Disaster Management in a Small Island Developing State

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If small island developing states are vulnerable to the adverse effects of climate change, Mauritius is more so. In 2018, the World Risk Report ranked the island among the most disaster-prone countries in the world. It is estimated that the country suffers $22 million in losses due to flooding each year (World Bank Group, 2016). An outlier event with a return period of one hundred years may cost up to $150 million (*ibid.*).

Flooding is a near-annual phenomenon. In March 2013, the capital city of Port-Louis became the centre of attention when a devastating flash flood hit. Cars got washed away, streets turned impassable, and eleven people lost their lives (BBC, 2013). In December 2018, a flash flood struck the northern village of Cottage, causing extensive property damage (NAO, 2019). As the inhabitants built back, flooding reached the village again in 2020 (Bissessur, 2020). In 2021, rainfall further South in Mauritius flooded several localities (Davies, 2021). People were stranded and had to be brought to safety (*ibid.*).

With recurrent floods hitting different parts of the island, the country's best bet would be to revisit the core policies surrounding disaster risk management. But the paralysing effect of the political economy impedes these vitally needed policy reforms. Some politicians, caught between economic development and disaster risk reduction, blame climate change for the increasing frequency of flooding (Ramano and Dombrowski, 2021).

While global warming matters, the impact of policy may be far greater in engendering flood risk. Collective action, or lack thereof, can contribute to increased vulnerability in various ways. In this paper, we highlight the overlooked drivers of flooding, and capture the spirit of the country and its government, determined to spring back, and rebuild better. By exposing the questionable assumptions of disaster risk management in Mauritius, this article sets the stage for a more thoughtful flood management strategy.

Setting the context for the analysis, the next section explores the human and physical geography of the island. The paper then examines disaster risk governance in Mauritius, before discussing alternative approaches; and singling out one.

Topography of Mauritius

Mauritius is an island of volcanic origin. Its central plateau is high above sea level and receives abundant rainfall. On its boundaries, the Moka mountain range dominates Port

Louis to the west. At the foot of the mountain, in the peripheries of the capital city, the village of Tranquebar is a sitting duck for disaster. It is not surprising that Tranquebar is a flood-prone area (IOM, 2016). When rain falls on the slopes, the water feeds the natural stream that runs downhill. With a vibrant urban centre downstream, much wealth and many lives are at risk of flooding.

Vast tracts of farmland stretch across the northern plains. Prolonged showers during the summer saturate the ground, resulting in accumulations all over the region. As a result, enormous volumes of water flow into low-lying areas, causing flash floods. The village of Cottage is a case in point. In 2019, a deluge carrying agricultural debris from nearby fields filled houses, damaging household possessions and threatening lives. Video footage emerging after the floods testifies the severity of the event, underlining the need for urgent adaptation measures.

It is common knowledge that communities near watercourses face higher levels of hydrometeorological hazards. For example, the low-lying village of Poste de Flacq (PDF), at the confluence of two rivers (River Poste de Flacq and River Sarcellas), is vulnerable to frequent riverine flooding. When the streams overflow, agricultural undertakings, residential properties, and businesses in the neighbourhoods suffer extensive material losses. We gathered from pilot interviews that river embankments along the Sarcellas have increased the volume of runoff to PDF. In addition, human settlements have encroached on natural flood drainage channels, increasing the vulnerability of the area (Carpayen, 2018).

Inter-island migration

The nexus between internally displaced people and disasters is a neglected dimension in policy debates, and research in this field is scant. Nevertheless, there is evidence that climate change, poverty, and poor social cohesion are fuelling migration from Rodrigues to Mauritius (Ragodoo, n.d.). Some Rodriguan migrants have settled in flood-prone and economically disadvantaged areas in the periphery of Port-Louis (IOM, 2016). These marginalized men and women often engage in precarious activities as street vendors or scrap metal collectors. Their socio-economic conditions and lack of decent employment opportunities may well contribute to the vulnerability of the region. It emerged from stakeholder engagement that people dumped waste into the stream, which blocked the water flow. This could partly explain the devastating floods that hit Port Louis in 2013.

Institutional setup

Mauritius has made significant progress in disaster risk governance. The National Disaster Scheme, a key policy document, was published in 2015 to guide the implementation of

the national disaster risk reduction strategy. In 2013, the National Disaster Risk Reduction and Management Centre was established as the 'focal institution for the State of Mauritius for the planning, organizing, coordinating and monitoring of disaster risk reduction (DRR) and management' (NDS, 2015). This was a decisive step in coordinating multi-stakeholder and multi-agency engagement in DRR.

The disaster management agency works with a wide range of collaborators. For instance, the Mauritius Meteorological Services (MMS) is equipped with a sophisticated Doppler radar for weather forecasting and is a key collaborator. It transmits safety-critical data to the NDRRMC, allowing the latter to issue emergency alerts. Likewise, the Land Drainage Authority is working on the Land Drainage Master Plan to provide the scientific basis for policy. This would enable the National Development Unit to better deploy a network of drains and culverts around the country. But this multi-agency arrangement renders coordination more challenging.

For this reason, the National Audit Office has highlighted that the flood management strategy lacks a central coordinating body (NAO, 2019). Yet, it is revealing that the Environment Protection Act 2002 provides a centralized architecture to bring together various state agencies. This law has created the space for a National Environment Commission (henceforth, the Commission), chaired by the Prime Minister. Government ownership at the highest level could bridge the persistent ideological gap among the different stakeholders. This would help integrate environmental concerns into development, while facilitating collaborative adaptation actions. Further, the Commission has the powers to set national priorities for environmental protection. Notwithstanding these merits, the Commission did not meet once in almost a decade (MNA 2020). This delay in assembling the fragmented disaster risk reduction capabilities postponed the elusive whole-of-government DRR approach.

Financing of adaptation

The National Environment Fund (NEF) was established under the Environment Protection Act (EPA) (2002) to finance projects pertaining to environment protection from budgetary provisions and grants (EPA, 2020). The Finance Act (2018) then amended the EPA to allow the NEF to finance projects related to flood management, landslide management and disaster risk reduction with a seed capital of Rs 2 billion (USD 47 million approximately) (MNA, 2018). From an adaptation lens, this is not a huge amount. It is short of meeting the growing climate change adaptation needs of the island. Nevertheless, the country lacks absorptive capacity and could not use the whole amount by the end of the financial year 2019/2020.

The budget estimates for the financial year 2019/2020 show that NEF financed the Flood Management Programme (FMP) and Climate Change Adaptation (CCA), beach rehabilitation, and coral reef restoration (MoF, 2019).

While the Government has every reason to forefront the NEF as the financing arm of the national DRR strategy, the structure of the fund is neither convincing nor inspires trust. The FMP, for example, focused on financing the digital elevation model of the island, developing drains, and auditing rivers and watercourses causing recurrent floods (GoM, 2019). This is a reductionist approach to flood control with an inbuilt affinity for engineering solutions. The policy ignores the broader dimensions of Disaster Risk Reduction, like retrofitting and reclaiming backfilled marshlands.

Regulatory framework

The Building Control Act (2012), the Town and Country Planning Act (1954), the Planning and Development Act (2004) and the Environment Protection Act (2002) form the legal corridor to regulate the construction sector. For instance, since the Building Control Act was introduced in 2012, a permit is a prerequisite for any construction near a waterway. But, it emerged from field visits that there is no credible commitment to enforce these laws. Widespread non-conformity has not been entirely harmless. Flooding at Le Hochet (a village near the capital Port Louis), for example, was partly due to poor enforcement of building codes. One respondent succinctly summarised the core problem:

> *Much has been said about Le Hochet and the government's inaction to address recurrent flooding. The actual issue is that people have encroached on natural drains. Somebody built a wall across a stormwater drainage channel, which caused the water to accumulate, flooding some 50 houses.*
>
> (Source: Pilot Interview)

Non-compliance is not all. Sometimes policy decisions seem to counter the aim of building a safer and more resilient society. For instance, the government has regularized many illegal buildings in flood-prone areas (GoM, 2016a). The underlying logic is that politicians often have an incentive to avoid actions to prevent disasters, because voters are more likely to reward ad-hoc interventions. (Healy and Malhotra, 2009). For disaster management professionals, this is an additional obstacle.

Wetland protection

Protecting wetlands is on the agenda, as these ecosystems provide important environmental services. While reducing the risk of flooding from rainfall associated with cyclonic systems (Laurance *et al.*, 2012), they help aquifers recharge (Van der Kamp and

Hayashi, 1998). These ecosystems regulate surface water and improve water quality through sedimentation, nutrient decomposition, and microbial uptake (Johnston, 1991).

Most of these ecologically sensitive areas are degraded, with over 50% fragmented (Laurence *et al.*, 2012). This trend is likely to continue with further anthropogenic activities (*ibid.*). This is potentially due to landscape transformation for economic pursuits (Hammond *et al.*, 2015). Starting in the 16th century, human settlements and agricultural exploitation drove the demand for land. Population growth and tourism activities have added further pressure on demand.

The rapid degradation of wetlands in Mauritius has not been without consequence. Laurance *et al.*, (2012) found that urban floods are more likely to erupt near fragmented wetlands. Anecdotal evidence points to landscape degradation and backfilling of wetlands for the recent flash floods hitting the village of Brahmstan in the east of Mauritius.

Reviewing the legal provisions pertaining to environmental protection is topical, and efforts are underway to update the inventory of Environmentally Sensitive Areas (ESAs). In 2013, the Government proposed a draft wetland bill (NAO, 2019). Almost a decade later, the bill still hangs in abeyance (MNA, 2020a). The major hurdle is that part of the coastal wetland is privately owned and may not be easily accessible for inspection.

Being a contracting party of the Ramsar Convention since September 2001 (Mamoun *et al.*, 2013), the island has three Ramsar sites (GoM, 2018a). This intergovernmental treaty restricts contracting parties from the 'unthinking, selfish exploitation of their sovereign natural patrimony' (Matthews, 1993). The National Ramsar Committee is active in representing ecological interests *vis-à-vis* developmental actors. The committee regulates development by sanctioning the issuance of Building and Land Use Permits. However, this mechanism does not address the increasing pressure for development on wetlands. Despite the safeguards in place, developments continue to encroach upon these fragile ecosystems with unique biodiversity (NOA, 2019). Recognizing that preserving wetlands is critical to progress towards the Sustainable Development Goals, the Government of Mauritius is developing the wetland bill with assistance from the United Nations Development Programme (GoM, 2020).

Considering alternative approaches

Relocation

Relocation to a flood-free locality could be a turning point. For many, this is the last option, and examples of successful relocations are rare (Sipe and Vella, 2014).

Relocation attempts are fraught with difficulties. The literature alludes to a general reluctance for flood-affected communities to participate in resettlement programmes. In

Bangladesh, flood victims showed little interest in relocation without the right economic incentives (Rashid *et al.*, 2007).

When working with internally displaced people, it is therefore crucial to consider their socioeconomic situations. Tranquebar offers an interesting case that exemplifies the necessity of preserving locational advantages in relocation programmes. With government help, some squatters of Tranquebar were able to resettle at Pointe aux Sable (Savripène, 2017), a village nestled in the shadows of the capital city.

In addition, timing is an important consideration in relocation planning. The chances of success are low if the authorities do not relocate the affected community quickly after a disaster. This is because people who have experienced at least one recent flood are less likely to resist a government buyout of their properties (Sipe and Vella, 2014).

With residents moving to flood-free areas, the relocation exercise is rarely complete. Resettlement is not a linear process that ends with the community moving into a new location. It is a dynamic process that takes several rounds to reach an end-point where the displaced population is better off (Claudianos, 2015). Therefore, it is advisable to back community displacements with a comprehensive conflict management plan. In a do-nothing scenario, the relocation exercise could lead to a troubled neighbourhood, creating an administrative challenge for the government.

Green Infrastructures

Spatial planning is gaining prominence in urban flood management (Minnery, 2015). Already some countries are deploying green infrastructures as a flood-control strategy. This can address the urban drainage deficit [(Mguni *et al.*,2016) and (Keeley *et al.*,2013)], by enhancing the capacity of soil to absorb, retain or redistribute storm water (Berland *et al.*, 2017). The Dutch Room for the River Directives, for example, aim to reduce flood risks while improving spatial quality near the rivers (Rijke *et al.*, 2012).

Scientific progress is making it easier to create, restore and enhance wetlands (LePage *et al.*, 2011). Restoring historical wetlands would enable society to harness the capacity of these water bodies to hold stormwater. However, this proposal is weak, given that restoration of these filled wetlands would likely lead to strong resistance, as Mauritius does not have a specific law for wetland protection.

Retrofitting

Traditionally, builders in Mauritius did not relate infrastructure design considerations to disaster risk. As a result, housing colonies in low-lying areas are commonplace. We can justifiably blame it on the information deficit prevailing during the early days of development. Neglecting to integrate disaster risk reduction in development has put some neighbourhoods at risk of floods.

Retrofitting these infrastructures can deliver important socioeconomic benefits. With some additional cost, the country can forestall a pattern of property loss due to flooding. For example, adding a second floor to existing buildings may house necessities, contributing to the rapid recovery of the neighbourhood.

However, it emerged from field visits that construction continues unabated in some flood-prone areas, and more than a few recent buildings do not feature a flood-resistant design. There are two reasons for this. First, public action may negatively influence preparedness. The case of the flood-prone village of Poste-de-Flacq illustrates this. One resident claimed:

> *After the government cleaned the river, the situation has improved. But unexpectedly, flood hit back.*

A minor government initiative led to a false sense of security. In January 2018, despite several interventions of the government to control the flood, the Poste de Flacq river broke its banks, inundating properties (Carpayen, 2018). This situation highlights not only the lack of preparedness, but also the futility of ad hoc measures.

Second, because adaptation measures often have significant positive externalities, some people opt to pursue a hands-off approach. The rainwater-harvesting scheme illustrates this. Households investing in a rainwater-harvesting system are eligible for tax rebates (MRA, 2021). If widely adopted, this scheme could reduce river runoff, while promoting sustainable development. Some stakeholders have argued that there is not enough demand for this programme, because there is no appetite for investment when utility connections are available at low cost. Meanwhile, roof discharge from private properties continues to swell river runoff.

Retrofitting at the community level also has its drawbacks. While dams, culverts and dikes could mitigate the adverse effects of floods, there is evidence that such measures may have counterintuitive consequences due to the 'safe development paradox' (Burby, 2006). By overestimating the capacity of flood defences to offer protection, people often accumulate wealth around these structures (Ferreira et al., 2013). This could lead to a major disaster when an outlier event overwhelms the capacity of these flood defences (*ibid.*).

Dykes and embankments channel higher volumes of water downstream. The increased runoff raises the exposure of lower riparian regions. Thus, policy interventions that ignore the downside of engineering interventions could lead to greater disasters. In recognition, some countries have a broader conception that considers the entire spectrum of risks. For instance, the United Kingdom has adopted a policy where planned actions at the catchment level are used to inform decision making at the neighbourhood scale (Scott *et al.*, 2013). In Bangladesh, the Flood Action Plan (FAP) initially relied on a policy dominated by politicians, consultants and donors. The World Bank backed FAP, pushed for massive engineering works to contain the impact of recurrent annual floods (Sultana *et al.*, 2008). However, pressures from civil society, including environmentalists, led donors

to conclude that large-scale embankments could not be justified (*ibid.*). Hence, the FAP favoured a participatory approach, responding to local needs (*ibid.*). Too often, societies cannot agree on the right level of public/private partnership in flood management due to competing interests of many stakeholders, making this option less desirable.

A hybrid approach

For developing countries, it is difficult to meet the simultaneous needs for disaster risk reduction and economic development. As discussed earlier, leaders avoid or delay climate-change adaptation (Healy and Malhotra, 2009) to focus on economic development that can create safety for all (Toya and Skidmore, 2007). For floods, the twin goals of development and flood resilience cannot be complementary. Urbanization, which is a consequence of development, leads to an increase in runoff by reducing the permeability of surfaces (Armson *et al.*, 2013).

So far, the government has shown a strong affinity for structural flood defences. Dams, culverts and drains are at the forefront of policy debates. But, flood-affected communities have reiterated the need to speed up the construction of flood defences. This serves to emphasize the limited capacity of a government caught in the maelstrom of climate change, economic development and a global pandemic.

Moreover, engineering flood defences are unlikely to be sustainable. Recent disaster management papers point to important adverse externalities of these measures. Dykes and levees are not effective against flood when infiltration of groundwater is high (Abbasov and Mahmudov, 2009). Additionally, flood defences have a limited capacity to offer protection (Ferreira *et al.*, 2013).

The Republic of Mauritius may consider a policy shift aligning with international best practice and lessons learned. For instance, decisions taken at the catchment level across the European Union are used to inform design considerations at the local level (Scott *et al.*, 2013). This concerted approach recognizes that flood is a natural process and is avoidable (Filatova, 2014). Similarly, adaptation efforts should aim to mitigate the adverse impacts of floods, rather than eliminate them (Alfieri *et al.*, 2016). It is therefore critical to make space for the river in the flood management strategy by incorporating elements of green infrastructure at the planning level.

To give wings to this new vision, we follow Chang (2008) to propose a two-fold strategy. First, policy should decide on the acceptable level of floods, reconciling the competing tensions between development and green infrastructures. To limit risk and additional exposure, local authorities would have to deny new building permits in designated flood zones. As for existing buildings, residents may consider retrofitting based on topography and flood risk levels.

Second, further development would depend on mitigation measures at the catchment level, using engineering and nature-based solutions. It is important to evaluate trade-offs between the various combinations of hard and soft measures to reach the most cost-effective flood management solution (Chang, 2008). Policy may control the level of development based on indicators like surface runoff and subsurface return flow (*ibid.*). In this context, Chang proposed the Tradeable Flood Reduction System (TFR) to reconcile development and mitigation measures between different zones.

The TFR requires policy makers to allocate permits to mitigation suppliers (land owners ready to allow floodwaters to accumulate on their properties) based on the acceptable risk level. Developers can buy these permits to preserve existing upstream green infrastructures or realign embankments, which exacerbate downstream flood risks. This system would allow the government and other stakeholders to influence the market by entering it.

Looking forward

If we are to find a lasting solution to the problem of recurrent floods, our approach to disaster risk reduction must change. Mauritius has to shed the belief that nature can be 'controlled through public works' (Sultana *et al.*, 2008). This analysis reveals the facets of the problem: a lack of political will and capacity. At any rate, structural development by itself would not provide lasting relief from recurrent flooding. Policymakers must recognize that flooding is a natural process, and society must make room for it. But, the two-fold solution we proposed poses additional problems. First, there is a need to develop legal and institutional infrastructures to support the implementation. Second, the government would have to conduct a periodic topographic mapping of the island to identify low-lying, flood-prone areas and green infrastructures. In the future, researchers could supplement this dialogue on flood management by conducting the analysis using alternative methods.

References

Abbasov, R.K. and Mahmudov, R.N. (2009). 'Analysis of non-climatic origins of floods in the downstream part of the Kura River, Azerbaijan'. *Natural Hazards*, 50 (2), pp.235-248.

Alfieri, L., Feyen, L., and Di Baldassarre, G. (2016). 'Increasing flood risk under climate change: a pan-European assessment of the benefits of four adaptation strategies'. *Climatic Change*, 136 (3), pp.507-521.

Armson, D., Stringer, P. and Ennos, A.R. (2013). 'The effect of street trees and amenity grass on urban surface water runoff in Manchester, UK'. *Urban Forestry & Urban Greening*, 12 (3), pp.282-286.

Berland, A., Shiflett, S.A., Shuster, W.D., Garmestani, A.S., Goddard, H.C., Herrmann, D.L. and Hopton, M.E. (2017). 'The role of trees in urban stormwater management'. *Landscape and Urban Planning*, 162, pp.167-177.

BBC. (2013). *Deadly floods hit Mauritius capital Port Louis*. Available at: https://www.bbc.com/news/world-africa-21989070

Bissessur, R. (2020). *Cottage: les inondations continuent*. https://defimedia.info/cottage-les-inondations-continuent

Burby, R.J. (2006). 'Hurricane Katrina and the paradoxes of government disaster policy: bringing about wise governmental decisions for hazardous areas'. *Annals of the American Academy of Political and Social Science*, 604, pp.171–191.

Carpayen, S. (2018). *Poste-de-Flacq: un village sévèrement touché par les inondations chaque année*. < Available at: https://www.lexpress.mu/article/324277/poste-flacq-un-village-severement-touche-inondations-chaque-annee > [Accessed 8 September 2020].

Chang, C.T. (2008). 'Introduction of a tradeable flood mitigation permit system'. *Environmental Science & Policy*, 11 (4), pp.329-335.

Claudianos, P. (2015). 'The influence of the social dimension in planned relocation outcomes'. In *5th International Conference on Building Resilience*.

Davies R. (2021). *Mauritius – Flash Floods in South East After 400mm of Rain in 24 Hours.* Available at: https://floodlist.com/africa/mauritius-flash-floods-april-2021

Environment Protection Act (EPA) 2002. Available at: https://www.mra.mu/download/TheEnvironmentProtectionAct2002.pdf

Ferreira, S., Hamilton, K. and Vincent, J.R. (2013). 'Does development reduce fatalities from natural disasters? New evidence for floods'. *Environment and Development Economics*, 18 (6), pp.649-679.

Filatova, T. (2014). 'Market-based instruments for flood risk management: A review of theory, practice and perspectives for climate adaptation policy'. *Environmental Science & Policy*, 37, pp.227-242.

Government of Mauritius (GoM). (2016a). *Public Infrastructure 'Port Louis to be free of squatters soon'.* Available at: < http://www.govmu.org/English/News/Pages/Port-Louis-to-be-free-of-squatters-soon-.aspx > [Accessed 3 May 2021].
Available at: < www.govmu.org/English/News/Pages/Wetland-Bill-in-preparation,-announces-Agro-Minister.aspx> [Accessed 3 May 2021].

Government of Mauritius (GoM). (2018a). *Mauritius to submit proposal to designate Caverne Patate as a Ramsar Site.* Available at: http://www.govmu.org/English/News/Pages/Mauritius-to-submit-proposal-to-designate-Caverne-Patate-as-a-Ramsar-Site.aspx

Hammond, D.S., Gond, V., Baider, C., Florens, F.B.V., Persand, S. and Laurance, S.G.W. (2015). 'Threats to environmentally sensitive areas from peri-urban expansion in Mauritius'. *Environmental Conservation*, 42 (3), pp.256-267.

Healy, A. and Malhotra, N. (2009). 'Myopic voters and natural disaster policy'. *American Political Science Review*, pp.387-406.

IOM. (2016) *Assessing the Evidence Opportunities and Challenges of Migration in Building Resilience Against Climate Change in The Republic of Mauritius*. Available at: https://publications.iom.int/system/files/pdf/assessing_the_evidence_mauritius.pdf

Johnston, C.A. (1991). 'Sediment and nutrient retention by freshwater wetlands: effects on surface water quality'. *Critical Reviews in Environmental Science and Technology*, 21 (5-6), pp.491-565.

Keeley, M., Koburger, A., Dolowitz, D.P., Medearis, D., Nickel, D. and Shuster, W. (2013). 'Perspectives on the use of green infrastructure for stormwater management in Cleveland and Milwaukee'. *Environmental Management*, 51 (6), pp.1093-1108.

Laurance, S.G., Baider, C., Florens, F.V., Ramrekha, S., Sevathian, J.C. and Hammond, D.S. (2012). 'Drivers of wetland disturbance and biodiversity impacts on a tropical oceanic island'. *Biological Conservation*, 149 (1), pp.136-142.

LePage, B.A. (2011). 'Wetlands: a multidisciplinary perspective'. In *Wetlands* (pp. 3-25). Springer, Dordrecht.

Mamoun, C.M., Nigel, R. and Rughooputh, S.D. (2013). 'Wetlands' inventory, mapping and land cover index assessment on Mauritius'. *Wetlands*, 33 (4), pp.585-595.

Matthews, G.V.T. (1993). *The Ramsar Convention on Wetlands: its history and development*. Gland: Ramsar Convention Bureau.

Mauritius National Assembly (MNA). (2018). *Finance Miscellaneous Provisions Act*.
Available at: https://tinyurl.com/2wmthkfy

Mauritius National Assembly (MNA). (2020). *Parliamentary debates 23 June 2020.*
Available at: https://mauritiusassembly.govmu.org/Documents/Hansard/2020/hansard222020.pdf

Mauritius National Assembly (MNA). (2020a). *Parliamentary debates 24 November 2020.*
Available at: https://mauritiusassembly.govmu.org/Documents/Hansard/2020/hansard352020.pdf

Mauritius Revenue Authority (MRA). (2021). *2021 Income Exemption Threshold (IET).* Available at: https://www.mra.mu/index.php/individuals/exemptions-reliefs

Mguni, P., Herslund, L. and Bergen Jensen, M. (2016).'Sustainable urban drainage systems: examining the potential for green infrastructure-based stormwater management for Sub-Saharan cities'. *Natural Hazards,* 82, (2), pp.241-257.

Ministry of Finance, (MoF). (2019). Economic Planning and Development.
Appendix C: Special and Other Budgetary Funds. Available at: https://tinyurl.com/hk9j9t7w

Minnery, J. (2015). *December. Flood Mitigation With and Without'Planning: The Roles of Ideas, Interests and Institutions*. 7th State of Australian Cities Conference, 9-11 December 2015, Gold Coast, Australia.

National Audit Office (NOA). (2019). *National Audit Report- Government Response to Mitigate the Impact of Flooding*.

National Disaster Risk Reduction and Management Center (NDRRMC). (2020). Ministry of Local Government and Disaster Risk Reduction. Available at:
<https://ndrrmc.govmu.org/SitePages/Index.aspx> [Accessed 2 May 2020].

National Disasters Scheme (NDS). (2015). National Disaster Risk Reduction and Management Centre (NDRRMC) Available at: https://tinyurl.com/DRRS2015

Ragodoo N.J.F. (n.d.). *Gender Migration as tool for development: The movement of women from Rodrigues Island to Mauritius.* Available at: https://codesria.org/IMG/pdf/NICOLAS_RAGODOO.pdf

Ramano K. and Dombrowski, K. (2021). *Mauritian minister warns: 'It is a matter of life and death'.* Available at: https://www.dandc.eu/en/article/small-island-developing-states-are-hardly-responsible-climate-change-most-affected

Rashid, H., Hunt, L.M. and Haider, W. (2007). 'Urban flood problems in Dhaka, Bangladesh: slum residents' choices for relocation to flood-free areas'. *Environmental Management*, 40 (1), pp.95-104.

Rijke, J., van Herk, S., Zevenbergen, C. and Ashley, R. (2012). 'Room for the River: Delivering integrated river basin management in the Netherlands'. International Journal of River Basin Management, 10 (4), pp.369-382

Russi, D., ten Brink, P., Farmer, A., Badura, T., Coates, D., Förster, J., Kumar, R. and Davidson, N. (2013). 'The economics of ecosystems and biodiversity for water and wetlands'. *IEEP,* 78. London and Brussels.

Savripène, M. A.(2017). *Squatters de Tranquebar relogés à Pointe-aux-Sables: un toit, mais à quel prix 11 jun 2017*. Available at: https://www.lexpress.mu/article/309534/squatters-tranquebar-reloges-pointe-aux-sables-un-toit-mais-quel-prix

Scott, M., White, I., Kuhlicke, C., Steinführer, A., Sultana, P., Thompson, P., Minnery, J., O'Neill, E., Cooper, J., Adamson, M. and Russell, E. (2013). 'Living with flood risk/The more we know, the more we know we don't know: Reflections on a decade of planning, flood risk management and false precision/Searching for resilience or building social capacities for flood risks?/Participatory floodplain management: Lessons from Bangladesh/Planning and retrofitting for floods: Insights from Australia/Neighbourhood design considerations in flood risk management/Flood risk management–Challenges to the effective implementation of a paradigm shift'. *Planning Theory & Practice*, 14 (1), pp.103-140.

Sipe, N. and Vella, K. (2014). 'Relocating a flood-affected community: good planning or good politics?'. *Journal of the American Planning Association*, 80 (4), pp.400-412.

Sultana, P., Johnson, C. and Thompson, P. (2008).' The impact of major floods on flood risk policy evolution: Insights from Bangladesh'. *International Journal of River Basin Management*, 6 (4), pp.339-348.

Toya, H. and Skidmore, M. (2007).' Economic development and the impacts of natural disasters'. *Economics Letters*, 94 (1), pp.20-25.

Van der Kamp, G. and Hayashi, M. (1998). 'The groundwater recharge function of small wetlands in the semi-arid northern prairies'. *Great Plains Research*, pp.39-56.

World Bank Group. (2016). *Disaster Risk Profile Mauritius*. Available at: https://www.gfdrr.org/sites/default/files/mauritius.pdf

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