InsuResilience
Solutions Fund

CLIMADA Climate Risk Analysis

Urban flood resilience against riverine floods in Uganda and Nigeria

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Summary

With increasing intensity and frequency of extreme weather events, climate change translates into unprecedented damages. This is especially true for communities in Africa. Detailed analysis of climate risks can help these communities to mitigate the risks and better prepare for the future.

Applying climate risk analysis for Kampala/ Uganda and Lagos/Nigeria demonstrates the useful information of the methodology applied. Investment and development decisions faced by governments, companies and households benefit by learning about:

- Expected damages and losses these districts will face due to riverine flood today
- How these risks will change over the coming decades and
- The cost-effectiveness of different adaptation measures to prevent and reduce these risks in order to strengthen their resilience against climate change.

Given the geographical similarities of the two African districts, climate risks will increase drastically for both by 2050. However, the results also reveal some interesting differences pointing once more to the importance to take the local context into account and break down national adaptation strategies to regional measures.

Context

Affected by natural disasters, Uganda and Nigeria already have a critical need for adaptation and climate risk management today[1]. Due to an extensive river system, large parts of the population in Uganda will be exposed to the impacts of riverine flood and lake spill over, such as during the severe flooding in May 2021 in the Eastern Region after days of heavy rainfall.[2] Given Uganda's dynamic economy and one of the fastest urbanisation growth rates of 5.4% in the East Africa region, this entails even higher risks for the capital city of Uganda, Kampala, over the coming decades.[3] In response to climate risks, Uganda has adopted an increasingly advancing strategic approach in managing disaster risk in recent years. Furthermore, the national government has facilitated considerable investments in disaster risk reduction and preparedness.

On the other hand, Africa's largest economy, Nigeria, increasingly suffers from annual flooding during the rainy season accelerated by climate change over the last decades. In Lagos, where the extensive river system drains into Lagos State, large parts will be exposed to the impacts of river overflow. Following a comprehensive post-disaster needs assessment, the Nigerian government has placed an increasingly proactive flood management approach in a national framework. However, a national flood risk management plan still needs to be adopted in practice.[4] An implementation gap remains with regard to risk-informed spatial planning and investments, as well as climate change adaptation measures.[5]

[1] Germanwatch e.V., 2021. Global Climate Risk Index 2021
[2] Davies, R., 2021. Uganda – Severe Flooding Affects Thousands in Butaleja. In: Floodlist.com. Available from: http://floodlist.com/africa/uganda-flooding-butaleja-may-2021 (Accessed 21.06.2021).
[3] Pozhidaev, D., 2020. Urbanization and the Quality of Growth in Uganda: The Challenge of Structural Transformation and Sustainable and Inclusive Development. In: P. S. Reddy, H. Wissink (eds.): Reflections on African Cities in Transition.
[4] Echendu, A. J., 2020. The impact of flooding on Nigeria's sustainable development goals (SDGs), Ecosystem Health and Sustainability, 6 (1).
[5] The World Bank Group, 2021. Climate Risk Profile: Uganda

Without action, climate risks jeopardize development efforts already achieved and threaten future economic growth in Uganda and Nigeria. Natural disasters and extreme events continue to cause significant damage to key economic sectors and public services of the country. According to the World Bank, about 0.4% of the national GDP is at direct risk from riverine and flash flooding each year in Uganda.[6] In 2012, Nigeria experienced extensive flooding contributing to reduced economic growth in agriculture and trade.[7] This does not only weigh heavily on fiscal budgets but also puts earlier development success at risk. However, as highlighted in the Global Risks Report, at present, spending on disaster recovery is still almost nine times higher than on prevention.[8] To turn this around and to secure a sustainable development of the country, the implementation of appropriate risk reduction and adaptation measures are therefore key factors.

What actions can Uganda and Nigeria take to mitigate these risks and implied financial losses? As fiscal capacities are limited, it is imperative for political decision-makers to prioritize the most cost-effective adaptation measures, i.e. those investments which will render the highest reduction of future damage for the same amount of investment costs implied.

To support the Ugandan and Nigerian government, a quantitative cost-benefit analysis of different adaptation measures has been carried out. The analysis was facilitated by the probabilistic risk modelling platform CLIMADA that offers a helpful tool to assess and prioritize the options available.

What are expected climate-related losses due to the identified climate risks?

Under current climatic conditions the results of the analysis suggest that already today the average damage to buildings and local infrastructure due to floods amounts to 22.2 and 3.7 million USD in Lagos and Kampala respectively each year. Climate risk analysis also allows to estimate how these risks will change over the coming decades – an important information for governments, companies as well as individual households confronted with long-term investment decisions. According to the analysis conducted, for both cities damages resulting from increased precipitation and subsequent flooding could almost double in Lagos by 2050 (+84%) summing up to USD 40.9 million i.e. 0.15% of total value of buildings and public infrastructure over the coming decades (see *Table 1*). In Kampala risks will also rise significantly; with an increase of approximately 60%, damages from riverine flood are expected to amount to USD 5.9 million p.a. by the year 2050, i.e. 0.15% of total value of buildings and public infrastructure.

Furthermore, a closer look at the data indicates that the expected damage from riverine flood in Lagos district is assumed to be almost equally driven by climate change (involving the increased flood risk) and economic growth until 2050. In Kampala district, instead, the higher expected damages could be mainly attributed to economic growth compared to climate change (see *Figure 1* below).

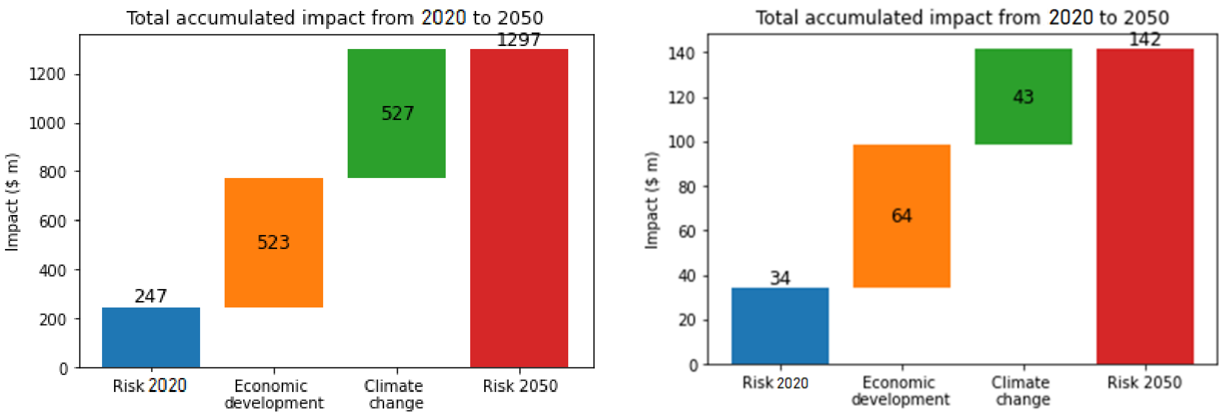
[6] Ibid.

[7] The World Bank Group, 2021. Climate Risk Profile: Nigeria

[8] World Economic Forum, 2019. The Global Risks Report, 14th Edition. Geneva

Table 1: Accumulated economic impact of flood on residential and commercial buildings by 2050, taking into account economic growth and climate change over the next decades (under future scenario RCP 8.5) for A) Lagos, Nigeria and B) Kampala, Uganda

	A) Lagos			B) Kampala		
Assets	Total Value	Expected Annual Loss in 2020 (in% total value)	Expected Annual Loss in 2050 (% increase to 2020)	Total Value	Expected Annual Loss in 2020 (in% total value)	Expected Annual Loss in 2050 (% increase to 2020)
Population (mn affected)	26.5	0.09 (0.3%)	0.19 (+104%)	1.63	0.02 (1.2%)	0.026 (+33%)
Roads (km)	15,565	19.9	39.3 (+98%)	641	3.6 (0.6%)	4.9 (+38%)
Buildings and public infrstructure (in USD mn)	26,900	22.2	40.9 (+84%)	3,900	3.7	5.9 (+59%)
thereof						
Hospitals	10.7	0.032 (0.3%)	0.06 (+84%)	2.4	0.008 (0.03%)	0.012 (+46%)
Schools	12,500	7.4 (0.06%)	13.7 (+85%)	1,863	1.4 (0.1%)	2.3 (+60%)
Buildings	14,400	14.5 (0.1%)	27.1 (+87%)	2,018	2.3 (0.1%)	3.55 (+57%)



A) Lagos/Nigeria

B) Kampala/Uganda

Figure 1: Accumulated economic impact of flood on residential and commercial buildings by 2050, taking into account economic growth and climate change over the next decades (under future scenario RCP 8.5) for A) Lagos in Nigeria and B) Kampala, Uganda

Which actions can Uganda and Nigeria take to protect its population and reduce future financial losses?

The grafical illustration of the results reveal that climate change will add to economic losses until 2050 mainly in areas (dark red coloured in *Figure 2*) close to the Bay of Lagos and Lake Victoria in Kampala. *Figure 2* highlights the hotspots where buildings highly exposed to climate risks are located. These are mainly at the south of the Lagos Bay and around the Murchison Bay in Kampala, which are especially exposed to the spill over of the lake on the shores due to increased river inflow.

The analysis also reveals where and to which extend people in the local communities are affected by floods. While 20,200 people in Kampala and 90,000 in Lagos are already annually affected by the impacts of riverine flooding today, these numbers may increase by 33% for Kampala and two-fold for Lagos by 2050 due to climate change and changing population dynamics.

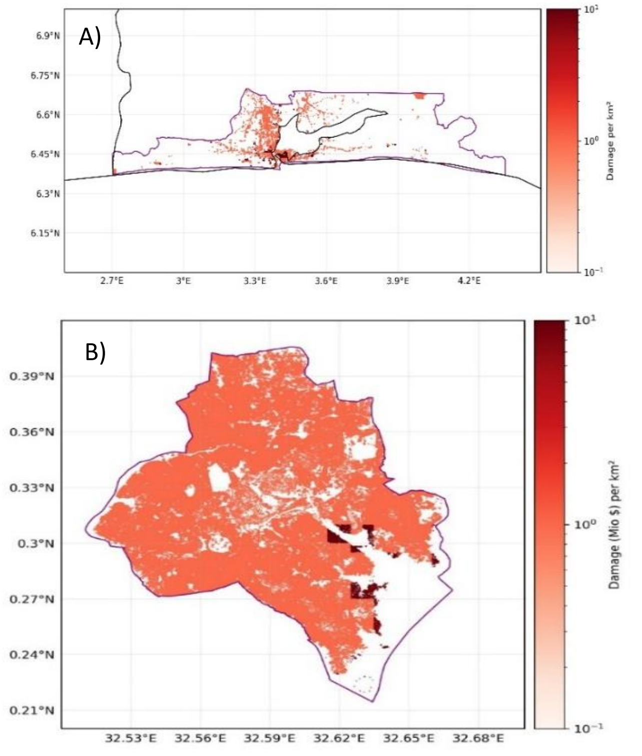


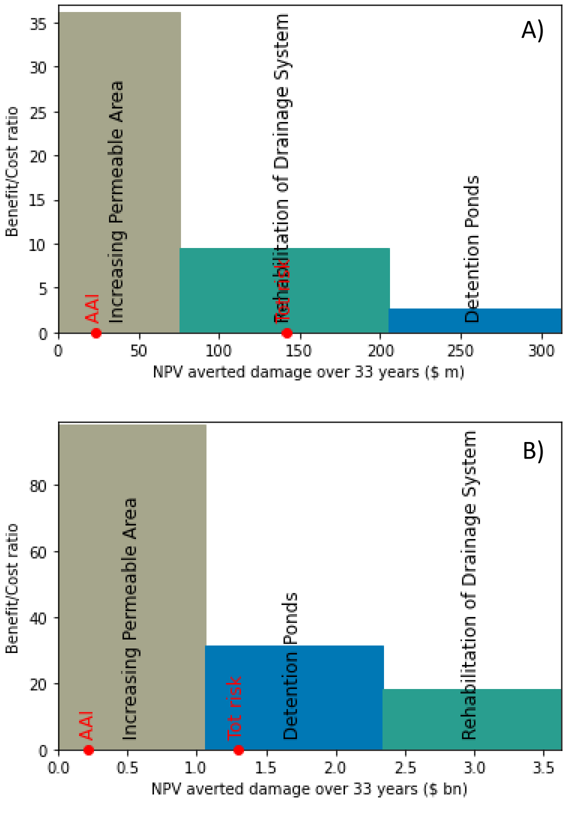
Figure 2: Expected increase of flood damage on residential and commercial buildings by 2050 due to climate change for A) Lagos, Nigeria and B) Kampala, Uganda

Specific hotspots down to a resolution of individual buildings can be analysed in more detail, giving a first guidance on where to focus planned efforts to increase resilience against riverine flood. This highlights where adaptation measures should be mainly focused, in order to avert expected impacts of flood risks in the future.

However, which specific measure will render the best protection to Uganda and Kampala? In order to address this question, a set of different adaptation measures including the increase of permeable areas through buffer strips along roads, improvement of drainage systems, and detention ponds were assessed in the study. The three adaptation measures were compared based on a) their respective cost-efficiency, estimating how much damage could be prevented in the future for each dollar invested, as well as b) their respective adaptation effectiveness, quantifying the absolute value of damages averted by each adaptation measure if implemented.

Comparing the cost-benefit ratios, significant differences can be observed with respect to the cost-efficiency of the individual adaptation measures:
The increase of permeable areas through buffer strips provides the best return on investment in averting expected damages due to riverine flood both for Lagos and Kampala. As the rehabilitation of the drainage system is associated with less benefits, i.e. averted future damages for each dollar invested, this measure turns out to be the least cost-effective in Kampala, and less cost-effective than increasing the amount of permeable areas in Lagos (reflected in *Figure 3* on the vertical axis measuring the benefit-cost ratio of the adaptation measures assessed).

However, decision makers will also need to make sure the selected measures will provide sufficient protection and avert future damages to the largest extent possible, i.e. their adaptation effectiveness. Thus the choice on which measure to prioritise should also take into account the effectiveness of the different measures considered (reflected in *Figure 3* on the horizontal axis measuring the net present value of averted damages). For Kampala e.g. rehabilitation of drainage systems proves to be more effective than increasing permeable areas. By reducing nearly all future losses of an accumulated volume of USD 142 million by 2050, rehabilitation of the drainage systems will be highly effective, although not representing the most cost-efficient measure for the government of Lagos.



AAI: Average Annual Loss (USD)
Tot risk: NPV of expected total losses by 2050 (USD)

Figure 3: Cost-benefit of adaptation measures for flood risk on residential and commercial buildings for A) Lagos, Nigeria and B) Kampala, Uganda

How can the analysis be used to enhance the resilience in Kampala and Lagos?

The detailed information on the location and extent of the expected impact of floods on the city's population and different assets enables national and local governments to prioritize potential adaptation measures in areas particularly at risk of flooding in the future. The analysis implies the need to enhance the resilience of the districts close to Lagos Bay and respectively around the Murchison Bay in Kampala, which are especially exposed to the spillover of the lake onto the shores due to increased river inflow. The identification of areas where the resilience status of critical infrastructure is more under pressure by future flooding is facilitated. After adapting the design and associated costs of the adaptation measures to the local context, the potential investment volume for adaptation measures gives a first indication about the implementation costs.

Even after prioritizing the most cost-effective assessed adaptation measure, namely increasing the permeable area in Lagos and Kampala, not all potential future losses can be avoided by physical or structural adaptation measures. Considering that the rapid urbanization challenges the implementation of space-consuming urban adaptation measures, insurance solutions could provide an effective complementary measure to increase resilience against climate change.