

Current state: In summer 2017 the United States of America announced its intention of exercising its right to withdraw from the Paris Agreement, as soon as it is eligible to do so. This will at earliest take effect in 2020 (one year after the submission), as such withdrawals can only be submitted three years after the date on which the agreement entered into force for that party. This announcement was a major disappointment for the global emission reducing efforts (Dujarric 2017). As of May 2018, all Paris Agreement signatories have at least one law or policy addressing climate change, which brings the global stock of climate legislation to a growth. Simultaneously emerging court cases, which are holding governments and greenhouse gas emitters accountable for climate change, are seeing some success. Still needed is the stronger linking of national and international processes to align countries' actions with the Paris Agreement goals (Nachmany & Setzer 2018).

Uganda's Climate Change Policy

Uganda ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1993 and the Kyoto-Protocol in 2005. In response to commitments under Articles 4 and 12 of the UNFCCC it submitted its 'First National Communication on Climate Change' in 2002. This comprised a national inventory of greenhouse gas and an assessment of vulnerability and adaptation needs together with a set of recommendations. The Ministry of Water and Environment acts as national focal point for the UNFCCC (UNFCCC 2018b).

Uganda has also submitted their "**intended nationally determined contributions (INDCs)**" in 2015, to show their intended post-2020 climate actions. To reduce the countries high vulnerability, the INDC sets the priority on adaptation, especially in the agricultural, forestry, infrastructural, water, energy and health sector. Thus, specific adaptation measures include for example the expanding of crop and livestock diversification, sustained forest restoration, improving water catchment protection, promoting renewable energy and early warning systems for disease outbreaks. Mitigation to reduce greenhouse gas emissions until 2030 is applied through several policies in the energy supply, forestry and wetland sectors (e.g. increasing renewable electricity generation, forest law enforcement, afforestation and wetland conservation). Uganda's contributions focus on the protection of vulnerable groups (e.g. women) to apply gender-responsive and human rights actions. Besides the specific adaptation and mitigation strategies the government also proposes plans to promote and enhance climate change education and research, public awareness and the transfer and diffusion of climate technology. The implementation of the INDCs relies on the help of international support, since the national sources can only cover for approximately 30% of the costs (Ministry of Water and Environment 2015). Further recommendations for adaptation and mitigation strategies against climate change in Uganda are listed at the end of the study of Tumusiime & Ageet 2018. At the national and local government levels, climate change is associated with disaster risk reduction and natural resource management with limited

discrete planning and budgeting for climate change activities. Furthermore, the establishment of the Climate Change Unit in the Ministry of Water and Environment provides an institutional mechanism to develop and implement a coherent national response (Hepworth 2010, Kyoheirwe et al. 2012, Tetra Tech ARD 2013).

- Uganda's National Adaptation Program of Action (NAPA) was developed under the leadership of the DoM in 2007. "NAPAs provide a process for Least Developed Countries (LDCs) 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 (UNFCCC, 2018c)". Whilst Uganda's NAPA is to be seen as a significant milestone, it is imperfect and even its full implementation would not address the key vulnerabilities facing the country in a comprehensive way. However, it does identify most of the key issues which Uganda faces under the best estimates of future climate and sets out a group of projects which could potentially benchmark how the country could adapt (Hepworth 2010).
- The National Development Plan (NDP) is Uganda's overall national framework that guides planning for all development sectors in the country. It also identifies strategies and interventions to address the effects of climate change. It makes a number of environmentally friendly proposals intended to promote sustainable development such as increasing electrification coverage and reducing power losses, increasing access to water for production or overhauling and automation of the meteorological instrumentation to enhance the predictability of the weather and climate parameters (Kyoheirwe et al. 2012).
- The second National Development Plan (NDPII) builds on the achievements of NDPI and is set for the period of 2015/16-2019/20. The goal is to achieve middle income status by 2020 and strengthening Uganda's competitiveness for sustainable wealth creation, employment and inclusive growth. Adaptation strategies aim at strengthening Uganda's resilience through increasing food security, reducing poverty, increasing education and enhancing the integrity of ecosystems. Simultaneously, mitigation policies will be practiced by expanding renewable energy, promoting energy efficiency and a green economy (Republic of Uganda, 2015b).
- The Renewable Energy Policy for Uganda was developed in 2007 with a focus on making renewable energy a substantial part of the national energy consumption. It rooted in the government's commitment on greenhouse gas emissions reductions under the Kyoto protocol. The overall goal of the policy is to increase the use of modern renewable energy from the current 4% to 61% of the total energy consumption by the year 2017 (Kyoheirwe et al. 2012). There is no new act as of September 2018.
- Uganda's Forest Policy and the National Policy for the Conservation and Management of Wetland Resources promote the conservation of Uganda's endangered forests and wetlands in order to sustain their ecological and socio-economic functions for the present and future well-being of the people. These policies provide for environmentally sound management of wetlands and forests as an adaptation means to conserve them (Kyoheirwe et al. 2012).
- A National Climate Change Policy was first drafted in 2012 and finalized in early spring of 2015. This policy aims at reaching a sustainable development in Uganda, which is characterized by climate-resilience and low-carbon emissions. The policy ensures that all stakeholders address climate change in Uganda with appropriate adaptation and mitigation measures and advocates the integration of climate change issues into planning, decision making and investments in all sectors. Sectoral policy priorities are listed and underlined with specific strategies (Republic of Uganda, 2015a).

Under the Kyoto Protocol, developing countries were encouraged to contribute to emission reductions through trading of emissions rights. The Clean Development Mechanism (CDM) allows mitigation projects in developing countries to earn certified emission reduction (CER) credits, which can be sold to industrialized countries to help them meet their emission targets. This mechanism aims at stimulating sustainable development and emission reductions in developing countries (UNFCCC 2018e) but is also criticized by many NGO's because it might lead to a decrease of real emission reductions in rich countries as it is easier to buy a certificate than reduce emissions directly.

Uganda currently has a total of 19 CDM projects, of which 14 are registered and 5 are at validation. The majority are reforestation or afforestation projects followed by hydropower plant projects (UNEP DTU Partnership 2018).

4.2 Disaster Risk Management Policy

Poor and developing countries are disproportionately affected by disasters. Today, more than one third of the world's poor live in multi-hazard zones, and low-income countries. These account for more than 70% of the world's disaster hotspots. At the same time the poor are disproportionately affected by factors increasing disaster risk, like disability or chronic diseases. Disaster Risk Reduction (DRR) aims to reduce the damage caused by natural hazards like earthquakes, floods, droughts and cyclones, through an ethic of prevention.

A hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. A hazard turns into a disaster only if it coincides with people or assets exposed and vulnerable to the hazard and lacking the capacity to deal with the impacts of the hazard. Disasters are hence the product of the social, political and economic context in which they occur and often follow natural hazards (Swiss NGO Platform, 2017).

Disaster risk management includes “preparedness, mitigation, response, rehabilitation and recovery”. It is “multi-disciplinary and involves the participation of a multitude of partners and stakeholders, ranging from national governments, non-government organizations, international cooperating partners, donors, civil society and the private sector” (SADC 2014).

Disasters are thus not purely the results of hazardous events, but have a social, political and economic component. They have the heaviest impact on poor and developing countries, with poorest people being hit the hardest and small-scale disasters causing the most harm. The effects of climate change increase the impact of disasters on the most vulnerable. Appropriate measures can prevent or reduce the impacts of hazardous events and have the potential to avoid disasters. Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) can save lives and livelihoods and aim to strengthen the resilience of communities. Disasters can be causes or consequences of development failures whereas development can increase or decrease disaster risks. Therefore, development activities need to take the prevailing risk context into account and to adjust accordingly. There are different responses to disasters: DRR and CCA are complementary approaches that can reduce both short- and long-term risk (Swiss NGO Platform, 2017).

International Disaster Risk Management Policy

In 2015, the world community agreed on three key policy frameworks:

- the Sendai Framework for Disaster Risk Reduction (SFDRR)
- the Sustainable Development Goals (SDG) as well as
- the Paris Climate Agreement (see chapter 4.1)

The **Sendai Framework for Disaster Risk Reduction**, the successor framework of the Hyogo Framework for Action, was adopted by 187 states at the Third UN-World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015. The Framework is valid between 2015 and 2030 and is the responsibility of the United Nations Office for Disaster

Risk Reduction, UNISDR. The Framework has one goal: “...to prevent new and reduce existing disaster risk...” and four priorities:

- Understand disaster risk: data and models on hazard characteristics, vulnerability, capacity and exposure.
- Strengthen disaster risk governance to manage disaster risk at the national, regional and global levels.
- Invest in Disaster Risk Reduction for resilience: housing, health, water, ecosystem management, environment, livelihoods.
- Enhance disaster preparedness for response and to “build back better”: early warning, structural standards, drills, civil defense.

(Swiss NGO DRR Platform 2017)

Uganda's Disaster Risk Management Policy

Uganda did an important step towards the implementation of the Hyogo Framework for Action by approving the first National Policy for Disaster Preparedness and Management in May 2011. The policy reflects a shift of focus from disaster response to disaster reduction, with the objective of providing a comprehensive disaster management framework to guide programming and actions of key stakeholders in this sector (OCHA 2014). In 2015 Uganda in addition implemented the Sendai Framework for Disaster Risk Reduction and established a national resilience committee (GFDRR 2017). Thanks to this framework, great planning and early warning systems the government could handle the effects of El Niño-enhanced rains in 2015 (Okiror 2015). The overall policy goal is to promote national vulnerability assessment, risk mitigation, disaster prevention, preparedness, effective response and recovery in a manner that integrates disaster risk management with development planning and programming. It provides a basis for the formulation of a comprehensive disaster preparedness and management legal framework and outlines an institutional framework from the national down to the community level (Government of Uganda 2011).

The lead agency is the Department of Disaster Preparedness and Management in the Office of the Prime Minister. It is supposed to coordinate risk reduction, prevention, preparedness, mitigation and response actions in the country in consultation with other line ministries, humanitarian and development partners, local governments and the private sector. On the operational level, the key institution will be the National Emergency Coordination and Operations Centre (NECOC) also established under the Office of the Prime Minister. It is responsible for the effective coordination, early warning and preparedness of the various emergency response institutions. It will among others ascertain training, general support and facilitation in order to implement its mandate (Government of Uganda 2011).

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