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## Mozambique Prisoner to a Vicious Cycle of Post-Cyclone Reconstruction and Losses

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### 1. Introduction

Cyclones have been registered in Mozambique<sup>1</sup> since at least the 1980s and over the past ten years they have occurred with greater intensity and frequency and at least once a year. In each cyclone cycle – which occurs between November and April – the Government shows that it is incapable of anticipating and responding although it possesses initiatives to mitigate the effects of extreme climatic events. Public and private infrastructures are damaged or totally destroyed and reconstruction becomes an interminable cycle of waste of resources. The pattern is repeated every year.

The National Meteorological Institute (INAM) has indicated that storms are becoming more intense due to global warming, which is increasing the risk to Mozambique. Cyclones Chido, in December 2024, and Dikeledi and Jude in January and March 2025, respectively, are the most recent examples of the increased frequency of cyclones in Mozambique, which have caused significant human and material losses<sup>2</sup>.

The occurrence of cyclones dates back for more than 40 years. The cycles of the rebuilding of infrastructures after each cyclone can be blamed, not on the unpredictability of nature, but on the failure to build resilient infrastructures<sup>3</sup> in the zones prone to extreme climatic events.

The Ministry of Public Works, Housing and Water Resources (MOPHRH) has promoted initiatives such as the Decree on Standards of Resilient Construction of Schools, and the Guide for the Construction of Resilient Housing, for building climate-resilient infrastructures. However, some infrastructures built under this initiative have been damaged or destroyed after the passage of new cyclones.

This article analyses how the government anticipates and responds to the socio-economic impacts caused by cyclones in Mozambique. The text is the result of bibliographical and documentary review, including scientific articles, reports, newspapers, internet sites and other documents relevant to the topic.

It is argued that, although there is a history of cyclones and alerts, what is missing is the construction of infrastructures with nature-based solutions (NbS) that are resilient to extreme climatic events. Hence, to face the vicious cycle of the destruction of infrastructures, it is proposed that resilient infrastructures be built with NbS, which consists of integrating natural and ecological processes into the design and construction of infra-

1 Mozambique is a country with a tropical to sub-tropical climate and occupies fifth position in the global ranking of climate vulnerability (AFRIKAIA, 2022). Because of its geographical location, the country is affected by tropical cyclones that form in the waters of the Indian Ocean, in an area known as the South West Indian Ocean Basin (SWIO). Cyclone formation and intensification is due in large measure to the energy generated by the intertropical convergence zone and the heating of the surface waters of the sea which exceeds 27°C (INAM, 2023).

2 Unicef Mozambique (2025, 18 de Janeiro). Ciclone Dikeledi e Chido em Moçambique. <https://www.unicef.org/mozambique/ciclone-dikeledi-e-chido-em-mocambique> [consulted on 14 April].

3 Infrastructure resilience is the capacity of the systems and their users to resist, adapt and recover from adverse events, including changes caused by climate development or alterations, minimising impacts and guaranteeing continuity of essential services (ADB, 2022).

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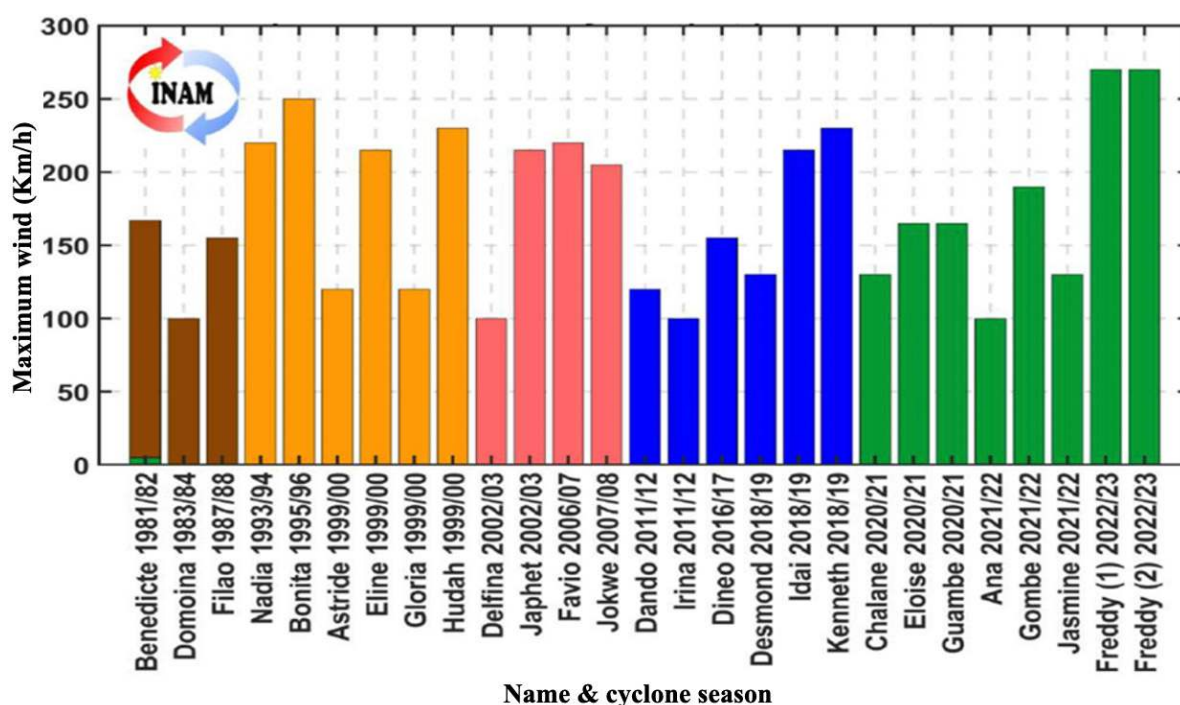
structures, with the aim of increasing their capacity to resist and adapt to the impacts of climate change, such as tropical cyclones and storms. As long as these elements are not present, the country will remain in a vicious cycle of loss of life and property.

The article is structured into five sections, namely: i) this introduction, which presents the problem, the objective, the methodology and the main argument; ii) the second section, which discusses the effects of the cyclones on Mozambique; iii) the third section which presents international models of resilient infrastructures built with NbS; and iv) the conclusion, and v) specific recommendations to overcome the problem.

## 2. Effects of the Cyclones on Mozambique

Mozambique has a history of severe cyclones. From 1980 to 2023, 27 cyclones occurred, according to the INAM data (graph 1). In the last 10 years, the cyclones have become more frequent and severe, such as the cases of cyclones Idai and Kenneth, which in 2019 affected the central and northern regions of Mozambique respectively, destroying much of Beira city and other coastal regions.

**Graph 1:** Cyclones that hit the Mozambican coast from 1980 to 2023.



**Source:** National Meteorology Institute, 2023<sup>4</sup>.

The effects of the cyclones that strike the country<sup>5</sup> include:

- Recurrent humanitarian crises, with thousands of people displaced<sup>6</sup>.
- Destruction of housing and public and private infrastructures, particularly in the vulnerable coastal areas.
- Decline in agricultural productivity which worsens food insecurity and makes economic recovery still more difficult.

<sup>4</sup> National Meteorology Institute (INAM) (2023). Relatório do Estado do Clima de Moçambique em 2023. <https://www.inam.gov.mz> [consulted on 14 September 2024].

<sup>5</sup> Instituto Nacional de Gestão e Redução de Desastres (INGD). [https://web.facebook.com/INGD.Mocambique/?\\_rdc=1&\\_rdr](https://web.facebook.com/INGD.Mocambique/?_rdc=1&_rdr) [consulted on 29 March 2025].

<sup>6</sup> Humanitarian crises are worsened by the lack of equitable and fair distribution of aid to people affected by cyclones/ This is one of the problems most reported after each cyclone. A significant part of the population affected by disasters does not receive the necessary humanitarian assistance, and among the beneficiaries the distribution of support is defective, marked by lack of transparency accompanied by suspicions of corruption and theft (Sebastião, 2019). This scenario is even worse, considering that more than half of the Mozambican population lives below the poverty line and about two thirds live in coastal areas, which are highly vulnerable to storms. The incapacity of the government to respond in an effective and efficient manner results in a precarious distribution of humanitarian aid.

- Increases in psychological problems and in cases of diseases such as malaria and cholera.
- Severe damage to the transport and communications networks, making the response to emergencies still more chaotic.
- Reallocation of funds to respond to climate emergencies.
- Mobilisation of financial resources which are never sufficient, and which are frequently badly administered.

In Mozambique, construction is undertaken without considering the minimum standards of adaptation to climate change. Inadequate materials and technologies are used for infrastructures erected in areas that are highly vulnerable to the risks of natural disasters. A further aspect is the lack of maintenance of infrastructures<sup>7</sup>, which compromises their durability, even when they are resilient to cyclones.

Although the Government is aware of the devastating effects of cyclones, its capacity for anticipation and post-cyclone response has proved insufficient and ineffective, given the magnitude of the disasters. An example that the government is aware of the need for resilient construction is the post-Cyclone Idai initiative to improve climatic resilience in the city of Beira<sup>8</sup>.

However, not all the infrastructures rebuilt after Cyclone Idai, which was one of the most devastating cyclones of the past decade, and with a structured plan of resilience, have remained intact in the subsequent cyclones, as shown by the case of the bridge over the Revúbuê river, in Tete city. Rebuilding this bridge in 2019, after Cyclone Idai, cost 3.7 million dollars, but it collapsed again in 2022 after the passage of Cyclone Gombe. Like the Tete bridge, between 2019 and 2022, 76 damaged bridges and 10 destroyed as the result of extreme climatic events were identified<sup>9</sup>.

Records of the last four months show the significant damage caused to infrastructures after Cyclones Chido (2024), Dikeledi and Jude (2025). An example of the failure to observe resilient construction was the destruction of the Naminawe Health Centre in Cabo Delgado province, after the passage of cyclone Chido, one month after it had been inaugurated, in November 2024. The cycle of reconstruction and destruction of infrastructures is repeated every cyclone season, affecting essential properties, such as houses, schools, health units, places of worship, roads and electricity pylons (Table 1).

**Table 1:** Infrastructures recently destroyed by cyclones Chido, Dikeledi and Jude.

Climatic event	Date of event	Provinces affected	Infrastructures damaged
<b>Chido</b>	December 2024	Cabo Delgado	118,605 houses totally destroyed, 1,126 classrooms damaged in 250 schools affected, 52 health units damaged, 13 places of worship and electricity pylons <sup>10</sup> .
<b>Dikeledi</b>	January 2025	Nampula	3,381 houses totally destroyed, 82 schools and 192 classrooms damaged <sup>11</sup> .
<b>Jude</b>	March 2025	Zambézia Nampula Sofala	32,934 houses totally destroyed, 674 classrooms damaged in 247 schools, 72 health units, 18 bridges damaged, 2,859 km of roads, 1,224 electricity pylons brought down, and 73 km of power lines destroyed <sup>12</sup> .

The impacts of the cyclones are widely known in Mozambique. Several years after the post-cyclone destruction there are still many lives at risk, households made homeless who have lost their property without replacement, and undertakings that remain damaged. The government authorities are proving incapable of anticipating and

7 Massingue, R. (2022, 17 April). Nem tudo está a desabar, diz ANE. In *O País*. <https://opais.co.mz/nem-tudo-esta-a-desabar-diz-ane/> [consulted on 22 April 2025].

8 United Nations Mozambique. (2021, 15 July). Director regional do ONU-Habitat para África visita Moçambique para fortalecer laços. Nações Unidas Moçambique. <https://mozambique.un.org/pt/126888-director-regional-do-onu-habitat-para-africa-visita-mocambique-para-fortalecer-lacos> [consulted on 22 April 2025].

9 Ibid<sup>7</sup>.

10 Instituto Nacional de Gestão e Redução de Desastres (INGD) (2024, December). Ciclone “Chido” causa impacto económico severo em Cabo Delgado. [https://web.facebook.com/INGD.Mocambique/?\\_rdc=1&\\_rdr](https://web.facebook.com/INGD.Mocambique/?_rdc=1&_rdr) [consulted on 31 March 2025].

11 Instituto Nacional de Gestão e Redução de Desastres (INGD) (2025, 16 January). INGD abre quatro centros de acomodação em Nampula. [https://web.facebook.com/INGD.Mocambique/?\\_rdc=1&\\_rdr](https://web.facebook.com/INGD.Mocambique/?_rdc=1&_rdr) [consulted on 30 March 2025].

12 Instituto Nacional de Gestão e Redução de Desastres (INGD) (2025, 15 March). INGD reforça assistência às vítimas do ciclone Jude. [https://web.facebook.com/INGD.Mocambique/?\\_rdc=1&\\_rdr](https://web.facebook.com/INGD.Mocambique/?_rdc=1&_rdr) [consulted on 30 March 2025].

responding to each climatic event. This poor performance should be replaced by more adequate actions to avoid further loss of life and of financial resources.

Mitigating the impacts of cyclones requires millions of dollars in investment<sup>13</sup>. The World Bank has made funds available for post-cyclone recovery, such as 150 million dollars for recovery post-cyclone Freddy in 2023<sup>14</sup> and 320 million meticaís to support recovery after cyclones Chido, Dikeledi and Jude<sup>15</sup>. The Government should ensure that the funds are invested in resilient infrastructures to avoid vicious cycles of reconstruction and destruction of infrastructures.

A clear example of post-cyclone reconstruction and destruction is the recent collapse of the footbridge under construction over the Ivagalane River, in Quelimane, on 31 March 2025, due to the action of the waters on the eve of its official inauguration<sup>16</sup>. This bridge is one of the infrastructures financed by the World Bank under the recovery plan after Cyclone Freddy<sup>17</sup>, which occurred in 2023.

The Quelimane Councillor for Infrastructures and Town Planning, Juvenal Simbine, said on the day of the incident that the real causes of the collapse of the bridge are still unknown. However, what is evident is the waste of money which, with adequate inspection and effective strategic planning, could have been avoided. The funds spent up until the time the bridge collapsed instead of solving the problems by building a resilient bridge with Nature based Solutions (NbS), shows that the country is perpetuating the cycle of destruction, since this bridge will need more funds for its repair.

Although the Government receives funds for post-cyclone recovery and strengthening of resilience, the lack of implementation of efficient measures can compromise the credibility of the projects and reduce international support. It is urgent that the country has resilient infrastructures with nature-based solutions, such as those used in Canada, China, Thailand, Rwanda and São Tomé and Príncipe, who face similar climatic challenges.

### 3. International Models of Resilient Infrastructures

Sustainable development in countries vulnerable to cyclones depends on the resilience of the systems of infrastructures to the high and growing risk of environmental catastrophes. The resilience of these infrastructures plays an essential role in sustaining economic growth and in promoting social welfare. Furthermore, the lack of investment in resilient infrastructures could institutionalise vulnerabilities for decades, compromising the capacity for future adaptation<sup>18</sup>.

Investing in resilient infrastructures could generate a triple dividend: avoiding damage and losses; unblocking economic potential and providing co-benefits for sustainable development<sup>19</sup>. These benefits include the protection of lives, reducing the costs of reconstruction and creating green employment, a pressing need for Mozambique.

Nature-based solutions (NbS)<sup>20</sup> are more effective and sustainable than the traditional engineering infrastruc-

13 Ministério de Obras Públicas, Habitação e Recursos Hídricos (MOPHRH) (2020). Projecto de Emergência para a Recuperação e Resiliência dos Ciclones Iдай e Kenneth. <https://documents1.worldbank.org/curated/en/099305006272270075/pdf/P17104004dd12c03c0b74d069f203230bce.pdf> [consulted on 3 April 2025].

14 World Bank Group (WBG) (2023, 19 May). Banco Mundial Disponibiliza \$150 Milhões para Apoiar a Recuperação Pós-Ciclone Freddy. *World Bank Group*. <https://www.worldbank.org/pt/news/press-release/2023/05/24/world-bank-mobilizes-150-million-to-help-afe-mozambique-recover-from-cyclone-freddy> [consulted on 3 April 2025].

15 Baloi S. (2025, 29 March). Banco Mundial disponibiliza 320 milhões de meticaís para recuperação pós-manifestações e ciclones. *In MZNEWS*. <https://mznews.co.mz/banco-mundial-disponibiliza-320-milhoes-de-metica-is-para-recuperacao-pos-manifestacoes-e-ciclones/> [consulted on 31 March 2025].

16 Jornal Notícias (2025, 2 April). Procuram-se causas da queda da ponte sobre o rio Ivagalane. <https://www.jornalnoticias.co.mz/2025/04/02/procuram-se-causas-da-queda-da-ponte-sobre-o-rio-ivagalane/> [consulted on 14 April 2025].

17 Integrity (2025, 6 April). Em Quelimane: Água derruba a Ponte Pedonal em construção sobre o Rio Ivagalane. *In Integrity*. <https://integritymagazine.co.mz/arquivos/41026?amp=1#origin=https%3A%2F%2Fwww.google.com%2F&cap=swipe,education&webview=1&dialog=1&viewport=-natural&visibilityState=prerender&prerenderSize=1&viewerUrl=https%3A%2F%2Fwww.google.com%2F&mp%2Fs%2Fintegritymagazine-co-mz.cdn.ampproject.org%2Fc%2Fs%2Fintegritymagazine.co.mz%2Farquivos%2F41026%3Fusqp=mq331AQIUAKwASCAAGM%25253D&kit=1> [consulted on 21 April 2025].

18 Asian Development Bank- ABD (2022). Disaster-Resilient Infrastructure: Unlocking Opportunities for Asia and the Pacific. <https://www.adb.org/sites/default/files/publication/791151/disaster-resilient-infrastructure-opportunities-asia-pacific.pdf> [consulted on 4 April 2025].

19 Hallegatte, S., Rentschler, J. e Rozenberg, J. (2019). Lifelines: The Resilient Infrastructure Opportunity. Sustainable Infrastructure. *In World Bank*. <http://hdl.handle.net/10986/31805> [consulted on 14 April 2025].

20 The International Union for Conservation of Nature defines Nature-based Solutions (NbS) as “actions to protect, sustainably manage, and restore natural or modified ecosystems that address social challenges in an effective and adaptive way, while simultaneously providing benefits for human well-being and biodiversity.” NbS are developed to tackle significant social challenges, including food security, climate change, water management,



tures<sup>21</sup>. Resilience can be achieved through a combination of approaches based on architecture, engineering and nature. While the NbS seek to protect, manage and restore natural ecosystems to strengthen resilience of the infrastructures, the architecture and engineering approaches involve investments in grey infrastructures, such as conventional man-made structures<sup>22</sup>, which are generally more expensive and environmentally invasive. There is increasing consensus that the combination of grey and green solutions is more effective and sustainable (Table 2).

**Table 2:** Practical applications of NbS.

Challenges	Engineering Solutions	Nature based Solutions (NbS)	Integrated Examples
<b>Management of urban stormwaters and flooding</b>	<ul style="list-style-type: none"> <li>- Adapt/Improve urban storm-water drainage systems, directing the water to receiving bodies such as rivers.</li> <li>- Creation of retention reservoirs (to store the water temporarily to avoid drainage overload).</li> <li>- Creation of deep drainage tunnels like those used in São Paulo and Singapore.</li> </ul>	<ul style="list-style-type: none"> <li>- Adoption of green rooftop<sup>23</sup>.</li> <li>- Creation of urban gardens and green spaces.</li> <li>- Restoration and management of riverine vegetation and wetlands.</li> <li>- Creation of floodable parks (green areas that work with temporary retention basins during heavy rains).</li> </ul>	<ul style="list-style-type: none"> <li>- Adoption of green rooftops, bio-valleys and rain gardens<sup>24</sup> to regulate the stormwater runoff and reduce the flows into the drainage system</li> </ul>
<b>Coastal flooding, storms, sea level rise and erosion</b>	<ul style="list-style-type: none"> <li>- Construction of dykes, permanent artificial walls, and temporary barriers against storms.</li> <li>- Construction of improved drainage systems.</li> </ul>	<ul style="list-style-type: none"> <li>- Conservation, management, restoration or creation of coral reefs (including the use of artificial substrate), oyster reefs, sea grass meadows, coastal wetlands, mangroves, swamps, sand dunes and beaches.</li> </ul>	<ul style="list-style-type: none"> <li>- Restoration and conservation of mangrove strips that support sea dykes as the first line of defence to reduce the risk of flooding and erosion.</li> </ul>
<b>Landslides</b>	<ul style="list-style-type: none"> <li>- Construction of containment walls.</li> <li>- Creation of a monitoring and alert system (use of humidity sensors and automatic rain gauges that forecast land slips).</li> </ul>	<ul style="list-style-type: none"> <li>- Planting of vegetation on the slopes.</li> <li>- Forestation and reforestation.</li> </ul>	<ul style="list-style-type: none"> <li>- Planting of vegetation on the slopes.</li> <li>- Strengthen the resilience of the containment walls.</li> </ul>
<b>Soil erosion and sedimentation</b>	<ul style="list-style-type: none"> <li>- Construction of containment walls.</li> <li>- Construction of terraces and contour lines.</li> <li>- Dredging Programmes.</li> <li>- Creation of retention basins and energy dissipators.</li> </ul>	<ul style="list-style-type: none"> <li>- Forestation and reforestation.</li> <li>- Management of coastal vegetation and wetlands.</li> <li>- Vegetable cordons and living barriers made from bamboo or grass.</li> </ul>	<ul style="list-style-type: none"> <li>- Restoration of hydrographic basins around dams to regulate water supply and reduce erosion and sedimentation.</li> </ul>

**Source:** Adapted from Asian Development Bank- ABD (2022).

The NbS also provides important co-benefits for the local communities. These solutions can stimulate local economies to strengthen means of livelihood, improve air quality, offer leisure opportunities and raise general well-being. In addition, they strengthen social cohesion and value the traditional knowledge of communities. The nature-based approaches also build bridges between climate mitigation and social and environmental goals. They are more effective than conventional alternatives in reducing the impacts of climate change<sup>25,26</sup>.

human health, disaster risks, and the promotion of social and economic development.

<sup>21</sup> Ibid<sup>18</sup>.

<sup>22</sup> Ibid<sup>18</sup>.

<sup>23</sup> Green rooftops are systems of vegetation cover installed on building rooftops. They have the potential to improve urban quality of life while helping to minimize environmental issues such as flooding, air pollution, and global warming.

<sup>24</sup> Rain gardens are sunken green areas designed to capture and allow the infiltration of rainwater, preventing flooding and waterlogging in urban areas.

<sup>25</sup> Griscom *et al.* (2017). Natural Climate Solutions. *Proceedings of the National Academy of Sciences (PNAS)*, 114 (44), 11645–11650. <https://www.pnas.org/doi/epdf/10.1073/pnas.1710465114> [consulted on 4 april 2025].

<sup>26</sup> Browder, G., Ozment, S., Rehberger B. I., Gartner T. e Lange G. (2019). Integrating Green and Gray: Creating Next Generation Infrastructure. World Bank Group. <https://openknowledge.worldbank.org/entities/publication/ddda3ed0-096e-59dd-a25d-3de884254eba> [Consulted on 4 April 2025].

The initiatives to restore the mangroves<sup>27</sup> in some regions of the country should be expanded and combined with engineering solutions. The implementation of NbS in Mozambique will protect thousands of people, avoid losses of millions of dollars and promote a model of sustainable development. It would also promote environmental conservation and the adoption of sustainable measures in mining, real estate and tourism projects, since it would avoid the destruction of sensitive ecosystems such as primary dunes, dune vegetation and mangroves that are important for coastal protection and to reduce the impacts of cyclones.

## 4. Conclusion

Although it is aware of the occurrence of extreme climatic events in an ever more frequent and severe form, the Mozambican government is not proving capable of anticipating and responding effectively to the effects of these events.

The lack of adequate anticipation and response worsens the effects of extreme climatic events particularly on the most vulnerable communities, due either to their geographical location in areas prone to the occurrence of these events and/or to their social and economic vulnerability.

To guarantee anticipation and response to extreme climatic events such as cyclones and storms, the Mozambican government should implement immediate actions to ensure that the infrastructures built today do not become the ruins of tomorrow. Investment in climatic resilience is an urgent need to protect lives, reduce economic losses and guarantee sustainable development.

Cyclical reconstruction without structural change perpetuates the country's vulnerability. The Government should implement effective public policies to guarantee that international funds are allocated to the construction of resilient infrastructures, adopting Nature-based Solutions, to minimise the negative effects of extreme climatic events, and transform the infrastructures of Mozambique into examples of adaptation and climatic resilience.

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27 Macamo, C. d. C. F., da Costa, F. I., Bandeira, S., Adams, J. B. e Balidy, H. J., (2024). Mangrove community-based management in Eastern Africa: experiences from rural Mozambique. In *Frontiers Marine Science*. <https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2024.1337678/full> [consulted on 24 April 2025].

## 5. Recommendations

To avoid loss of life and of financial resources, and to maintain credibility in the implementation of projects of resilient infrastructures, the following are recommended:

### **To the Ministry of Public Works, Housing and Water Resources:**

- Involve bioclimatic architects in the projects to build infrastructures resilient to tropical storms and cyclones.
- Introduce regulations making it obligatory to build climate resilient infrastructures and drainage channels in all public construction.
- Adopt Nature-based Solutions in the construction of resilient infrastructures, which includes:
- Create retention basins and urban green spaces.
- Invest in green and blue infrastructures, such as rain gardens, green rooftops and natural drainage systems, and involve local communities in maintaining and managing green spaces.
- Promote the planting of mangroves and native coastal vegetation throughout the country.
- Promote the creation of coral reefs, oyster reefs and sea grass meadows.
- Build dykes, containment walls and infrastructures for urban stormwater drainage.
- Train municipal staff and public managers in NbS.
- Include NbS in the master plans and the urban drainage plans.
- Establish fiscal incentives or credits for undertakings that adopt NbS.
- Create indicators to assess the benefits of the implanted NbS.
- Publicise successful pilot projects to inspire other regions.
- Regular maintenance of the urban drainage systems and improving the sanitary conditions.
- Make the public aware of systems to catch and conserve rainwater, and of methods to build homes and settlements that are climate resilient based on local materials.
- Hold regular inspections of public works and strengthen mechanisms to hold contractors responsible if they fail to comply with measures to build resilient infrastructures.

### **To Parliament:**

- Revise and pass legislation that imposes the construction of infrastructures resilient to extreme climate events.
- Step up inspection of Government actions concerning the construction and reconstruction of infrastructures resilient to extreme climate events.
- Make working visits to the infrastructures built and rebuilt in the context of extreme climate events, through the Parliamentary Commission on Agriculture, the Economy and the Environment.
- Include, in the questions to the Government, themes referring to the construction of infrastructures resilient to extreme climate events.

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