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Designing Effective National Climate Adaptation Plans in Curaçao and Sint Maarten

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Designing Effective National Climate Adaptation Plans in Curaçao and Sint Maarten

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Executive Summary

While Curaçao and Sint Maarten contribute relatively minimal to global greenhouse emissions, they face significant physical risks from climate change and are disproportionately exposed, due to their geographical location and small size, to climate-related disasters. National Adaptation Plans (NAPs) can help countries prepare for these risks by providing an evidence-based, coordinated and systematic approach to adaptation over the medium and long term. A NAP outlines how a country will adapt to climate change and typically includes four key elements: laying the groundwork and identifying gaps, developing the adaptation strategy, implementing adaptation actions, and establishing systems for monitoring, reporting, evaluation and review.

This policy note reviews the basics of NAPs, existing adaptation efforts in Curaçao and Sint Maarten, and selected lessons from academic literature from Small Island Developing States and the Caribbean. It highlights four interrelated pillars of effective NAPs: clear framing, robust evaluation, strong governance and implementation capacity, and alignment with broader development priorities. These pillars emphasize the importance of linking adaptation measures to specific vulnerabilities, sectors and population groups; assessing a broad range of adaptation options; avoiding maladaptation, strengthening coordination; and integrating adaptation into wider policy and budget frameworks. This is not an exhaustive list, and many other guidelines may also be useful, particularly regarding communication and evaluation. Taken together, these pillars suggest that successful adaptation planning requires not only sound technical analysis, but also institutional coordination, stakeholder engagement, and long-term policy commitment.

For Curaçao and Sint Maarten, a NAP offers an opportunity to connect existing initiatives, define clear priorities, and promote long-term coordination. Key priorities include establishing clear roles and responsibilities, strengthening cross-sectoral coordination, and creating formal communication channels between government agencies, stakeholders and the public. The development of sectoral plans, the integration of adaptation into budgets and planning frameworks, investments in capacity building and knowledge management, and the use of tools such as the Caribbean Climate Online Risk and Adaptation Tool can further strengthen implementation. Aligning adaptation efforts with broader development goals, disaster risk reduction frameworks, and the Sustainable Development Goals can help ensure that NAPs remain strategic, coordinated, and resilient over the long term.

For the Centrale Bank van Curaçao en Sint Maarten (CBCS), climate adaptation is relevant because climate-related extreme weather events can affect people, businesses, infrastructure, economic activity, employment patterns, labor supply, electricity supply, inflation, price volatility, financial stability, and monetary policy transmission. Curaçao and Sint Maarten can build on ongoing national adaptation efforts, while also learning from experiences across the Caribbean and benefiting from their position within the Kingdom of the Netherlands.

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I. INTRODUCTION

Climate change is becoming an increasingly pressing global challenge. The past ten years have been the warmest on record, with 2024 ranking as the hottest year to date (World Meteorological Organization, 2025). As a result, many countries are beginning to focus not only on climate change mitigation but also on adaptation.

Climate mitigation refers to the efforts by countries to reduce greenhouse gas emissions and limit the extent of global warming. While Caribbean countries contribute minimally to global greenhouse gas emissions due to their small size and therefore may see limited marginal returns from their own mitigation efforts, they face significantly greater physical risks from climate change and, thus, potentially higher marginal returns from adaptation strategies (Cevik, 2022). This heightened vulnerability is largely due to their location in the Atlantic hurricane belt, which makes them disproportionately exposed to climate-related disasters. In this context, climate change adaptation, defined as the process through which individuals, communities, organizations, and countries "adjust to actual or expected climate change and its effects" and "seek to moderate or avoid harm or exploit beneficial opportunities", becomes particularly critical for these countries (IPCC, 2014).

The development of a National Adaptation Plan (NAP), often presented as a single document, is typically an important step in designing an actionable long-term adaptation strategy. A NAP is a plan that outlines how a country will adapt to climate change in the medium and long term. Its purpose is to "provide an evidence-based, coordinated and systematic approach" to the challenge of climate change adaptation (Woodruff and Regan, 2019).

A majority of countries around the world are currently developing or have already developed NAPs. For example, 144 developing countries are engaged in this process (COP30 Brasil, 2025). Several Caribbean countries have already published NAPs, including Trinidad and Tobago, Saint Lucia, Saint Vincent and the Grenadines, Grenada, and Suriname. Curaçao and Sint Maarten are currently in the process of developing their national adaptation strategies. Others, such as Aruba and Bonaire, are also actively developing their plans.

Adaptation planning is especially critical in the Caribbean due to the region's high vulnerability to climate change. Factors contributing to this vulnerability include high average temperatures, climate-sensitive ecosystems, and the small geographic size of many countries, which means that a greater proportion of land, and, consequently GDP, can be affected by natural disasters. Furthermore, tourism-dependent economies are particularly susceptible to losses in tourism-related revenue and damage to infrastructure, amplifying the overall economic impact (Virgil et al., 2022).

As the need for adaptation planning is felt globally, especially in island nations, a growing body of literature has emerged on adaptation in Small Island Developing States (SIDS), including both Caribbean and Pacific islands. Although literature specifically focused on adaptation planning in the Caribbean remains limited, it can still offer useful insights for the design of NAPs in Curaçao and Sint Maarten. Additionally, the United Nations Framework Convention on Climate Change (UNFCCC) provides the most comprehensive framework for developing NAPs and can serve as a key set of guidelines for the design of NAPs in Curaçao and Sint Maarten.

This policy note gives an overview of some best practices in designing NAPs which have been discussed in the academic literature on climate change adaptation in SIDS and the Caribbean. These practices may be useful for regional NAP design and implementation, particularly when complemented by broader guidance already provided by the UNFCCC. By sharing these best practices, the Centrale Bank van Curaçao en Sint Maarten (CBCS) aims to contribute to the design of NAPs in Curaçao and Sint Maarten and to raise awareness among key stakeholders of the importance of effective climate change adaptation planning and implementation.

For the CBCS itself, climate change adaptation and the existence of a NAP are particularly relevant, as the risks of people, businesses and infrastructure being affected by climate-related extreme weather events are increasing. Without a NAP, economic activity, employment patterns, labor supply, electricity supply, among other factors, may be adversely affected. These could result in significant economic losses and lead to higher inflation and greater price volatility. In turn, these effects could undermine financial stability and reduce the effectiveness of monetary policy transmission. This policy note outlines the basics of NAPs and then discusses four pillars of effective NAPs: framing, evaluation, governance and implementation, and broader developments. The concluding section briefly summarizes the best key practices identified.

II. BASICS OF NAPs

KEY ELEMENTS

National Adaptation Plans (NAPs) are national strategic plans that provide guidance not only to government institutions, but also to communities, the private sector, and other relevant stakeholders. The primary goals of NAPs are:

(a) "To reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience."

(b) "To facilitate the integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programs and activities, particularly within development planning processes and strategies, across all relevant sectors and at different levels, as appropriate" (UNFCCC, 2012).

NAPs also play a key role in clearly communicating national adaptation priorities and the requirements for achieving them, including actions across various sectors and organizations. The UNFCCC framework for NAP development provides a useful starting point, as it is comprehensive and designed to be tailored to the diverse needs of different countries. Table 1 presents the main components of the NAP process, which may be adjusted to a country's specific context.[1]

Table 1 Summary of key elements of the NAP process

A. Lay the groundwork and address gaps	Organizing institutions, gathering existing data, identifying gaps
B. Preparatory elements	Developing the NAP: assessing climate risks and adaptation actions, engaging stakeholders, and setting the agenda
C. Implementation strategies	Taking action, securing funding, and assigning responsibilities
D. Reporting, monitoring, and review	Tracking progress, evaluating results, and updating the NAP over time

Source: UNFCCC, National Adaptation Plans: Technical Guidelines for the National Adaptation Process, December 2012.

The first element (A) involves laying the groundwork for a successful NAP process. This stage largely consists of stocktaking, including assessing what information is already available on climate change impacts, vulnerabilities, and adaptation, and identifying existing information and capacity gaps that need to be addressed in subsequent stages of the NAP process. It also involves reviewing the institutional landscape, planning the overall process, and deciding how it will be governed. This stage may include identifying ways in which climate adaptation can be aligned with other development goals. The importance of integrating sectors such as health care is also emphasized in the literature.

[1] For an extensive table and further details, see from page 24 onwards of the technical guidelines: UNFCCC, National Adaptation Plans: Technical guidelines for the national adaptation process, December 2012.

The second element (B) concerns the development of the NAP document itself. The aim of this stage is to develop a comprehensive adaptation strategy, set priorities and identify implementation pathways. This includes analyzing current climate conditions and future scenarios, setting adaptation goals, identifying adaptation options at the sectoral, subnational, national, and other relevant levels, and assessing these options in consultation with stakeholders. Furthermore, the plan is broadly communicated, including to the general public, and integrated into relevant sectors and national planning processes where necessary.

The third element (C) focuses on translating adaptation plans into action. It involves defining implementation arrangements, mobilizing financial and technical resources, and integrating climate adaptation into national and subnational development plans, budgets, and policy frameworks. This element also emphasizes the importance of capacity building, coordination mechanisms, and regulatory support to enable effective execution.

Finally, the fourth element (D) concerns the establishment of systems for tracking progress and continuously improving the NAP process. This includes developing, monitoring, and evaluating frameworks with measurable indicators, feedback mechanisms, and regular reporting. The purpose is to assess the effectiveness of adaptation actions, adjust plans as needed, and ensure transparency and accountability. By institutionalizing learning and review cycles, countries can respond dynamically to evolving climate risks, new data, and emerging policy needs.

While these represent the typical steps in the NAP process, in practice, many countries without an official NAP, including Curaçao and Sint Maarten, have already completed part of this process, though not necessarily in this order or under the overarching umbrella of a NAP. As such, an important part of the NAP development process is to incorporate, and where appropriate build upon, existing priorities and initiatives. In the case of Curaçao, the *Routekaart Klimaatstrategie Curaçao - Kòrsou na kaminda* (January 2024) and in the case of Sint Maarten the *Nature Policy Plan Sint Maarten 2021-2025* (October 2021), among other relevant publications.

COMMON CLIMATE CHANGE ADAPATION ACTIONS IN SIDS

Research by Klöck and Nunn (2019) on SIDS generally classifies adaptation into two broad categories: structural or physical adaptation, and social or behavioral adaptation. The first category refers to changes in the engineered and built environment. Examples include physical structures such as seawalls and other coastal protection measures to address coastal erosion and sea-level rise, often in combination with ecosystem-based measures such as mangrove replanting and conservation. Structural adaptation also includes responses to extreme weather events, including strengthening infrastructure and houses.

The second category, social or behavioral adaptation, can also play an important role in responding to extreme weather events. This may include, for example, the collective efforts of island communities to prepare for such events through the preservation of food supplies for emergencies and the reinforcement of housing structures to withstand high wind speeds.

To illustrate common adaptation actions, Robinson's (2015) study on climate change adaptation trends in SIDS examined seven Caribbean SIDS: Antigua and Barbuda, Belize, Dominica, Guyana, Jamaica, Saint Lucia, and Trinidad and Tobago. These countries most commonly identified hurricanes, rainfall, and drought as the main climate-related hazards requiring adaptation responses. The largest number of adaptation measures were identified in the coastal zone and in the agriculture and forestry sectors. When broader categories of vulnerability were considered, economic vulnerability, including poverty, emerged as the most frequently reported, followed by social vulnerability as the second most commonly addressed category.

In addition, Caribbean SIDS most often reported engagement with other national governments and regional organizations. Some countries also indicated greater involvement of the local private sector,

in particular, the hospitality sector in Antigua and Barbuda as well as researchers and universities in Guyana. Lastly, the most frequently reported adaptation measures on these islands included vulnerability and impact assessments, such as risk evaluations, the systemic monitoring of climate variables and resources, the development of climate models, data management initiatives, and research focused on adaptation.

III. EXISTING ADAPTATION EFFORTS IN CURAÇAO AND SINT MAARTEN

CURAÇAO

Curaçao is currently in the process of developing its National Adaptation Strategy. This process builds on earlier climate-related work, including the *Routekaart Klimaatstrategie Curaçao – Kòrsou na kaminda,* and is intended to bring existing initiatives, stakeholder input, expert knowledge, and public perceptions together into a more coherent long-term adaptation framework. Although the strategy is still under development, several important elements of the national adaptation planning process have already been initiated, including climate risk analysis, stakeholder engagement, public consultation, the identification of adaptation options, and the development of a shared long-term vision.

The stakeholder process presented during the National Adaptation Strategy workshop of 11 September 2025 shows that Curaçao's approach is structured around a sequence of analysis, ambition-setting, action development, and convergence. The process is designed to first identify a broad range of possible actions and strategic objectives and subsequently narrow these down into a more focused and integrated strategy. Key components of the process include sessions with ministries, stakeholder workshops, a national adaptation survey, and an adaptation database developed by the University of Curaçao (UOC) together with other universities within the Kingdom of the Netherlands.

The emerging vision for Curaçao's adaptation strategy is that by 2050, Curaçao will be more resilient to the adverse effects of natural disasters and biodiversity loss caused by climate change, while also striving to become an important hub in renewable energy. The goals presented during the workshop include increasing resilience to the consequences of climate change, conserving and regenerating biodiversity and ecosystem services, realizing a carbon-neutral footprint, and taking advantage of opportunities associated with climate change. While mitigation-related objectives, such as carbon neutrality, fall partly outside the current adaptation scope, their inclusion reflects the broader climate-resilient development context in which the strategy is being developed.

Curaçao's emerging framework also reflects a broad understanding of adaptation. Rather than focusing only on physical protection measures, it includes economic, social, environmental, cultural, and institutional dimensions of resilience. A resilient economy is thereby defined as one that is diversified, circular, and supported by a financial sector that incorporates climate change considerations into supervision and regulation. Resilient people are linked to health, mobility, access to critical services, safe spatial planning, infrastructure that can withstand extreme events, social cohesion, cultural identity, justice, and animal welfare. Resilient nature is linked to expansive and connected ecosystems, high environmental quality, diverse microclimates, and rich biodiversity.

The process has identified eight priority themes for adaptation: water management, coastal management, the built environment, culture and people, the economy, the financial sector, food security, and green infrastructure. These themes are intended to guide the identification of concrete adaptation actions and to connect them to the broader adaptation vision. This thematic structure is useful because it helps avoid an overly general approach to adaptation and instead encourages the identification of specific vulnerabilities, sectors, actors, and implementation pathways.

A notable feature of Curaçao's approach is the distinction between reactive, preventive, and transformative adaptation actions. Reactive actions are short-term measures that help restore the existing way of life and address the immediate impacts of extreme weather events, such as early warning systems and heat protocols. Preventive actions are forward-looking measures that aim to protect existing systems, such as improving drainage to reduce flash flood risks or creating cooling areas. Transformative actions aim to improve the way of life by addressing the root causes of climate vulnerability and generating wider co-benefits, for example through catchment-wide flood prevention, nature-based solutions, pocket parks, and green corridors. Meanwhile, the process has continued beyond the initial stakeholder session. A public survey has been rolled out at several locations, including supermarkets, to obtain a broader picture of how residents experience climate change and which adaptation measures they consider important.

The Curaçao Climate Change Platform (CCCP) can be positioned as a key coordinating and enabling mechanism within Curaçao's NAP framework. It brings together stakeholders from government, the private sector, financial institutions, academia, and NGOs to support evidence-based climate policy, stakeholder consultation, knowledge exchange, and coordination on climate risks and adaptation priorities. Its work aligns closely with Curaçao's emerging adaptation priorities, including green infrastructure, water management, the built environment, coastal zone management, cultural heritage, food security, and the resilience of the economy and financial sector. By linking technical expertise, sectoral priorities, capacity building, and awareness activities to policy development, the platform can help prevent fragmented adaptation efforts and serve as a bridge between Curaçao's climate roadmap and the formal NAP.

Taken together, these efforts indicate that Curaçao has already initiated several important elements of the national adaptation planning process. The country has begun developing a long-term adaptation vision, identifying priority themes, gathering stakeholder and public input, compiling adaptation options, and organizing actions within a results-based framework. The work following the stakeholder sessions is now focused on translating this preparatory work into an implementable strategy, with clear responsibilities, financing arrangements, monitoring indicators, and mechanisms for periodic review. The aim is to further develop and finalize the NAP and submit it to the ministers by mid-2026.

SINT MAARTEN

Sint Maarten is also taking steps to strengthen its national adaptation planning framework. Through the Ministry of Public Housing, Spatial Planning, Environment and Infrastructure (VROMI), the government is working to establish a stronger policy basis for the country's long-term vision, goals, and priority actions for climate change adaptation and resilience building. Although Sint Maarten does not yet have a completed NAP, ongoing initiatives are intended to provide the evidence base, institutional structure, and strategic direction needed for future adaptation planning.

Two related processes are currently being advanced. The first is the development of a National Climate Change Adaptation Report and Framework through the European Union-funded Green Overseas (GO) Program. This initiative will assess climate change impacts specific to Sint Maarten, identify vulnerabilities and possible adaptation measures, and propose policy recommendations. The second is the development of a National Adaptation Strategy through the International Panel on Deltas and Coastal Areas, supported by Climate Adaptation Services (CAS). This strategy is expected to serve as the first national strategic document organizing Sint Maarten's adaptation priorities, identifying key risks and objectives across sectors, clarifying institutional responsibilities, and guiding planning, investment, and implementation.

Together, these processes are intended to create the structure and methodology needed for a future NAP. They suggest that Sint Maarten's adaptation process is being developed in stages: first by strengthening the evidence base and identifying vulnerabilities, then by defining strategic priorities

and responsibilities, and ultimately by creating the conditions for a more comprehensive and actionable national plan.

Stakeholder engagement has been a central component of this process. A National Convergence Workshop on strengthening national adaptation planning in Sint Maarten was held on 12–13 March 2026. The workshop brought together stakeholders from government, civil society, and the private sector involved in climate change, disaster risk management, and resilient development. Its objectives included reviewing and validating priority climate risks, affected sectors, projected impacts up to 2100, and proposed adaptation measures. The workshop also addressed key gaps and constraints related to policy, enforcement, coordination, data and monitoring, financing, and capacity. In addition, the workshop helped move the process toward practical implementation by focusing on ownership and implementation pathways for priority adaptation measures. This included identifying lead institutions, supporting actors, sequencing, and dependencies. Such a focus is important because climate adaptation in Sint Maarten will require coordination across several policy areas, including spatial planning, infrastructure, disaster risk management, environmental protection, economic resilience, and social development.

Overall, Sint Maarten's adaptation efforts are at an important formative stage. The country is building the evidence base, identifying priority climate risks and affected sectors, developing a national strategy, and engaging stakeholders in defining both adaptation priorities and implementation pathways. The National Climate Change Adaptation Report and Framework and the National Adaptation Strategy are important steps in this process, but the work is still centered on consolidating the analytical foundation and strategic direction needed for a future NAP. Building on these outputs, Sint Maarten's next steps will be to translate the strategy into concrete priority actions, assign lead and supporting institutions, identify funding sources, and establish clear timelines, monitoring indicators, and review mechanisms for implementation.

IV. FOUR PILLARS OF EFFECTIVE NAPS

Given the widespread implementation of adaptation plans worldwide,[2] there is much to learn from literature and from existing experience regarding their design and implementation. This section focuses on key research papers in the SIDS and Caribbean adaptation literature, as more general sources, such as those of the United Nations, already provide globally applicable guidance. This body of research is particularly relevant for the unique challenges that small island states face in designing and implementing NAPs, as it addresses issues specific to these contexts. Accordingly, this section discusses four pillars of effective NAPs: framing, evaluation, governance and implementation, and broader development considerations.

FRAMING

In the context of policy, framing refers to "meaning making" and is associated with the process of conceptualizing and interpreting the scope and significance of an issue, identifying appropriate policy solutions, and determining where responsibilities for action lies (Vanhala and Calliari, 2022). In other words, "framing is a process that allows actors to construct and represent meaning in order to understand a particular event, process, or occurrence. It is crucial in all policy practice as it determines specifically who and what is actually included, and who and what is ignored and excluded" (McEvoy et al., 2013). In the context of climate change adaptation, framing therefore refers to the process of conceptualizing and interpreting the scope and significance of adaptation, identifying appropriate policy responses, and determining who is responsible for action. In NAPs, two key components of effective framing are long-term orientation and specific, multi-level framing.

[2] The UNFCCC keeps a repository of adaptation plans published worldwide: NAP Central https://napcentral.org/

Long-term orientation

Since the goal of a NAP is to establish a comprehensive, long-term strategy for climate adaptation, both short-term and long-term climate developments should be considered in its design. Adaptation plans, including sector-specific strategies, should be forward-looking and oriented toward long-term objectives, rather than being primarily reactive and focused only on immediate or current issues (Klöck and Nunn, 2019; Virgil et al., 2022). Nevertheless, many of the adaptation actions discussed in literature address everyday climate-related challenges, or climate variability, rather than long-term climate change, even though the latter is often presented as the main rationale for adopting such measures (Klöck and Nunn, 2019).

This tendency is also reflected in Lewis and Su (2021) who found that in Saint Vincent and the Grenadines, Grenada, and Saint Lucia, national policies for agriculture, water, forestry, and coastal zones focused primarily on adaptation to extreme weather events such as hurricanes, droughts, and floods, while also acknowledging longer-term climate change trends. However, adaptation strategies remained largely incremental rather than transformational. This may reflect limited long-term climate data, the perceived cost of transformational actions, and institutional or behavioral barriers that sustain existing resource systems and policy approaches. As a result, short-term event-based responses tended to receive greater emphasis than more diverse long-term adaptation strategies. For water management specifically, short term strategies included water conversation, rainwater harvesting, and disaster management, while long-term strategies included integrated water resource management, upgrading and improving pipelines and infrastructure, and constructing solar desalination plants (Lewis and Su, 2021).

Specific, multi-level framing

Clear framing is important to effective NAPs, as vagueness can affect later implementation and the ability to measure effectiveness. Research by Robinson (2015) on SIDS suggests that there is often insufficient clarity about the vulnerabilities and affected populations that are being targeted by a specific adaptation action, and suggests the following guiding questions be used (p. 683):

1. "Adaptation to what?"
2. "Who or what adapts?"
3. "How does adaptation occur?"

The first question refers to the shortcoming that some of the SIDS studied often refer to climate change adaptation in a more general term in their NAPs or national communications, rather than a more specific climate and climate-induced vulnerability when explaining their adaptation measures. The second question relates to the negligible mention of vulnerable populations or subpopulations being targeted nor specific mentions of targeted sectors where relevant. The final question encourages deeper reflection on the adaptation process beyond its initial stages. The study highlights a prevailing tendency to adopt a 'whole-of-country vulnerability' framing of climate change impacts, portraying nations as uniformly at risk rather than identifying specific populations or sectors affected by climate-related phenomena. This broad framing makes it difficult to justify targeted adaptation measures and to evaluate their effectiveness (Robinson, 2015).

Furthermore, the level of framing is also important as many SIDS engage with actions on the conceptual level, while tangible adaptation decisions are made and taken to a lesser extent (Robinson, 2015). The same study concludes that while there are no clear ways to measure optimal framing levels, it is also critical for adaptation to occur at the meta-level, namely the values and beliefs influencing public discourse on climate change issues, as audiences rely on frames to make sense of and discuss an issue (Nisbet, 2009). The media was frequently cited as an actor in the NAP efforts of the countries studied, and its inclusion is particularly important for shaping and communicating these frames alongside other key stakeholders. Problems related to framing can

often be addressed by linking adaptation actions with vulnerabilities, vulnerable populations, sectors and actors, and communicating these links broadly.

Related concerns are raised by Klöck and Nunn (2019), who note that adaptation in SIDS often focuses on the most direct and visible impacts of climate change, while giving less attention to more indirect and less visible effects, including those in sectors such as health. They also observe a frequent preference for hard coastal protection measures in response to erosion and flooding, despite a large literature documenting their shortcomings (Klöck and Nunn, 2019). Similarly, social adaptation measures may strengthen resilience, but do not always address underlying vulnerabilities. By contrast, relatively little attention is given to institutional adaptation, such as reforms to laws, regulations and government policies. Lastly, Klöck and Nunn (2019) conclude that many documented adaptation measures in SIDS are reactive and can be classified as coping measures rather than adaptation, highlighting the need for a longer-term and more strategic approach to climate resilience.

In short, effective framing requires a long-term approach to climate-change-related issues, with clearly specified strategies for relevant sectors, key actors, and vulnerable populations. Furthermore, fostering broad public discourse on climate change and adaptation can help to integrate adaptation planning more fully across society and institutions.

EVALUATION

To be effective, evaluation should be embedded throughout the NAP process rather than treated as a one-off exercise at the end. According to Beauchamp (2023), evaluations should take place at strategic points throughout the NAP process to assess the performance of an intervention. While evaluation generally occurs at the end of a stage or intervention, it can also take place during the planning stage to inform design, during implementation to support adjustments and after implementation to assess overall performance.

Evaluation is closely interlinked with monitoring and learning, as all three are crucial for assessing progress, improving implementation, and adapting plans over time. Monitoring refers to the ongoing collection and analysis of information to track the progress in the NAP process, while evaluation assesses performance at specific stages. Together, monitoring and evaluation generate lessons that inform adaptation planning. Therefore, learning should be an ongoing process, involving the acquisition and sharing of knowledge that can lead to changes in beliefs, practices, behavior, and policy (Beauchamp, 2023).

Thomas et al. (2019) identify three key analytical stages that are particularly relevant for evaluation in adaptation planning in Caribbean SIDS: (i) assessment of hazards, impacts, vulnerability, or risk; (ii) identification of adaptation options; and (iii) appraisal and reappraisal of adaptation options.

Assessment of hazards, impacts, vulnerability, and risk

The assessment of hazards, impacts, vulnerability, and risk (HIVRA) is a critical early stage in the adaptation process (Thomas et al., 2019). This step may include developing risk scenarios, assessing the frequency and severity of climate shocks, and identifying vulnerabilities across communities, sectors, and infrastructure. It is also important to include both qualitative and quantitative information in the HIVRA, as this supports a more comprehensive understanding of specific adaptation measures (Thomas et al. 2019), and contributes to the development of a robust monitoring and evaluation framework (Lamari et al., 2016). While many Caribbean SIDS have conducted HIVRA's, there remains a need to better integrate them into adaptation planning (Thomas et al. 2019).

Identification of specific adaptation options

The next step is to identify specific adaptation options that address the vulnerabilities identified in the HIVRA. In practice, policy makers often rely on cost-benefit analysis, cost-effectiveness analysis, or multicriteria analysis. However, these approaches may not fully capture all underlying uncertainties (Dittrich et al. 2016). Hence, in data-poor contexts, expert judgment and stakeholder feedback can also provide valuable insights (Thomas et al., 2019).

When selecting adaptation actions, there is often a tendency to move quickly toward a specific strategy, due to, for example, stakeholder pressure. A well-designed NAP, however, should first identify and robustly appraise a range of options before selecting the most appropriate course of action (Thomas et al., 2019). Nevertheless, the identification and appraisal of a range of adaptation options is not yet widespread in Caribbean SIDS, and many adaptation planning documents fail to establish clear linkages between specific climate risks and proposed responses.

Research by Petztold and Magnan (2019) on small islands reveals that two adaptation measures dominate across island types i.e., coastal protection measures, and migration or relocation measures. Coastal protection structures are typically intended to reduce the impacts of sea-level rise and extreme weather events such as hurricanes and storm surges, while mitigation and relocation policies are often considered where land is affected by saltwater intrusions. This illustrates the importance of linking adaptation choices to clearly identified vulnerabilities rather than relying on generic or pre-selected responses.

While small countries often have to make adaptation decisions in the absence of accurate and precise climate predictions, it is helpful to prioritize "no-regret" strategies that are beneficial regardless of how future climate conditions evolve. Additionally, it is important to select actions that are flexible, and where possible, reversible, to draw on available climate models and projections to determine appropriate safety or security margins for new investments, and to employ institutional and financial tools such as insurance schemes and early warning systems, while maintaining a long-term perspective (Dessai et al., 2009).

Meanwhile, selected adaptation responses should be suited to the specific vulnerabilities they are intended to address. Robinson (2015), drawing on Eriksen et al. (2011), argues that a good adaptation response "should fit the adaptation problems being addressed, reduce the targeted vulnerabilities, manage uncertainty, increase adaptive capacity, and support sustainable development goals and objectives".

The following questions can be helpful when evaluating adaptation responses (Robinson, 2015):

1. Does the adaptation response address the critical vulnerabilities?
2. Is sufficient attention being paid to a particular vulnerability?
3. Will the adaptation response have any future unintended negative consequences?

The last question is particularly important as some adaptation responses may be maladaptive. Robinson (2015) notes limited evidence that maladaptation risks are systematically considered in SIDS national communications. Barnett and O'Neill (2010) propose five criteria for identifying maladaptation: whether adaptation actions (1) increase greenhouse gas emissions, (2) disproportionately burden the most vulnerable, (3) have high opportunity costs, (4) reduce incentives to adapt, or (5) set paths that would significantly limit the choices available to future generations. Applying these criteria can improve the selection of adaptation measures.

Appraisal and reappraisal of adaptation options

Adaptation options should not only be assessed during the drafting of a NAP, but also reviewed, and where necessary revised over time. More generally, adaptation should be conceptualized as a multi-stage, iterative process (Robinson, 2015), in which continuous feedback extends beyond the initial selection of measures.

Empirical examples illustrate this need for flexibility. For example, a village in Fiji shifted its adaptation strategy towards mangrove replanting after its seawalls repeatedly collapsed (Klöck and Nunn, 2019). This highlights the importance of maintaining a range of adaptation options, as well as establishing clear criteria for their evaluation.

The literature also emphasizes the importance of stakeholder involvement in evaluating adaptation success, particularly in contexts of limited resources. However, there is often no universally agreed definition or metric of adaptation success, resulting in differing assessments among actors and across evaluation periods (Adger et al., 2005). The limited understanding of the long-term effectiveness and sustainability of adaptation responses in SIDS constrains the selection of appropriate long-term measures. Therefore, periodic re-evaluation is essential to ensure that these responses remain effective and aligned with evolving needs.

GOVERNANCE AND IMPLEMENTATION

Effective adaptation governance requires clear documentation of roles, responsibilities, and accountabilities, as well as the existence of strategic and operational objectives, and sound reporting practices among agencies with climate-change adaptation oversight (Virgil et al., 2022). Additionally, transparency in decision-making, stakeholder engagement and public participation in the adaptation decision-making process are critical elements of good governance (INTOSAI, 2010).

A common criticism of NAP processes, however, is that they tend to focus heavily on preparatory elements while placing less emphasis on actual implementation and the subsequent assessment of adaptation measures. To ensure that the later stages of the process run smoothly, it is useful to consider the following guiding questions during the development of a NAP (Virgil et al. 2022):

1. Has the government established good and effective systems for monitoring and coordinating adaptation activities?
2. Are there clear, well-defined, and documented roles and responsibilities for climate change adaptation actors?
3. Are adaptation efforts coordinated across government agencies, ministries and other stakeholders involved in climate change adaptation?
4. Do effective channels of communication exist among climate change actors?
5. Are there processes in place to communicate important climate-related information to the adaptation coordinating agency or committee?

In this regard, communication is frequently identified as one of the key weaknesses affecting climate change governance in the Caribbean due to the absence of proper frameworks for communication between the coordinating agency and the various stakeholders and institutions involved in the adaptation process. Addressing this issue should, therefore, be a priority in the development of a formal NAP.

For example, Grenada's NAP stipulates that communication between the National Climate Change Committee, the secretariat and other key actors is required, although a proper framework for how data should be gathered and reported to these coordinating bodies was lacking. More generally, the absence of an effective framework for communicating key performance data to the adaptation coordinating agency is a common limitation in many adaptation plans and reduces their overall adequacy (Virgil et al., 2022).

Countries may benefit from developing comprehensive sectoral plans alongside the NAP in order to establish clear sectoral objectives and comprehensive lists of implementation activities (Virgil et al., 2022). For example, the sectoral plans submitted by Saint Lucia to the UNFCCC were more extensive than several general adaptation plans. In Jamaica, there was also a clear requirement for the leading climate change agents within ministries and relevant departments and agencies (MDAs) to coordinate, monitor, evaluate and report on the development of individual sectoral plans to the government's Climate Change Division.

Building on the governance challenges discussed above, the literature also identifies a lack of climate change specialists and other skilled personnel as a common barrier to the design and implementation of effective adaptation measures. Other major barriers include weak institutional coordination between organizations involved in climate change adaptation, poor governance, and conflicts between adaptation objectives and other national or organizational policy goals (Virgil et al., 2022).

More recent research on Caribbean SIDS identifies financial constraints, budgetary restrictions, and income levels as some of the primary challenges to implementing national adaptation measures (Robinson, 2018). In addition, Klöck and Nunn (2019) found that governments, private sector actors, communities, and individuals often struggle to mobilize the financial resources required for implementing adaptation measures. Other frequently cited constraints include (i) inadequate technical capacity and resources; (ii) limited data and records; (iii) insufficient human resources, manpower, and high employee turnover; and (iv) limited knowledge, understanding, and technical expertise across Caribbean SIDS (Robinson, 2018; Klöck and Nunn, 2019).

In this context, policy coherence is particularly important. It promotes the efficient use of resources, supports synergies across policies and departments, and reduces overlap by better integrating sectoral objectives (Lafferty and Hovden, 2003). Policy coherence also requires the involvement of committed stakeholders from the start of the adaptation process and throughout implementation, as well as the development of complimentary policies across sectors that do not contradict one another and instead contribute to common goals (Lewis and Su, 2021).

Consistent with these broader challenges, Lewis and Su (2021) found that the implementation of NAPs in selected Caribbean islands is often hindered by limited coherence across sectors, weak coordination in policy implementation, and insufficient political commitment. In particular, sectoral policy development often follows a siloed approach, with limited integration across ministries and agencies. This can reduce information sharing, weaken coordination, and lead to duplication efforts. The study also indicates that policy implementation is often driven by the lead agency rather than through coordinated, multi-sectoral collaboration. In addition, many projects remain fragmented and dependent on external funding, which can undermine their continuity and integration.

Lewis and Su (2021) also identified some positive developments. In Saint Vincent and the Grenadine's, institutional restructuring involved moving the Sustainable Development Unit, which is responsible for climate change measures, to the ministry of economic planning in order to better align planning and climate policy and to place greater emphasis on climate change adaptation. Likewise in Grenada, increased integration of climate change into sectoral policies took place over the past decade. In Saint Lucia, recent revisions to national policies aimed at better integrating climate change considerations were found to have improved policy coherence. Experts in the country noted that the Department of Sustainable Development played a leading role in raising awareness of climate change and facilitating the mainstreaming of adaptation across government, which in turn, helped strengthen cross-sectoral communication. At the same time, Lewis and Su (2021) noted, however, that project-driven responses and dependence on international funding have hindered progress.

Building on these findings, Lewis and Su (2021) proposed a set of recommendations to strengthen governance arrangements and improve implementation:

1. Legislation should be updated to incorporate climate change and to define institutional responsibilities for adaptation planning and implementation. This, in turn, requires political will and commitment to mainstream climate change across policies and to overcome siloed approaches between ministries and departments.
2. Develop a sustainable financing framework, as only relying on donor funding does not create policy coherence. Instead, climate change adaptation should be integrated into annual, medium-term, and long-term government expenditure and budgetary frameworks, supported by resource mobilization strategies that can also facilitate access to international climate change funding for long-term programs.
3. Establish a cabinet-appointed cross-sectoral committee to support the lead institution. Such a body could take the form of a cross-sectoral board composed of members who champion climate change adaptation within their respective sectors.
4. Establish a central clearing house mechanism managed by the lead entity. One of the main constraints in SIDS is the loss of institutional memory, as data is often lost due to staff turnover or inadequate storage systems. A clearing-house mechanism that serves as an information source of inventories and data sets could therefore play an important role in managing and communicating relevant information.
5. Identify capacity needs and training for key personnel. Most experts noted that having a more coherent policy mix, in which climate change is fully mainstreamed, may take approximately ten to twelve years.
6. Use or develop mainstreaming tools. For example, the Caribbean Community Climate Change Center (CCCCC) established Caribbean Climate Online Risk and Adaptation Tool (CCORAL), an online platform designed to assess climate risk and identify adaptation pathways to support climate-resilient decision-making.
7. Develop a framework for independent reviews as there is a need for an overarching body to audit adaptation policies and assess the implementation of related projects.

Additionally, although NAPs provide an overarching framework for short- and long-term adaptation, disaster risk reduction remains a key priority in the Caribbean due to the region's high vulnerability to extreme weather events. This area also has its own disaster risk platforms and coordination committees to oversee disaster response. To avoid fragmentation and improve overall effectiveness, these disaster risk processes should be harmonized with broader adaptation planning efforts (UNDP, 2018).

BROADER DEVELOPMENTS

As noted earlier, adaptation is not limited to physical and structural interventions, such as coastal protection, strengthening housing, or upgrading water-storage facilities, but also involves behavioral and social change (Klöck and Nunn, 2019). A broader perspective is therefore needed to understand how adaptation policy fits within wider national and local development contexts.

From this perspective, studies of Caribbean countries point to persistent policy fragmentation, whereby climate change adaptation is often treated separately from other important socio-economic concerns. Experts have identified competing development priorities such as healthcare, poverty alleviation, and investment in road infrastructure, as factors that directly constrain the effective implementation of climate policies (Lewis and Su, 2021). Furthermore, many countries in the region have not linked their adaptation efforts to the Sustainable Development Goals (SDGs), a step that could help align climate action with broader development objectives and reduce these types of discrepancies (Virgil et al, 2022).

The broader governance challenges are intricately connected to the vulnerability of both natural and human systems to climate change. Human systems, including the economy, governance structures, and agricultural production, shape how people organize their lives and interact with the natural environment, while also reflecting the unequal distribution of climate impacts, which are often experienced first and most severely by vulnerable communities. (Robinson and Wren, 2020). While

adaptation policies are most often developed at the national level, local communities are often the first to experience climate impacts and are not always sufficiently prioritized in the development of adaptation policies (Jaja et al., 2017).

In this context, vulnerability can be seen as a counterpart to resilience in responding to climate change (Hay and Mimura, 2013). Adaptation actions can therefore be designed both to reduce vulnerability, as well as to strengthen resilience through more robust socio-economic systems and livelihoods (Hay and Mimura, 2013). A literature review on Caribbean islands identified limited institutional capacity and weak institutional cooperation as major obstacles to implementing adaptation measures that protect vulnerable communities (Robinson and Wren, 2020). Livelihoods dependent on fisheries and agriculture were found to be among the most impacted by climate change at the community level. More specifically, lack of cooperation across levels of government and limited administrative capacity are recurring barriers to local adaptation in the Caribbean, while a smaller number of studies also identified insufficient data availability at the local level as a challenge (Holdschlag and Ratter, 2016; Robinson and Wren, 2020).

At the same time, competing developmental priorities may cause climate change adaptation to be overlooked and can also reflect weak complementarity between policy documents, thereby undermining implementation by governing bodies (Lewis and Su, 2021). Nevertheless, examples of more integrated and multi-sectoral responses do exist. In Barbados, climate information has been incorporated into health surveillance systems, while climate change adaptation has been integrated into urban planning and planning regulations in Saint Vincent and the Grenadines and Jamaica (UNDP, 2018).

IMPLICATIONS FOR NATIONAL ADAPTATION PLANNING

The literature reviewed above highlights four interrelated pillars of effective NAPs: clear framing, robust evaluation, strong governance and implementation capacity, and alignment with broader development priorities (Figure 1).

Figure 1 Four pillars for effective NAPs

FRAMING	EVALUATION	GOVERNANCE AND IMPLEMENTATION	BROADER DEVELOPMENTS
• Strategy includes long-term issues related to climate-change • Specific, multi-level framing, including creating sectors-specific strategies and identifying key actors and vulnerable populations • Create public discorse on climate change • Frame adaptation as an multi-stage, iterative process	• Identify a range of adaptation options • Select adaptation options using a clear methodology • Choose 'no-regret' adapation actions and screening for maladaptation criteria • Re-evaluate and redirect he adaptation response over time • Multistakeholder involvement in implementation	• Establish systems for monitoring and coordinating adaptation activities • Establish communication channels between coordinating agency and various stakeholders and instituutiosn involved in teh adaptaiton porcess • Create sectoral plans and objectives • Ensure coherence between policies of various sectors	• Consider indirect or less-visible impacts of climate change, for example in the health care sector • Link adaptation efforts to broader development goals and SDGs

This is not an exhaustive list, and many other guidelines may also be helpful and merit further research, particularly with regard to specific aspects of the process, such as communication and evaluation. Taken together, these elements suggest that successful adaptation planning requires not

only sound technical analysis, but also institutional coordination, stakeholder engagement, and long-term policy commitment.

For Curaçao and Sint Maarten, these findings underline the importance of developing adaptation plans that are practical, well-coordinated, fiscally realistic, and integrated with wider economic and social objectives.

V. ADAPTATION PLANNING IN SUB-NATIONAL ISLAND JURISDICTIONS

While most research on island adaptation focuses on SIDS, more limited research attention has been given to dependent islands of continental states or, more specifically, to sub-national island jurisdictions (SNIJs). SNIJs are islands or groups of islands that combine some degree of autonomous self-government with formal collaboration in a wider political partnership (Petzold and Magnan, 2019).

This category is particularly relevant for Curaçao and Sint Maarten as neither country is a sovereign state. Instead, both are constituent countries withing the Kingdom of the Netherlands and therefore share characteristics commonly associated with SNIJs. As a result, some of the governance challenges and institutional advantages identified in the SNIJ literature may provide useful insights for the design and implementation of NAPs in these two countries.

Research on island territories worldwide identifies several specific challenges for SNIJs. Firstly, SNIJs are generally not directly represented in the United Nations mechanisms and similar international programs and may be excluded from bilateral adaptation assistance or are required to access support from the national government (Petzold and Magnan, 2019). In addition, limited integration of local and national (or supra-national) climate change institutions and policies, unclear departmental responsibilities, low public awareness, and weak communication across socio-economic groups have been identified as barriers to effective adaptation in SNIJs (Petzold & Magnan, 2019).

At the same time, SNIJs may also benefit from important institutional advantages, including access to national insurance regimes, disaster response systems, funding channels, and technical expertise from the mainland (Schwebel, 2018). They may also be better positioned to draw on external climate change expertise, research bureaus, and other knowledge institutions than many sovereign small island states (Petzold and Magnan, 2019).

Although research on adaptation in SNIJs remains limited and is not always directly representative of the circumstances of Curaçao and Sint Maarten, it still offers a useful complementary perspective. In particular, it highlights how adaptation planning in these countries may need to account not only for the common vulnerabilities of small islands, but also for the specific opportunities and constraints arising from their constitutional relationship within the Kingdom of the Netherlands.

VI. CONCLUSION

A national adaptation plan (NAP) is an important step that many countries take to prepare for the growing impacts of climate change, especially in island or Caribbean contexts, which are especially vulnerable to its effects. For Curaçao and Sint Maarten, a NAP offers an opportunity to connect existing initiatives, define clear priorities, and promote long-term coordination.

In recent years, awareness of the implications of climate change has grown in both Curaçao and Sint Maarten. However, the next step is to translate that awareness into action by identifying concrete steps and working toward a comprehensive strategy that is not only developed, but also effectively implemented, monitored, and updated over time. In this process, Curaçao and Sint Maarten can

learn from experiences across the wider Caribbean region, while also benefiting from their position within the Kingdom of the Netherlands.

The literature from the Caribbean and SIDS highlights four key pillars for effective NAPs: clear framing, robust evaluation, strong governance and implementation, and alignment with broader development priorities. Effective plans should be clearly framed and linked to adaptation measures for specific vulnerabilities, sectors, and population groups. They should also identify and appraise a broad range of adaptation options before selecting specific actions, while avoiding maladaptation. Iterative review, multi-stakeholder engagement, and the prioritization of "no-regret" or reversible measures can further enhance the legitimacy, flexibility, and long-term effectiveness of adaptation planning.

For Curaçao and Sint Maarten, these insights point to several practical priorities. These include establishing clear roles and responsibilities, strengthening cross-sectoral coordination, and creating formal communication channels between government agencies, stakeholders, and the public. The development of sectoral plans with defined objectives and implementation activities can improve clarity, accountability, and policy coherence. Integrating adaptation into national budgets and planning frameworks, investing in capacity building and knowledge management, and making use of decision-support tools such as CCORAL can further strengthen implementation. In addition, aligning adaptation efforts with broader development goals, disaster risk reduction frameworks, and Sustainable Development Goals can help ensure that NAPs are strategic, coordinated, and resilient over the long term.

At the same time, Curaçao and Sint Maarten should continue to collaborate closely with partners in the Caribbean region, as many of the climate risks they face are shared across island jurisdictions and can benefit from regional knowledge exchange and cooperation. They may also benefit from the expertise available within the Kingdom of the Netherlands, particularly in areas such as water management, coastal protection, climate risk assessment, and adaptation planning. In this regard, experience from the BES islands (Bonaire, Sint Eustatius, and Saba), is especially relevant, given their similar small-island context, exposure to Caribbean climate risks, and institutional links within the Kingdom. The *Klimaateffectatlas BES* brings together information on the current and expected future impacts of climate change for these islands, with the aim of helping governments, residents, and communities better understand and prepare for climate risks. It also shows how available knowledge can be centralized through collaboration between Dutch and Caribbean knowledge institutions, including Climate Adaptation Services (CAS), *Koninklijk Nederlands Meteorologisch Instituut* (KNMI), *Instituut voor Milieuvraagstukken* (VU-IVM), Wageningen University & Research (WUR), and the Dutch Caribbean Biodiversity Database (DCBD). Combining regional collaboration with lessons from the BES islands and broader Dutch technical and research expertise can help both countries develop stronger and more context-appropriate adaptation strategies.

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