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Future by Design

Policy Brief

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Policy Implications for Mauritius of Projected Climate Changes based on the Findings of the IPCC AR6 WG1

Key Policy Insights

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On 9 August 2021, the IPCC Secretariat held a press conference to present the Summary for Policy Makers (SPM) of the Working Group I (WGI) contribution to the Sixth Assessment Report (AR6), "Climate Change 2021: The Physical Science Basis". Three Information Bulletins[1] were formulated to synthesize the observations for Small Island states generally, and, in particular, for those located in the West Indian Ocean region. Ten policy implications of the IPCC AR6's scientific findings for Mauritius are discussed, including the information gaps that will need to be filled to strengthen the evidence base for sound decision-making.

P1

Adaptation strategies for Mauritius and the Outer Islands will need to factor in the impacts of climate change that accounts for at least a 1 – 2 °C rise within the next twenty to forty years

The AR6 stresses that Small Islands are *very likely* to experience an increase of 1°C – 2°C by 2041–2060 and by 2°C – 4°C by 2081–2100 under Scenario 4 (see Information Brief - IB/2021/3). Put differently, this means that if the world develops without significant reductions in emissions of greenhouse gases (GHGs), the latest scientific evidence affirms that there is between 90 – 100 % probability of such rises in temperatures to happen and that Small Islands, including Mauritius, will have no choice but to increase adaption efforts to manage climate risks.

The AR6 does not explicitly indicate how those probabilities evolve for Small Islands under alternative mitigation pathways (i.e. Scenarios 1, 2 and 3 for Small Islands). However, it warns that there is more than 50 % probability that the 2°C threshold will be exceeded in the period 2041 – 2060 based on the current ambitions laid within Nationally Determined Contributions (i.e. under Scenario 3). AR6 also stipulates that, even with the most ambitious global efforts to reduce emissions, the world, including Mauritius, is *very likely* (i.e. with 90 – 100 % chance) to experience around 1.6 °C average increase in temperature by the year 2041 – 2060.

Given the relatively close timelines (one to two generations apart) and the very high probability of occurrence, it is thus essential that adaptation strategies, commensurate with a 1-2°C rise in temperatures be formulated, implemented, monitored and evaluated accordingly.

P2

Downscaled models related to climate impact drivers (e.g. rainfall patterns, sea level rise, mean temperatures, tropical cyclones and other extreme climatic conditions) need to be developed for Mauritius

Analyses of the projected impacts of climate drivers focusing on the West Indian Ocean (WIO) region – including Mauritius - are

1 *Information Bulletins: IB/2021/1, IB/2021/2 and IB/2021/3 (Future by Design 2021a, b & c)*

conspicuously lacking – as opposed to an over-representation of data for the Caribbean and Pacific Islands. This means that the global scientific community, at this point in time, is left to rely on global models or on proxies relevant to other regions to depict anticipated climate changes in the WIO region. This is problematic since the absence of appropriate downscaled models results in climate anomalies not being captured or meaningfully represented at the geographical scales relevant to islands of similar size to Mauritius.

Consequently, this also means that global policies, and by extension, national ones that aim at addressing climate change cannot, at this point in time, adequately rely on locally-appropriate evidence. Hence, there is dire need for the development of downscaled models for Mauritius, including institutional strengthening to develop indigenous capacity to carry out such analyses.

P3

Based on the downscaled information (P2), to carry out scenario analyses of the impacts of (a) single climate events, (b) concurrent climate events, and (b) their cross-sectoral impacts

Contextualised climate research (i.e. science driven evidence-based policy recommendations) on Mauritius is quite scarce, and even more scant are studies that adopt a pathways approach to 2050 and beyond.[2] Where they exist, studies have dealt with single climate events at the expense of concurrent climate events and cross-sectoral impacts of compound events. While there are a few donor-funded studies that have started to bridge this gap, there is a notable paucity of scientific research that explicitly address the impacts of climate changes (gradually changing, climate variability and slow onset events) as applied to the case of Mauritius. Of particular interest is to better understand the impacts of climate change and climate variability on potential loss and damage to lives and infrastructure.

Scenarios analyses, including detailed vulnerability assessments, will thus be required for the expected impacts of a 1-2 °C rise in temperature (with different levels of warming) on key sectors such as agriculture, water, biodiversity, health, tourism, fisheries, infrastructure, amongst others, including its impacts on outer islands, and taking into account singular events such as increases in average temperature, frequency and intensity of heavy rainfall; heat waves; cold extremes; decrease in average precipitation; storm surges; and sea level rise, among others.

Due to interactions and feedback mechanisms between climate drivers (see Information Brief - IB/2021/2) and socioeconomic needs (such as provision of water, food, energy, mobility, amongst others), AR6 warns that multiple climate impact drivers – i.e. concurrent climate events - may potentially produce dangerous hazard combinations. For example, multiple climate-related drivers may affect multiple regions at the same time, or in a sequence of events that could amplify their overall impacts, potentially leading to failures of a country's basic societal functions. Single and concurrent events can be further amplified by non-climate hazards such as inappropriate land use planning.

Adding to this complexity is the fact that these compound events may not necessarily take place in Mauritius. One hypothetical illustration for Mauritius could include a failure to access global food markets as a result of combined or sequential droughts/heatwaves in Australia and South Africa, and flooding in Asia thereby disrupting food supply and availability in Mauritius. While the probability of such a combination of events to happen is currently undefined, the risk to food security can be disproportionately high, even when the probability of occurrence can be low. The ongoing COVID-19 pandemic has clearly demonstrated the dire socioeconomic consequences of an external shock on Mauritius. Lessons learned should foster anticipatory policy planning in the face of increasing food insecurity due to both internal and external climate shocks.

The WG1 report refers to an emerging scientific literature that assesses connected extremes and their associated hazards, and explicitly warns that compound effects of climate change can lead to severe impacts. In light of this finding, and over and above the scenario analyses for single events mentioned previously, modelling of compound events of different climate impact drivers will, therefore, be required to address potential cases of:

- different extents of expected sea level rises (slow onset climate change) with tropical cyclone surges (climate variability),
- the compound effects of ocean acidification and warming (gradually changing anomalies) on marine life and productivity,
- water and food security risks taking into consideration local climate changes and climate impacts in main food import markets, and
- climate-related disasters such as flash flood events combined with non-climate impact drivers such as land-use changes.

The WGI of AR6 does not explicitly analyse the compound impacts of climate impact drivers with non-climatic drivers such as changes in land-use (this specific example is covered within the Special Report on Climate Change and Land). However, given that Mauritius has already been heavily impacted with flash floods (including damage to property and loss of lives), leading to an increasing amount of public finances being geared to land drainage infrastructures, it is essential that the compound climate impacts (current and future climate changes) be conjugated with land use planning scenarios to better understand development outcomes under different climate scenarios.

P4

Financial implications of policy recommendations

Climate change adaptation is generally a "public good" (i.e. a service made available to all members of a society) and the private sector has little incentive to invest in adaptation, unless it is directly impacted by climate change. Therefore, the burden of adaptation costs rests largely on governments. Consequently, decision makers will require a thorough understanding of the expected costs (capital, operational, administrative, transaction) involved in the implementation of adaptation measures. Thus, vulnerability studies and other assessments mentioned earlier will need to be complemented with economic and financial analyses to inform climate adaptation policy options.

P5

Coastal development planning to cater for at least 0.4 m (and up to 1.6 m) of sea level rise in the long term (i.e. by 2080-2100)

Since climate change is a so-called "stock-flow" problem[3], the existing amount of atmospheric GHGs will continue to cause future

2 *The analogy is the same regarding mitigation pathways. Deficiencies in policy planning limits mitigation analyses to the 2030 time horizon at best.*

3 *Climate change is sometimes described as a "stock-flow" problem (by economists, generally), conceptually describing the fact that (i) existing changes in the climate depend on the amount of greenhouse gases in the atmosphere (i.e. a stock), and (ii) mitigation measures (that can be designed and implemented by man) address the rate at which greenhouse gases are emitted or removed from the atmosphere (i.e. the flow).*

climate changes regardless of efforts to reduce emissions. One of those impacts is sea level rise (SLR), which is a slow onset event – initially very small changes that increase exponentially due to time delays between cause and effects.[4]

Slow onset climate change is of critical importance because it lends itself to myopic policy making, as relatively small impacts are discarded or actions deferred in time until the problem becomes potentially unmanageable or options for remedial actions become more limited and more costly.

According to the WG1 report, the minimum rise that Small Islands will face is of the order of 0.4 m by the year 2100. However, this figure corresponds to a hypothetical world wherein very ambitious emissions reductions are implemented to achieve net-zero CO_2 emissions globally by 2050. This means that 0.4 m is a conservative figure and it can reasonably be assumed that, based on current socio-economic development pathways, the likely SLR could be up to 1.6 m by end of the century. Consequently, it is important that existing coastal infrastructures (e.g. road network, hotels, power lines, harbour) be retrofitted and new coastal development be designed to cater for SLR ranging from 0.4 m to 1.6 m.

P6

Long-term shoreline retreat strategies and the socioeconomic implications thereof)

While a 0.4 m increase in sea level may not, on face value, seem much, one should be reminded that such a level corresponds to a rise in the vertical axis. Depending on the coastal profile, this rise can translate into many more units of inland flooding – i.e. on the horizontal axis. Given that 0.4 m of sea level rise is a conservative figure and that this 0.4 m of vertical rise will spread over horizontally (with more inundation happening on low-lying areas), and that scientific assessments project up to 1.6 m vertical
rise in sea level, some level of shoreline retreat measures will be required in the future.

Out of all the findings of the WG1 report, the expected shoreline retreat of at least 100 m of shoreline across Small Islands is the one that is the most alarming for Mauritius. As a destination with its beaches as main tourist-puller, the implications of a 100 m shoreline retreat will be catastrophic to the tourist industry, over and above the huge social and environmental losses for its population and local biodiversity.

However, this scenario is one that is expected to unpack by 2100, and corresponds to a worst-case scenario (Scenario 5) of no additional climate policy being implemented globally. Nonetheless, WG1 findings also point to an irremediable rise of at least 40 cm by 2100 (for most ambitious Scenarios), implying that inundation maps for at least 40 cm SLR and up to 1.6 m will be needed (if not already available under consultancy studies undertaken in Mauritius already[5]) and that shoreline retreat will be inevitable. Strategies to cope with such planned retreat will, consequently, be needed in the medium-to-long term given the relatively long lifespan of hard coastal infrastructures. Those strategies will be informed by downscaled models in P1.

This stark fact also implies that new long term policy orientations regarding land use in low-lying areas in Mauritius will need to be formulated and integrated into outline planning schemes. Among others, these may include

- restricting development in risky areas;
- amending building codes and other related legislations to cater for SLR for at-risk infrastructures;
- reviewing legal frameworks such that some structures may be pulled down when a threshold SLR is reached; and
- providing incentives for relocation.

Socioeconomic analyses of the implications of different scenarios of SLR will, also, be required. As mentioned earlier, compound effects of SLR, storm surges and intense precipitation on coastal flooding and the loss and damage will need to be investigated using scenario modelling.

P7

The impacts of salt water intrusion in aquifers will need to be evaluated and appropriate strategies devised to enhance water security

There is high confidence of increased saltwater intrusion into aquifers of Small Islands as a result of the expected SLR, coupled with elevated risks of storm surges and intense precipitation events that increase surface runoff.

Given that potable water supply in Mauritius is sourced primarily from groundwater (around 50 % of total supply is from groundwater, with potable water extracted from 163 boreholes), with the remaining potable water being collected via reservoirs and rivers, the country has a high dependency on aquifers. Being an already water-stressed country, Mauritius is, therefore, at greater risk of water shortage should salt water contaminate its aquifers. It is thus essential that a proper targeted scientific study be undertaken on a priority basis to evaluate such risks (e.g. based on downscaled models and projections of climate impacts) and appropriate costed strategies devised accordingly. Consequently, the existing National Water Policy and the National Integrated Water Resources Management Plan of Mauritius will need to be updated to better reflect the actual risk of saltwater intrusion.

P8

Vulnerability assessment of strategic infrastructures to a potential Category 5 cyclone and response measures

While the WG1 report specifies that the frequency of tropical cyclones will diminish over time in the WIO region, it concurrently warns that the intensity of cyclones will increase, with a high possibility of Category 4-5 storms forming in the Indian Ocean basin. Despite the fact that Mauritius has not experienced such category cyclones since a few decades, the potential damage to critical infrastructure is a cause of concern, and warrants preparedness.

Vulnerability assessments of critical infrastructure (e.g. power lines, harbour, airport, exposed buildings) to gusts of the order of more than 209 km/h (a Category 4 cyclone is one that produces sustained winds of the order of 209 to 251 km/h, while a Category 5 cyclone produces sustained winds higher than 252 km/h, according to the Saffir-Simpson Hurricane Wind Scale) will be required. Prioritised response measures should then be formulated for implementation.

P9

Adaptation measures will be required to cater for at least a 0.86 °C increase in sea surface temperatures in the long-term

The WG1 report stipulates that, notwithstanding emissions reductions efforts globally, a minimum average increase of around

4 *In the WIO region, Relative Sea Level Rise rates based on satellite altimetry for the period 1993-2018 increased to 3.65 mm per year, compared to a Global Mean Sea Level change of 3.25 mm per year. Sea Level Rise for Mauritius has been reported at 5.6 mm per year over 2007–2016.*

5 *Inundation maps were developed for the DRR Strategic Framework and Action Plan under the Africa Adaptation Programme. Using regional climate models that are not appropriate for the geographical size of Mauritius, the maximum SLR = 49 cm was investigated. This shows the need for developing new flooding hazard maps using up to date data and appropriate methodologies.*

0.86 °C in sea surface temperatures will be experienced by 2081 – 2100, with these figures increasing to 2.89 °C in worst case scenarios for the same time period.

Given the impact of increases in sea surface temperatures (as well as ocean acidification) on seagrasses, mangroves, rocky shores, coral reefs and other marine ecosystems, there is a need to explicitly analyse the expected consequences. Studies addressing risks to marine biodiversity, coastal infrastructures, and tourism are needed to inform sound policy making. Subsequently, appropriate adaptation measures may be formulated and implemented. An important fact to remember is that coral reefs and coastal ecosystems constitute the first line of no-cost defence against high energy waves.

P10

The impacts (current and projected) of increased incidences of marine heatwaves on potential sea food catch will need to be evaluated

Regardless of mitigation ambitions, an increase in marine heatwaves around Small Islands is anticipated. In view of local ambitions to develop a so-called "blue-economy", Mauritius stands to gain by evaluating the climate change risks and impacts of marine heatwaves on its large Exclusive Economic Zone and to formulate appropriate policy measures (e.g. dynamic evolution of sustainable yields) accordingly. Such studies may cover:

- Migratory habits of pelagic fish, and
- the compound effect of sea surface temperature rises and ocean acidification on fish stocks, amongst others.

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