The macroeconomic case for climate adaptation in Rwanda

Paul Watkiss, Blanche Butera, and Jonathan Bower

- Even if the Paris Agreement goal of reducing the global temperature rise to below two degrees, the economic costs of climate change in Rwanda are projected to be large.
- Climate change will affect medium-term development and poverty reduction, as well as long-term growth and Vision 2050 goals. It is also a major macroeconomic risk and likely to affect the public finances of Rwanda.
- Climate impacts over the next 20 years are already locked-in: these potential impacts can only be reduced with adaptation.
- This policy brief explores how adaptation can cost-effectively reduce the near-term economic costs of climate change.
- There is a greater need to integrate climate change adaptation into economic policy making and public financial management.

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The economic threat of climate change

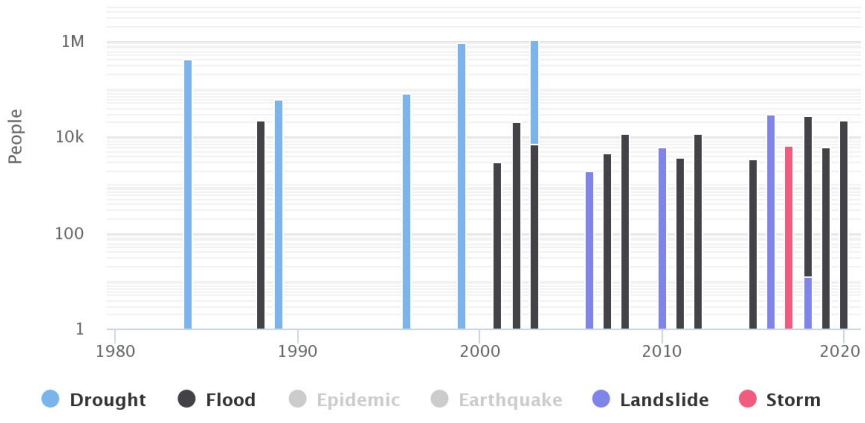
Rwanda already experiences high economic costs from climate extremes.

While Rwanda has enjoyed high levels of economic growth over the last decade, it already experiences economic losses from climate-related variability and extreme events, such as major floods, droughts, and storms (CIMA, UNISDR 2018/20191), see Box 1. Soil erosion is becoming a greater problem, major floods happen almost annually, and there have been several major droughts over the last decade.

BOX 1: Climate Variability and Extreme Weather Events

Rwanda experiences high levels of year-to-year rainfall variability. This is due to many factors but includes El Niño – Southern Oscillation (ENSO) events. El Niño events are often associated with wet conditions and La Niña with dry conditions. This leads to intense rainfall, frequent floods but also periodic droughts. These events are now happening very frequently, as shown below. Major flood events occurred in 1997, 2001, 2006, 2007, 2008, 2009, 2011, 2012, 2015, 2018, 2019, 2020. Major drought events occurred in 1998-2000, 2003, 2005-2006, 2012-2013-and 2016-2017. The impact of these events is increasing, as shown below in the people affected, although this increase is driven by socio-economic change (population growth, exposure) as well as by changes in extremes.

FIGURE 1. Number of people affected by Hazards. 1980-2020. Source World Bank Climate Portal/EM-DAT.



1 CIMA, UNISDR. Disaster Risk Profiles. https://www.gfdrr.org/en/disaster-risk-country-profiles

These events have macroeconomic consequences. For example:

- The Northern, Western and Southern provinces experience high levels of rainfall related soil erosion, and this erosion is estimated to cost 2% of agricultural GDP/year in lost productivity (SEI, 2009[2]).
- In 2012 the failure of the rainy seasons and a major drought led to a below-average harvest and a 4% decline in 2013 GDP growth due to lower agricultural output in Rwanda.
- The World Bank Agricultural risk assessment for Rwanda (Giertz, et al., 2015[3]) estimated extreme weather years (floods and droughts) lead to up to a 10 percent loss of total agricultural production value.
- Major flood events now occur almost annually and there have been increases in flood related damage (fatalities and property) in Kigali and other major cities (Minema, 2019[4]: Tsinda et al., 2019[5]).

Observations show that the average temperature of Rwanda is increasing, with around 1.4°C of warming over the past few decades (RoR, 2018)[6]. These temperature increases have economic impacts, e.g., from increased energy demand for cooling. They also have potential effects on agriculture, which include changing average suitability for key crops, changing prevalence and range of pests and diseases, and the greater likelihood of damage to crops from high temperatures.

> **Even if the Paris goals are achieved, the economic costs of climate change in Rwanda are likely to be very high.**

Future climate change has the potential to exacerbate the existing impacts of current climate variability in Rwanda and is likely to lead to new risks. There are robust climate projects predicting a future increase in temperature between 1°C and 2.5°C of warming by the middle of this century. There will also be increases in the number of hot days and heat events. The climate models also project that climate change will also increase the intensity of heavy rainfall events. These changes will lead to increased impacts and economic costs.

2 Stockholm Environment Institute (2009). Economics of Climate Change in Rwanda. Report to DFID And GoR

3 World Bank. RWANDA AGRICULTURAL SECTOR RISK ASSESSMENT WORLD BANK GROUP REPORT NUMBER 96290-RW. Åsa Giertz, Mohinder S. Mudahar, George Gray, Rhoda Rubaiza, Diana Galperin, and Kilara Suit. October 2015. Available at https://documents1.worldbank.org/curated/en/525111468180254519/pdf/96290-WP-P148140-Box393232B-PUBLIC-TAP-Rwanda-ASRA-WEB-10062015.pdf

4https://www.minema.gov.rw/fileadmin/user_upload/Minema/Publications/Reports/Annual_Disaster_Effects_Report_2019.pdf

5 Tsinda, A. et al., (2019). Estimating damage costs of flooding on small- and medium-sized enterprises in Kigali, Rwanda. September 2019. Jamba: Journal of Disaster Risk Studies 11(1). DOI: 10.4102/jamba.v11i1.755

6 Republic of Rwanda (2018). Republic of Rwanda. Third National Communication under the UNFCCC. Ministry of Environment. https://unfccc.int/documents/184307

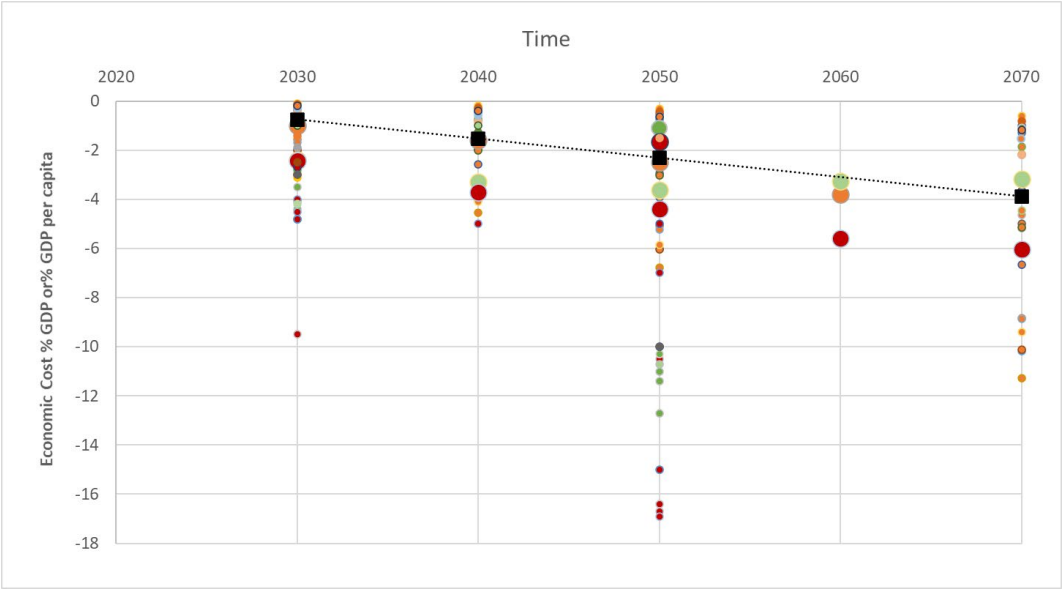
The economic costs of climate change in Rwanda are estimated at around 1% of annual GDP costs by 2030, increasing to 2.5% by 2050[7]. From a synthesis of the current macroeconomic literature at the global, regional, and national level, Rwanda is projected to experience high economic costs from climate change, even over the next twenty years. Research includes computable general equilibrium (CGE) models (Kompas et al., 2018[8]) and econometric studies that consider the effects of climate change impacts on growth rates as well as output (Kahn et al., 2019[9]).

In the longer-term, after 2050, the economic costs will depend on global mitigation and the progress towards the Paris Agreement of 2015 (UNFCCC, 2015[10]). In Figure 2, the potential economic costs for a central pathway over time for Africa and for Rwanda are presented. The values in the figures show the impacts on GDP in each and every year, but it is also likely that climate change will affect growth rates. This will lead to cumulative effects over time, as the impacts on growth reduce the future size of the economy, as compared to the expected development path. Under this modelling, Rwanda to achieve upper middle-income and high-income status, i.e., it will affect the achievability of Vision 2050.

Studies that look at the impact of climate change on growth by mid-century estimate that impacts could be equivalent to almost a lost decade of economic growth.[11] Climate change is also projected to affect the poorest and most vulnerable people most in relative terms, e.g., as a percentage of income. Climate-related shocks already keep people in poverty, or can drag them back into poverty, because these groups have fewer resources, higher vulnerability, and lower adaptive capacity. Climate change will therefore make it more challenging to achieve the NST and the Vision 2050 goals of eliminating poverty altogether in Rwanda.

7 These values are from the Kompass Study for a 3C pathway.
8 Kompas, T., V.H. Pham and T.N. Che. (2018). The Effects of Climate Change on GDP by Country and the Global Economic Gains from Complying with the Paris Climate Accord. Earths Future 6, 1153–1173. https://doi.org/10.1029/2018EF000922
9 Matthew E. Kahn, Kamiar Mohaddes, Ryan N. C. Ng, M. Hashem Pesaran, Mehdi Raissi and Jui-Chung Yang (2019). Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis. IMF Working Paper, October 2019.
10 https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf
11 Vivid Economics (2020). CLIMATE CHANGE & GROWTH. How will climate change affect South Asia's economic future. Report prepared for DFID Action on Climate Today / Climate Proofing Growth and Development.

FIGURE 2. Selection of economic studies over time for regions and countries in Africa, for a 3˚C pathway, showing Rwanda in black line.



Data shown are from a series of recent studies, for low (green), medium (orange) and high (red) warming scenarios, including World Bank EACC (2010), OECD (2015), Kompas et al. (2018), Baasch et al. (2020), AfDB (2020), COACCH (2021), De Bruin et al. (2020), and include regional studies for Africa and country studies. Small circles represent country studies, large circles represent regional studies.

Climate change will affect sovereign creditworthiness and the public finances

Severe weather and climate events, including natural disasters, are already the second-most frequent source of contingent liabilities in emerging markets, and they can be a direct cause of sovereign defaults from the impact on government finances and economic growth. For example, Hurricane Ivan in 2004 was the direct cause of Grenada's subsequent debt restructuring (Moody's, 2016)[12].

Climate change will be a global mega-trend impacting on sovereign creditworthiness. Several of the major international credit rating agencies have undertaken studies looking at the influence of climate change on sovereign credit ratings (Standard & Poor's, 2014[13]; Moody's, 2017[14]). They anticipate that climate change will feed through to sovereign creditworthiness through various transmission channels. These include the impact on economic

12 Moody's Investors Service (2016). Understanding the Impact of Natural Disasters: Exposure to Direct Damages Across Countries, 28 November 2016. https://www.eenews.net/assets/2016/11/30/document_cw_01.pdf
13 S&P Global Ratings (2014). Climate Change Is A Global Mega-Trend for Sovereign Risk, 2014. https://www.maalot.co.il/publications/GMR20140518110900.pdf
14 Moody's Investors Service (2017). How Moody's Assesses the Physical Effects of Climate Change on Sovereign Issuers, 7 November 2016 https://www.eticanews.it/wp-content/uploads/2017/01/Moodys-climate-change-and-sovereigns-November-7.pdf

performance (e.g., reduced economic growth), fiscal performance (e.g., reduction in some tax revenues, additional government budget for disaster recovery and infrastructure damage from climate shocks, increased social costs) and external performance (e.g., reduced exports of agricultural products for foreign currency). This will lead to elevated macro-financial risks.

These studies all identify Sub-Saharan Africa as one of the most vulnerable regions globally. The largest impacts are projected for climate vulnerable countries and will lead to basis points or rating notch downgrades for sovereign ratings. Climate change is more important for this region because of the relative share of agricultural (a climate-sensitive sector) gross domestic product (GDP), lower economic diversification, less climate-resilient public infrastructure, and lower capital market flexibility compared to other world regions. Climate change will also affect the public finances of countries by increasing government expenditure and public debt, as well as by reducing government revenues, affecting fiscal stability. It will also affect the affordability of insurance in higher risk countries, not least because there is strong evidence of rising hazard levels from climate change (IPCC, 2021[15]). This could therefore increase the level of uninsured assets.

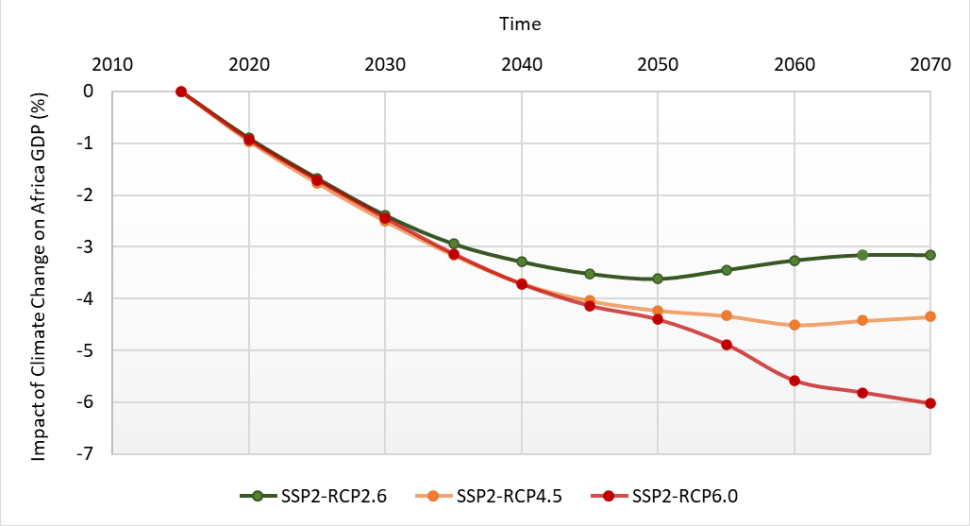
The economic benefits of adaptation

> **Only adaptation can reduce the economic costs of climate change in Africa and Rwanda over the next 20 years.**

The benefits of mitigation policies have a relatively limited impact in the short-term, due to the inertia in the climate (IPCC, 2018). To put this another way, the **level of climate change in the next 20 years for Rwanda is already locked in, and these impacts can only be reduced by adaptation**. This is shown below: irrespective of the scenario, the future economic costs of climate change only diverge significantly after 2040 (COACCH, 2021[16]).

15 IPCC (2021). Summary for Policy Makers. IPCC 6th Assessment Report, Working Group 1.
16 COACCH (2021). The Economic costs of climate change. Policy Brief. Forthcoming.

FIGURE 3. Estimates of the economic cost of climate change for Africa for different scenarios over time.



Source: COACCH (2021). RCPs = Representative Concentration Pathways. RCP2.6 is broadly in line with the goals for the Paris Agreement, while RCP6.0 is a high warming projection. All values are presented for SSP2, a middle of the road Shard Socio-economic Pathway.

A number of the economic studies of climate change also include analysis of adaptation. These find that adaptation can reduce the economic costs of climate change very significantly and it is cost-effective for both low- and high-warming pathways (GCA, 2019[17]; De Bruin and Ayuba, 2020[18]). However, while adaptation is found to be highly beneficial, the amount of adaptation (and the cost) involves policy choices. There are benefits from introducing economic decision making to the adaptation agenda. This can help in assessing the priorities for intervention, whether this is to provide direct support, or create the enabling environment for private sector adaptation.

There is a strong economic case to act now for some adaptation interventions.

Given the long timescales involved in climate change, it is not necessary to do all adaptation today. However, it is important to act early in key areas, where delaying adaptation will make it much harder to tackle future climate risks or make large future costs inevitable (GCA, 2019). A key issue is to **identify which adaptation actions are urgent for Rwanda**, and what can be done later as part of an adaptive management approach. There are three areas where early adaptation action can be justified in economic terms (Watkiss and Betts, 2021[19]).

17 Global Commission on Adaptation (GCA). 2019. Adapt Now. www.gca.org.
18 De Bruin K. and Ayuba V. (2020). What does Paris mean for Africa? An Integrated Assessment analysis of the effects of the Paris Agreement on African economies. ESRI working paper n. 690.
19 Watkiss, P and Betts, R (2021) Climate Change Risk Assessment 3 Evidence Report. Chapter 2. Method.

- Low and no-regret adaptation. Rwanda already experiences large economic costs from climate extremes today, and these are growing. There are large net economic benefits from reducing these impacts today with low- and no-regret actions, i.e., which are good to do even without future climate change. These actions, such as weather and climate services, have high benefit-to-cost ratios. There is a need to scale-up these actions.

- Addressing near-term decisions with lock-in. There are some decisions or investments that will be taken in the next few years, which could lock-in future costs in Rwanda. For example, infrastructure built over the next five years will operate under a very different climate to today. If future climate risks are not considered in design, climate change could cause asset damage or failure, and affect operating costs and/or revenues (ADB, 2021[20]). Integrating climate resilience into infrastructure design makes sense and has high benefit-to-cost ratios (4:1, Hallegatte et al., 2019[21]).

- Early adaptive management. There are some low-cost preparatory actions that can be taken today, to improve future decisions, so called option values (Defra, 2020[22]). This is especially for decisions that have long lead times or involve major but uncertain future change. The early steps in longer term adaptation pathways do not involve high costs today, but they are key for delivering future economic benefits. For example, it takes years to develop, pilot and scale-up new climate resilient crops (long lead-time) so early action is needed to provide new varieties for the future.

Policy recommendations

A number of key policy recommendations are made.

There is a need to consider how climate change will affect Rwanda's public finances. Given the scale of risk, it would be useful to understand the impact of climate change on the national economy and the public finances.

There is a need to integrate climate change in public financial management, as well as development policy and budgetary cycles. It would be useful to integrate climate change in national public financial management as well as development planning. This could be driven by a lead from MINECOFIN (in coordination with sector ministries) and include climate adaptation at strategic level in government policy and strategy.

20 ADB (2021) A System-Wide Approach for Infrastructure Resilience: Technical Note. https://www.adb.org/publications/system-wide-approach-infrastructure-resilience
21 Hallegatte, S., J. Rentschler, and J. Rozenberg. 2019. Lifelines: The Resilient Infrastructure Opportunity. Sustainable Infrastructure Series. Washington, DC: World Bank.
22 Defra (2020) Accounting for the Effects of Climate Change: Supplementary Green Book Guidance, November 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/934339/Accounting_for_the_Effects_Of_Climate_Change_-_Supplementary_Green_Book_.._.pdf

A rapid scale up of adaptation in the next 20 years is needed in Rwanda, but it is important to consider what to do first and where to prioritise. There are high economic benefits from adaptation, but a key need is to prioritize adaptation based on its economic returns, to ensure the best use of available finance.

There is an important role for MINECOFIN to identify the strategic economic case for adaptation action. Adaptation has often been seen as an environmental problem. However, like any public policy area, it is useful to consider the justification for policy action (the market and policy failures), to identify where it is appropriate for government to act, and to design strategy and policy as with other public policy areas. There would be significant benefits from adopting a more conventional economic perspective to scale-up adaptation in Rwanda.