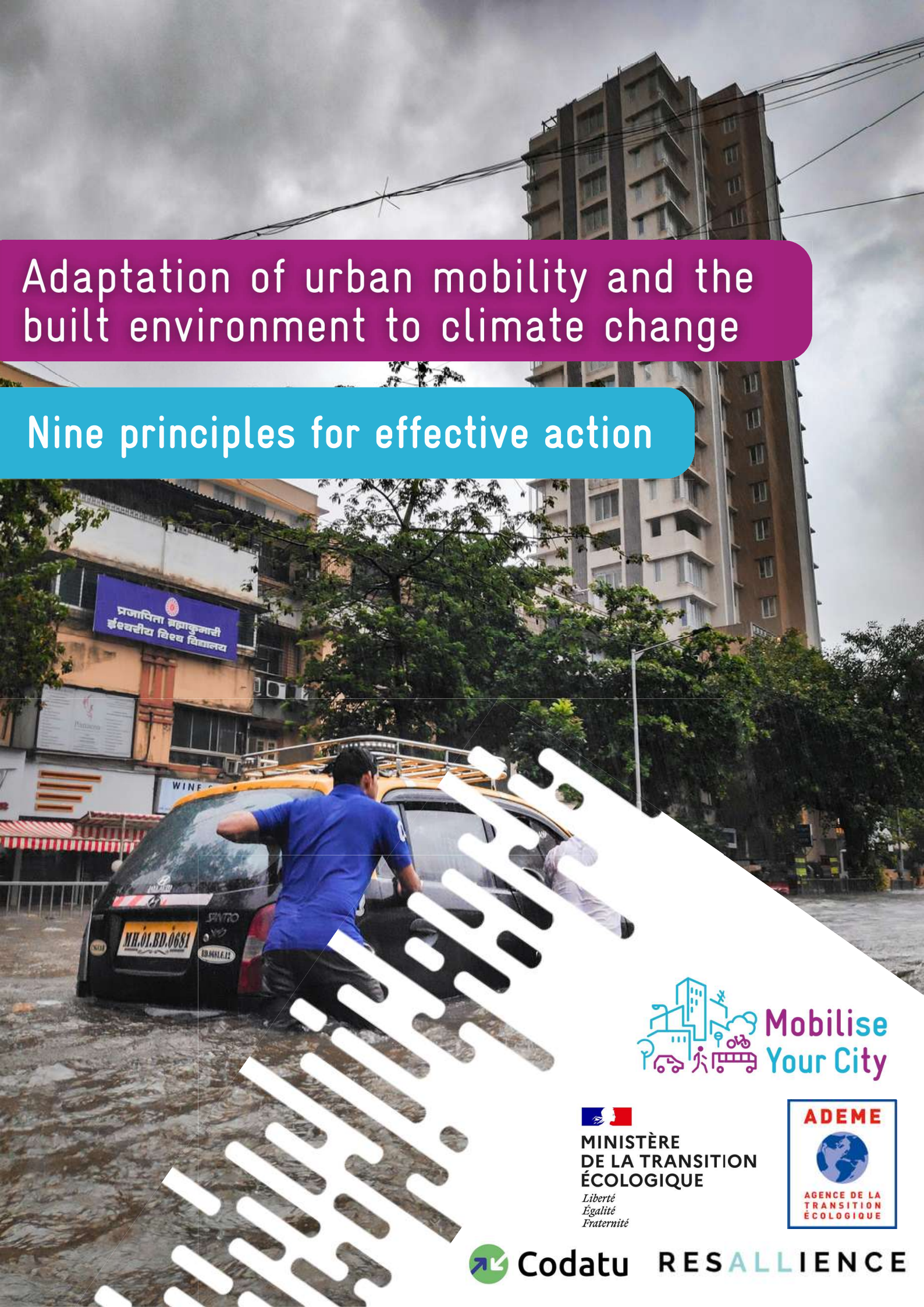
Adaptation of urban mobility and the built environment to climate change

Nine principles for effective action



Mobilise Your City

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE
Liberté
Égalité
Fraternité

ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

Codatu

RESALLIENCE

Table of Contents

List of Acronyms and Abbreviations

ADB	Asian Development Bank
ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie)
AFD	Agence française de développement
APCA	Asset Planning for Climate Change Adaptation
BRT	Bus Rapid Transit
C40	C40 Cities Climate Leadership Group
CEE	Centre for Environment Education
CTCN	Climate Technology Centre and Network
DCCS	Durban Climate Change Strategy
EU	European Union
FEE	Foundation for Environmental Education
GCA	Global Center on Adaptation
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GlobalABC	Global Alliance for Buildings and Construction
IPCC	Intergovernmental Panel on Climate Change
KFW	Kreditanstalt für Wiederaufbau
MCA	Multi Criteria Analysis
MOPHRH	Mozambique's Ministry of Public Works, Housing and Water Resources
MRV	Monitoring, Reporting, and Verification
NBS	Nature-based solutions
TfC	Transport for Cairo
TII	Transport Infrastructure Ireland
TRMP	Transformative Riverine Management Programme
UHI	Urban heat islands
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
USD	United States dollar

1. Introduction

The latest report of the International Panel on Climate Change (IPCC) Working Group 2 (IPCC, 2022) states that human-induced climate change, including more frequent and intense extreme events as well as slow onset events, has caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability. The consequences, losses and damages are detrimental in cities, where populations, ecosystems and infrastructures are concentrated. Infrastructure, including transportation systems, is being compromised by climate events, resulting in economic losses, disruptions of services and impacts on well-being.

As defined by the IPCC (2022), adaptation in human systems involves adjusting to the current or expected climate and its effects to moderate harm or take advantage of beneficial opportunities. In urban mobility, adaptation is crucial for reducing the impact on critical infrastructure such as roads, public transport, and emergency services. Enhancing the resilience of these systems improves the quality of life for all citizens and reduces socio-economic impacts, particularly for vulnerable communities.

While progress in adaptation planning and implementation has been made, significant gaps remain between current adaptation efforts and the levels needed to effectively respond to climate impacts and reduce risks (IPCC, 2022). Most observed adaptations are fragmented, small-scale, incremental, and sector-specific, primarily addressing current impacts or near-term risks. Additionally, there is a greater focus on planning rather than actual implementation.

ADEME, CODATU, MobiliseYourCity, and RESALLIENCE propose nine principles for effective adaptation actions, focusing on the connection between urban mobility and the built environment. These principles are expected to be implemented within urban transport planning processes and projects, facilitating adaptation strategies across sectors (such as transport and housing) and at different levels (including buildings, neighbourhoods, cities, and countries).

The formulation of these principles stems from an analysis of adaptation in urban mobility and the built environment sectors. This analysis was enriched by a collaborative process, including workshops with experts and implementation partners to assess the principles' relevance and feasibility. Contributions came from experts at ADB, ADEME, AFD, CODATU, Despacio, Global ABC's adaptation hub, GIZ, KFW, MobiliseYourCity, the Ocean & Climate Platform, RESALLIENCE, Transport for Cairo, and UN-Habitat.

This policy report presents an overview of the principles in Chapter 2 and a detailed description in Chapter 3. Case studies illustrating their application are discussed in Chapter 4. Chapter 5 provides indications of the way forward.

This report should be cited as:

ADEME, CODATU, MobiliseYourCity, and RESALLIENCE. (2025). Adaptation of urban mobility and the built environment to climate change: Nine principles for effective action (Full report). [S. Bekombo Priso, M. Gomez, P. Sohouenou (eds.)]. MobiliseYourCity.

2. The principles at a glance

The figure illustrates the principles.

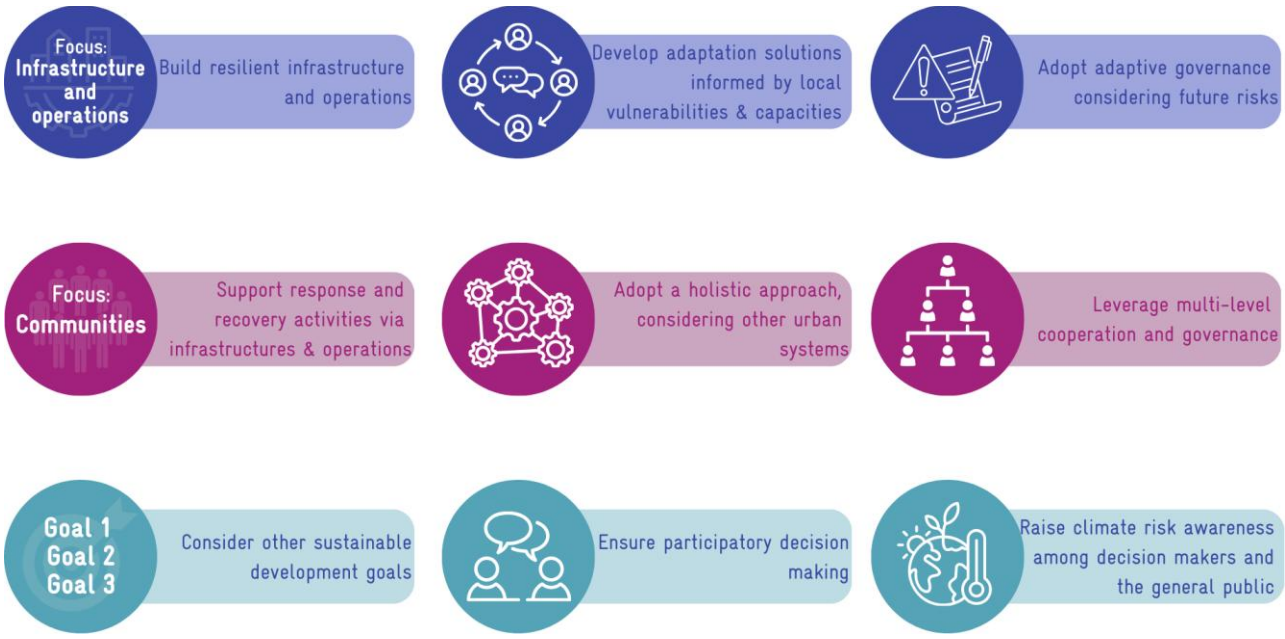


Figure 1: The principles illustrated

Source: own elaboration

The table on the next page outlines the nine principles and their relevance, which varies based on the adaptation components (mean vs goal), the stage of the project, and the specific project component.

		Adaptation component		Project stage				Project component	
No.	Principles	Mean	Goal	Planning	Design	Implementation	Operation	Governance	Engineering
1	Build resilient infrastructures and operations.								
2	Support response and recovery activities via infrastructure and operations.								
3	Consider other sustainable development goals.								
4	Develop adaptation solutions informed by local vulnerabilities and capacities.								
5	Adopt a holistic approach considering other urban systems.								
6	Ensure participatory decision-making.								
7	Adopt adaptative governance considering future risks.								
8	Leverage multi-level cooperation and governance.								
9	Raise climate risk awareness among decision-makers and the general public.								

Table 1. Relevance of the principles depending on the adaptation components (mean vs. goal), the stage of the project, and the project component

Source: own elaboration

3. Definition and implementation of the principles

The principles guide the development and implementation of effective climate adaptation actions in the urban mobility and built environment sectors. Implementing these actions requires applying interconnected principles, as illustrated in the case studies (Chapter 4).

Key enabling factors include financial resources from local public sources, bilateral funding, international and multilateral funds such as the Green Climate Fund, innovative financing mechanisms like green bonds, and private sector investments. Additionally, building local capacity within public and private sector entities is crucial to leveraging existing capabilities during implementation.

01

Build resilient infrastructures and operations

Definition: Create urban systems that can withstand and rapidly recover from climate hazards exacerbated by climate change. It requires understanding and adapting to current and future climate conditions.

Implementation: The first step is to assess the context and define risk levels per timeframe for each location and infrastructure. Following this, several strategies can be adopted: (i) relocating infrastructures from risk areas, (ii) building robust and safe infrastructures using structural and operational standards and margins, (iii) building redundant infrastructures to reduce impacts from failures, and (iv) preparing for emergency response and rapid recovery. The final step is monitoring climate risks and climate change to adapt infrastructures and operations.

Experts and the project promoter may define an "acceptable level" of risk. Infrastructure may be deemed non-essential if adaptation costs exceed the benefits, making it preferable to allow failure in certain circumstances. Given the uncertainty of climate change forecasts, the focus should be on low-regret or no-regret adaptation measures that are effective now and in future scenarios.

Examples: In practice, this principle could involve relocating facilities (e.g. a bus depot) from landslide-prone areas, adopting resilience standards and certifications (e.g. SuRe), and implementing early-warning and response systems. Planning and design should enhance operational resilience; for example, constructing a BRT platform with strategic turning zones enables buses to make U-turns during reduced operations.

The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Elevate road profiles and buildings	Elevate new structures above flood-prone areas to prevent damage and disruptions.	In its climate strategy, Ho Chi Minh City (Vietnam) requires new developments to elevate between 2 to 2.5 meters above mean sea level and building a polder system around the city (C40 Cities Climate Leadership Group, 2016)
Use permeable pavements	Permeable pavements can help manage stormwater, reduce surface runoff, and mitigate localised flooding.	Permeable pavements have been implemented in different cities such as Sydney (Australia) or Beijing (China) (Ferguson, nd.).

Table 2. Example measures for the first principle

Source: own elaboration

02

Consider supporting response and recovery activities via infrastructures and operations

Definition: Infrastructures and institutions should be planned, designed and operated to protect communities and support crisis management activities, including rescue, evacuation and recovery of essential community services. This principle requires understanding the climate vulnerabilities of the urban communities and addressing them using the infrastructure and operations.

Implementation: This principle integrates climate adaptation and disaster risk reduction co-benefits into urban development projects. Two objectives are proposed: i) protecting communities from climate hazards, including extreme weather events and slow-onset events such as sea-level rise or desertification, and (ii) facilitating rescue and evacuation during severe events.

Examples: For instance, a land development project could designate strategic areas for emergency response, including housing, healthcare, and firefighting services. Similarly, a BRT network might include an early-warning system for floods that is beneficial for other urban modes of transport.

The table below lists example measures related to this principle.

Potential measures	Description	Example of implementation
Build climate defence systems	Climate defence systems can reduce climate risk for communities surrounding the infrastructure.	The Green Urban Infrastructure project in Beira, Mozambique (Case study 1) enhanced the city's resilience to flooding.
Identify strategic emergency response areas	Strategic emergency response areas to protect people and assets during catastrophic events.	In Toyooka, Japan (Case study 7), strategic emergency response areas are designated to ensure rapid access to essential services and improve disaster response efficiency.

Table 3. Example measures for the second principle

Source: own elaboration

03

Consider other sustainable development goals

Definition: Design and implement adaptation measures that align with broader sustainable development goals, such as climate mitigation, biodiversity conservation, and poverty reduction. The aim is to avoid adverse economic, social, and environmental impacts while supporting objectives like reducing greenhouse gas emissions, preventing land degradation, promoting health and well-being, achieving zero hunger, and fostering peace and justice.

Implementation: Integrating sustainable development goals into decision-making enables the assessment of economic, social, and environmental impacts. This allows prioritising projects that address multiple goals or whose resilience benefits considerably outweigh associated emissions and impacts. Nature-based solutions (NBS) exemplify this approach by simultaneously supporting adaptation, promoting biodiversity, reducing air pollution, creating economic opportunities, and more.

Examples: The Green Urban Infrastructure in Beira Municipality project presented as case study 2 resulted in a public park along a restored river, reforested mangrove forests, and a new urban park administration. This project created new green spaces, reduced city flooding, and provided economic, social, and cultural opportunities for the urban population, including a significant recreational area in the city centre.

The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Nature-based solutions	NBS can address multiple development goals such as adaptation, biodiversity promotion, air pollution reduction, etc.	The Green Urban Infrastructure in Beira, Mozambique (Case study 1) provided multiple benefits to the residents of Beira.
Multicriteria analysis (MCA)	MCA can help consider benefits beyond adaptation and resilience	Oslo implemented a Climate Budget policy limiting GHG emissions permitted across the city each year, monitoring progress and identifying the most impactful interventions (Shin and Kustar, 2024.)
Climate adaptation integration into community planning	Integrating climate change adaptation into urban and community planning helps consider the greater perspective.	The Asset planning for climate change adaptation framework used in Cartagena, Colombia (Case study 3) leverages climate change adaptation as a starting point for upgrading poor settlements.

Table 4. Example measures for the third principle

Source: own elaboration

04

Develop adaptation solutions informed by local vulnerabilities and capacities

Definition: Climate adaptation of urban systems must be tailored to the local context, considering the local climate, urban specificities, socio-economic characteristics, capacities, and governance. Local authorities and populations' firsthand experience with climate variability and extremes is invaluable for climate risk assessments.

Implementation: Local adaptation actions are shaped by national fiscal, regulatory, and policy contexts, requiring collaboration across government levels (OECD, 2023). Effective adaptation must include local knowledge and practices, as community-specific risks and documented impacts of past extreme weather events can enhance hazard models and risk assessments. Local authorities' insights into their territory's capacity to address climate risks are crucial for evaluating adaptive capacity. Inputs from site visits, stakeholder interviews, and community participation can be integrated into decision-making. Organisations like the United Nations Development Programme, the European Union, and the International Panel on Climate Change, emphasise the importance of local leadership and capacities in climate adaptation.

Examples: The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Assess local climate and land use conditions	Updated and accurate information on local climate conditions and land use can improve climate hazard and risk models.	In Ouagadougou, Burkina Faso (Case study 5), consultants used satellite technologies to compensate for the lack of recent urban land-use data and maps, assessing territorial dynamics, the importance of green infrastructure, and their state of conservation.
Assess local adaptative capacities	Updated and accurate information on local capacities can improve climate vulnerability and risk assessments.	To build a climate adaptation plan for a neighbourhood in Cartagena, Colombia (Case study 3), authorities collected local knowledge on climate hazards and adaptative capacities (i.e. institutions already supporting the community) through a participatory process.

Table 5. Example measures for the fourth principle

Source: own elaboration

05

Adopt a holistic approach considering other urban systems

Definition: Consider how adaptation efforts for an urban system, such as transport, interact with and impact other interdependent systems, like energy supply and urban drainage. This approach addresses indirect risks and system linkages to enhance overall urban resilience.

Implementation: Key stakeholders (e.g., bus and rail operators, electricity suppliers, etc.) should begin by assessing their interconnections and dependencies with other infrastructures and organisations. This can be followed by fostering cross-sector collaboration to enhance adaptation. Effective communication among city management departments is crucial for a holistic approach to cross-sectoral and large-scale adaptation measures.

Examples: Flood risk reduction in BRT systems could involve strengthening solid waste collection to maintain drainage capacity and repurposing embankments for flood protection. Planning at the basin level enhances effectiveness by addressing upstream impacts.

A holistic approach may include modifying policies, establishing institutional frameworks, and implementing processes that facilitate communication among sectoral organisations and communities, ensuring adaptability to evolving circumstances and uncertainties.

The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Develop integrated adaptation measures at the appropriate scale	Consider the impacts of adaptation measures on surrounding ecosystems and infrastructures.	In Buenos Aires, Argentina, the flood risk management approach evolved from a reactive strategy focused on isolated grey infrastructures to an integrated approach considering interconnected grey and green measures at the river basin level (World Bank Group, 2023).
Develop cross-sectoral coordination	Develop and implement coordinated measures that address risks across multiple systems and sectors.	The Toyooka (Japan) City Action Plan is based on a holistic approach, with 17 organisations, including Toyooka City, the Kobe District Meteorological Observatory, Hyogo Prefectural Police, local railway and bus operators, and telephone companies, collaborating to define each entity's actions during a disaster (Case study 7).

Table 6. Example measures for the fifth principle

Source: own elaboration

06

Ensure participatory decision-making

Definition: Involve all relevant community members in the climate adaptation process, emphasising marginalised groups such as vulnerable populations, indigenous people, women, youth, and the elderly. Inclusiveness should be central in the decision-making process and the objectives of adaptation efforts, ensuring that diverse perspectives and needs are considered.

Implementation: Inclusiveness requires a bottom-up, transdisciplinary approach. Although public participation is more time- and effort-intensive for decision-makers, it is valuable for identifying effective measures. This approach fosters collaboration between locals and planners, prioritises community needs, enhances policy acceptance, and promotes shared ownership and a unified vision for urban resilience. Participatory processes should be designed to engage relevant stakeholders and prevent gridlocks.

Examples: The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Foster consensus and collaboration	Working to build consensus between residents and planners promotes shared ownership and solidarity.	The Transformative Riverine Management project in Durban (South Africa) collaborated with stakeholders from academia, civil society, and concerned residents involved in riverine management (Case study 6).
Consider community needs	Prioritising adaptation measures that address the specific issues and concerns of various community groups, including vulnerable populations, fosters inclusiveness	To build a community-based adaptation plan for a neighbourhood that deteriorated into slums in Busan (Korea), authorities adopted a participatory process to address climate risks and community needs (Case study 4).

Table 7. Example measures for the sixth principle

Source: own elaboration

07

Adopt adaptative governance considering future risks

Definition: Design and implement urban adaptation strategies that respond to emerging and evolving risks. This approach involves learning from experience, monitoring risks, and adjusting policies and actions based on new information to manage future uncertainties.

Implementation: This principle has two key components. First, it involves adjusting standards and measures based on new climate risk evidence. For example, monitoring sea level rise and implementing sea walls once a critical threshold is reached. This strategy is useful when climate projections are highly uncertain, thresholds or triggers are well defined, and future action can adequately address the risks.

Second, adaptive governance breaks down the adaptation challenge into several local issues, making each more manageable scientifically and politically. This approach allows for testing different policies and scaling up successful ones to reduce vulnerability to climate change. Identifying the entity and level of government responsible for developing policies is essential for accountability and effective implementation.

Examples:

The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Plan for regular evaluation and adjustment of resilience measures	Assessment planning and adjustment of resilience measures based on emerging climate risk evidence help to account for uncertainty.	The Climate Change Action Plan of Cape Town, South Africa, includes a coastal and sea-defence decision framework that seeks to continuously evaluate and plan for coastal defences in emerging high-risk areas (City of Cape Town, 2021).
Define and distribute responsibilities	Defining responsible entities, governmental levels, and timelines for action implementation helps ensure execution and accountability.	The City Plan of Lagos, Nigeria, outlines adaptation actions, specifying lead and collaborating agencies, stakeholders, and implementation timelines (Lagos State Government, 2021).

Table 8. Example measures for the principle seven

Source: own elaboration

08

Leverage multi-level cooperation and governance

Definition: Increase collaboration across sectors and scales to enhance urban adaptation efforts. This cooperation aligns adaptation actions with broader strategies, leverages shared knowledge and best practices and prevents maladaptation by accounting interlinked impacts.

Implementation: This principle can be implemented in various ways. First, it involves aligning projects and adaptation measures with local, regional and national climate change strategies and plans. Second, adaptation efforts can benefit from knowledge and best practices exchanged between cities.

Multi-level cooperation and governance require understanding adaptation impacts and strategies, maximising synergies and avoiding maladaptation.

Examples: One example of maladaptation can be found in Fiji, where seawalls were built to protect against rising sea levels. The implementers initially did not consider the impacts of this measure. These seawalls shifted vulnerability along the coast, impacting other coastal populations due to changes in sediment deposits and threatening marine ecosystem health (Piggott-McKellar et al., 2020).

The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Build and participate in city networks	Facilitate the exchange of information, experiences, and good practices between cities to foster adaptation.	Resilience Cities Network gathers over 100 cities committed to urban resilience across Africa, Asia Pacific, Europe, the Middle East, and the Americas. It brings global knowledge, practice, partnerships, and funding to its member cities (Resilient Cities Network, 2024).
Foster collaboration across levels of government	Planning and implementing adaptation measures that are coordinated between different levels of government	The City Plan of Lagos, Nigeria, clearly outlines adaptation actions, specifying the lead agencies, collaborating agencies, and stakeholders (Lagos State Government, 2021). The collaborating stakeholders include local, national and international stakeholders.

Table 9. Example measures for the eighth principle

Source: own elaboration

09

Raise climate risk awareness among decision-makers and the general public

Definition: Limited awareness of climate risks among decision-makers and the general public hinders effective adaptation and resilience. Addressing this challenge requires actions such as education programs, community leadership initiatives, and citizen engagement, all framed within climate scenarios to assess their impacts on infrastructure, ecosystems, and communities.

Implementation: The principle seeks to provide educational and awareness-raising tools that build capacity to anticipate climate risks and develop effective responses. This can be achieved through:

1. Education programmes tailored to local contexts: This could include workshops and trainings for practitioners that address climate change impacts according to the priorities of local communities. This approach improves the acceptance and long-term success of adaptation projects.
2. Promoting community leadership and action: Engage youth, decision-makers and community leaders as ambassadors for climate adaptation. Their involvement can generate a multiplier effect, increasing awareness and promoting community resilience.
3. Inclusive citizen engagement: Conduct awareness campaigns that engage citizens and reinforce ownership and commitment to climate solutions.

Examples: The table below lists example measures related to the principle.

Potential measures	Description	Example of implementation
Promote citizen participation and awareness	Citizens' participation in workshops and trainings fosters the appropriation and long-term success of projects.	In Ouagadougou, Burkina Faso (Case study 5) an "Environmental Week" was organised in three schools to raise awareness about global and local climate risks and objectives.
Develop educational programs	Create and share educational materials to raise awareness of climate change and encourage action.	GCA, CEF, & FEE (2022) compiled 15 case studies showcasing initiatives by educational institutions in Africa and worldwide to raise awareness about adaptation and climate resilience in schools."

Table 10. Example measures for the ninth principle

Source: own elaboration

4. Case studies

This section presents case studies implementing the proposed principles as part of an urban project.

The case studies implement several principles; the following table shows the most relevant ones:

Case studies	Principles illustrated
Case study 1: Green Urban Infrastructure in Beira Municipality, Mozambique.	• Principle 2: Support response and recovery activities via infrastructure and operations • Principle 3: Consider other sustainable development goals • Principle 8: Leverage multi-level cooperation and governance
Case study 2: Climate adaptation of urban light rail as part of the Transport Infrastructure Ireland (TII) climate adaptation strategy	• Principle 1: Build resilient infrastructures and operations • Principle 5: Adopt a holistic approach considering other urban systems • Principle 7: Adopt adaptative governance considering future risks
Case study 3: Asset planning for climate change adaptation in Cartagena, Colombia	• Principle 3: Consider other sustainable development goals • Principle 4: Develop adaptation solutions informed by local vulnerabilities and capacities • Principle 6: Ensure participatory decision-making
Case study 4: Participatory process to integrate climate change adaptation in Saebat Maeul community planning in Busan, Korea	• Principle 4: Develop adaptation solutions informed by local vulnerabilities and capacities • Principle 6: Ensure participatory decision-making. • Principle 9: Raise climate risk awareness among decision-makers and the general public
Case study 5: Use of digital technologies to develop a methodology to increase climate resilience in Ouagadougou, Burkina Faso, through nature-based solutions	• Principle 3: Consider other sustainable development goals • Principle 4: Develop adaptation solutions informed by local vulnerabilities and capacities • Principle 9: Raise climate risk awareness among decision-makers and the general public
Case study 6: Transformative Riverine Management in Durban, South Africa, supported by the C40 network	• Principle 6: Ensure participatory decision-making. • Principle 8: Leverage multi-level cooperation and governance
Case study 7: The disaster preparedness and business continuity approach of Toyooka, Japan.	• Principle 1: Build resilient infrastructures and operations • Principle 2: Support response and recovery activities via infrastructure and operations • Principle 5: Adopt a holistic approach considering other urban systems

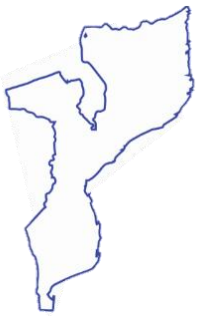
Table 11. Case studies and principles illustrated

Source: own elaboration.

Case study 1: Green Urban Infrastructure in Beira Municipality, Mozambique

Type of country: Developing country

Context



With its 2700km coastline, Mozambique is highly vulnerable to coastal flooding, which has become more frequent and severe, causing damage to infrastructure, homes, and livelihoods. In March 2019, Cyclone Idai led to catastrophic flooding, affecting over 1.8 million people. It resulted in more than 600 deaths and caused 2 billion USD in damages. Beira, the fourth largest city, was severely impacted due to its low elevation, poor infrastructure, and high poverty rates. A large part of Beira was submerged, partly due to the degraded Chiveve River ecosystem, which was clogged with waste, reducing its flood mitigation capacity.

In response, the Beira City Council prioritised climate change adaptation. The Chiveve Rio and Green Urban Infrastructure project developed an urban park along the Chiveve River, integrating green and grey infrastructure measures to reduce the city's susceptibility to flooding.

The riverbed was dredged during the rehabilitation phase, which lasted until 2017, and the shoreline was cleared of waste and sediments. A new tidal outlet was built at the river's mouth to regulate its flow and protect the city centre from flooding. The fishing port was also dredged to ensure accessibility regardless of the tides, and a new road was constructed to improve land access to the port.

In the second phase, completed in 2021, a public park was created along the river to serve as a catchment and overflow area during floods. The park features playgrounds, sports facilities, a botanical garden, markets, restaurants, sanitary facilities and more. The project also includes mobility components like bridges, pedestrian routes, and a 5.5 km cycle path to enhance connectivity between the city centre and the river valley.

Principles implemented

- **Principle 2: Support response and recovery activities via infrastructure and operations**

  The project's investments in grey and green infrastructure, such as upgraded drainage systems, retention basins, and reinforced coastal areas, have significantly reduced Beira's flood risk, protecting lives and properties. Restoring mangrove forests along the coastline has strengthened the defence against erosion and storm surges, supporting the local ecosystem and biodiversity. During Cyclone Freddy in March 2023, Beira experienced much lower flooding levels. Residents also noted less severe flooding after Cyclone Idai in 2019. The World Bank estimates that these investments reduced flood damage in the target area by 9 million USD.

- **Principle 3: Consider other sustainable development goals**

  The park enhanced flood protection in Beira and improved living conditions. Public health benefited from better waste management, new job opportunities arose, accessibility increased, and residents gained access to green spaces and recreational activities in the middle of the city. Cultural, social, and sporting events are held in the park to encourage

community engagement and promote its sustainable use. To ensure its sustainability, an independent park administration was established. During the first four years of the park's development, funds were used for park management and urban planning trainings. The park administration is also trained to generate extra income through public-private partnerships.

- **Principle 8: Leverage multi-level cooperation and governance**

  The project fostered collaboration among a group of stakeholders, integrating climate change adaptation efforts among local and international actors. This included cooperative agreements with the municipality, GIZ, and KFW. Inspired by the project's success, the World Bank has supported research on lessons learned that could promote collaboration with other cities facing similar challenges.

Figure 2: Chiveve Rio and Green Urban Infrastructure project during construction

Source: TPF, 2020

References

KFW. (2024). Project information: Mozambique urban development. https://www.kfw-entwicklungsbank.de/Global-commitment/Subsahara-Africa/Mozambique/Project-information-Urban-development/

University of Notre Dame Global Adaptation Initiative-NDGAIN. (2023). ND-GAIN Adaptation Brief: Cities and Climate Change Project 3CP: Rio Chiveve and Green Urban Infrastructure Project. https://gain.nd.edu/assets/565162/nd_gain_adaptation_brief_mozambique.pdf

TPF. (2020). Green Infrastructure Park in Beira City. https://tpf.pt/obra.php?n=drenagem-e-protecao-contra-cheias&p=parque-de-infraestruturas-verdes-na-cidade-da-beira&lang=en

Case study 2: Climate adaptation of urban light rail as part of the Transport Infrastructure Ireland (TII) climate adaptation strategy

Type of country: Developed country

Context

In 2019, Ireland declared a climate and biodiversity emergency due to the increasing impacts of climate change. To address this, the Irish government developed the Climate Action Plan 2021, which mandated TII to update its strategy for adapting the light rail and national road networks to the changing climate. In response, TII prepared the Climate Adaptation Strategy (2022), building on its 2017 strategy. This updated strategy incorporates significant developments in climate adaptation, such as an improved understanding of climate impacts on infrastructure, better guidance on adaptation planning, and advances in climate science and awareness of climate risks in Ireland.

TII manages assets such as the national road network, national and regional rural greenways, and Dublin's light rail network (Luas). The Luas network consists of two tram lines, 67 stops, and 81 trams, and is vulnerable to flooding, storms, and heatwaves. These events can damage assets and disrupt services, leading to significant safety, financial, and reputational impacts.

Principles implemented

- ### Principle 1: Build resilient infrastructures and operations

  TII's light rail network used to experience disruptions to Luas services due to flooding and significant snowfall. In 2011, a Luas electrical substation was flooded by an overspilling river, including the water pumps and taking a week to drain. This hindered maintenance on the Luas Green Line for 18 months until the substation was restored.

  In response, several measures were implemented to prevent similar events:

  - Substation standards were updated to withstand 100-year events and survive 300-year floods (however, the document does not specify whether the '100- and 300-year events' refer to current or future climate conditions)
  - Flood protection walls and improved pumping capabilities were installed at the substation.
  - The incident underscored the importance of inter-organisational collaboration, quickly resolving the pump capacity issue with the Public Works Office.

  According to TII, no similar flooding of a Luas substation has occurred, despite other flood events in Dublin.

  More recently, TII developed a Severe Weather Management Plan to minimise the impact of extreme weather on Luas services. This plan includes detailed procedures, such as ceasing Luas operations to manage severe weather conditions.

- **Principle 5: Adopt a holistic approach considering other urban systems**

In its climate strategy, TII recognises how dependent and interconnected it is with other systems. Climate vulnerabilities in TII's infrastructure can disrupt National Road and light rail networks, leading to cascading impacts like restricted access to healthcare and essential supply chains. Conversely, TII relies on water for construction and operations, energy supply for Luas and streetlights, and telecommunications for traffic management. TII's adaptability could be compromised if these interdependent services aren't resilient to climate change. To address this, TII will collaborate with organisations such as the Department of Transport, Climate Action Regional Offices, local authorities, and Climate Ireland.

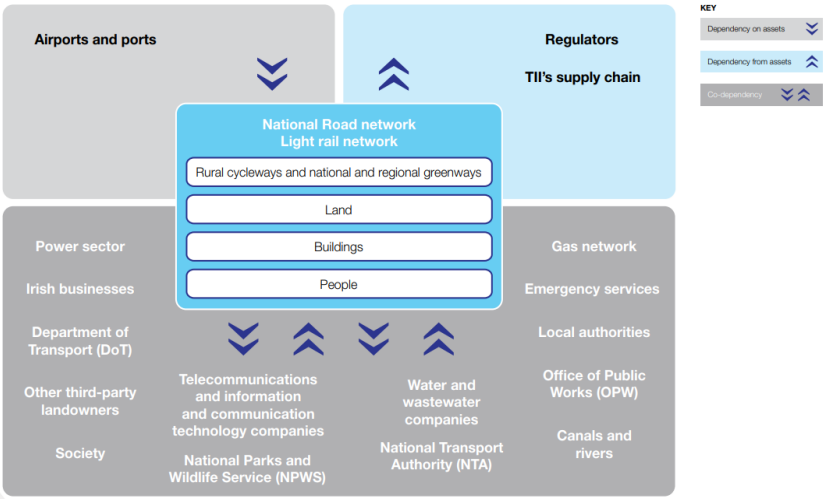


Figure 3: Interdependencies between TII and other infrastructure systems and organisations

Source: TII (2022)

- **Principle 7: Adopt adaptive governance considering future risks**

The Climate Adaptation Strategy of TII follows a six-stage process: (i) Preparing the ground, (ii) Climate impact screening (iii) Prioritisation (iv) Priority impact assessment, (v) Develop a plan, and (iv) Implement, evaluate, and review. Stage (vi) illustrates the adaptative governance principle as it requires TII to regularly assess its progress on proposed actions and update its climate adaptation measures with new climate risk insights or lessons from extreme weather events. Monitoring its climate adaptation plans will help identify and prevent potential maladaptation or unforeseen side effects. This process will inform TII's next Climate Adaptation Strategy and is integral to the 5-year climate adaptation cycle adopted by the government.

References

Transport Infrastructure Ireland. (2022). TII Climate Adaptation Strategy. https://www.tii.ie/media/bpvf2gms/climate-adaptation-strategy-2022_v2.pdf

Transport Infrastructure Ireland. (2022). TII Climate Adaptation Strategy: Appendix https://www.tii.ie/media/tarh1z5n/tii-climate-adaptation-strategy-2022_appendix.pdf

Case study 3: Asset planning for climate change adaptation in Cartagena, Colombia

Type of country: Developing country

Context

Cartagena de Indias, a key port city in Colombia, relies on tourism, port activities, and the chemical, oil, and plastics industries. Cartagena is threatened by climate change. By 2040, the city expects a 30% increase in extreme rainfall, a sea level rise of 15-20 cm, and a temperature rise of 1.2°C, reaching 29.1°C (Invemar et al., 2012). These hazards will be exacerbated by population growth in disadvantaged communities, biodiversity loss, and ecosystem degradation. By 2040, 70% of mangroves, 35% of road infrastructure, and 25% of housing and population could be at risk of flooding, with all beaches facing erosion.

In Cartagena, the Policarpa Salavarrieta neighbourhood is an informal settlement vulnerable to climate hazards due to the lack of land regularisation and infrastructure. Its residents identified rain, flooding (41%), and heat (29.4%) as significant issues. Poor road conditions and inadequate drainage cause transport problems and floods.

In 2011, the Global Urban Research Centre, the Universidad Tecnológica de Bolívar and city officials implemented Asset Planning for Climate Change Adaptation (APCA) to support community asset planning for climate change adaptation.

Principles implemented

- **Principle 3: Consider other sustainable development goals**

  This case study shows that climate change adaptation can be used as an entry point for planning to upgrade vulnerable city settlements. The APCA started a process of transformation that addresses vulnerability and deals with core development and urban poverty deficits faced by communities. Proposed actions included canal improvements, housing enhancements, and conducting topographical and rainfall surveys to mitigate rain and flooding impacts.

- **Principle 4: Develop adaptation solutions informed by local vulnerabilities and capacities**

  The APCA development is based on the assessment of local vulnerabilities and capacities. Communities were asked to list and rank weather issues and identify their effects. The APCA also listed institutions in the neighbourhood (e.g., businesses, schools, Red Cross, etc.), identifying those that supported the community in building resilience or responding to severe weather events. Thanks to this work, the identified adaptation strategies were associated with institutions supporting or undermining these actions at household, community and business levels.

- **Principle 6: Ensure participatory decision-making**

  This case study illustrates how a "bottom-up" approach can help to address climate adaptation by designing feasible local solutions that can be mainstreamed into "top-down" citywide strategic planning. Using participatory tools (e.g. surveys, focus groups, etc.), the APCA identified risks and adaptation measures considering community inputs. The process identified that local communities know about weather and environmental hazards, perceive variations in weather patterns and identify their effects on assets and well-being at the household and community level.

  Key insights highlight the significance of leveraging climate change adaptation to uplift marginalised areas, empower communities engaged in "autonomous adaptation strategies," enhance institutional capacities for scaling solutions, and tear down misconceptions regarding climate event awareness in vulnerable communities.

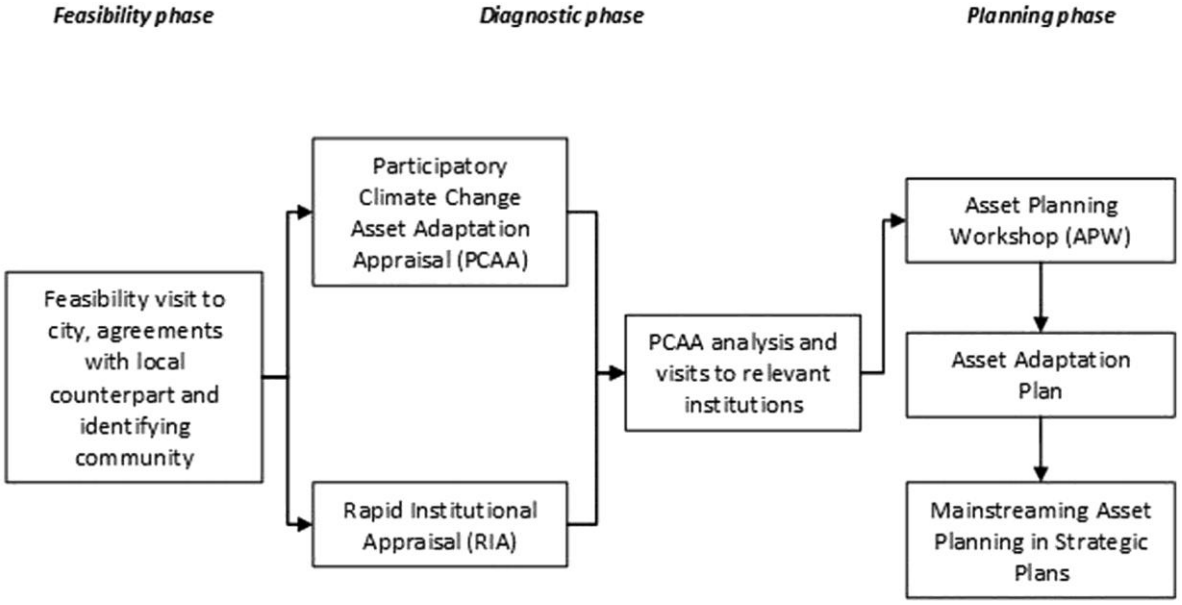


Figure 4: Connections between APCA elements

Source: Stein, A., & Moser, C. (2014)

References

Alcaldía de Cartagena de Indias, MADS, INVEMAR, CDKN y Cámara de Comercio de Cartagena. (2014). Plan 4C: Cartagena de Indias Competitiva y Compatible con el Clima. Resumen ejecutivo. Editores: Zamora Bornachera, Anny Paola; López Rodríguez, Ángela; Martínez, Claudia y Lacoste, Mathieu. Cartagena de Indias. Serie de Publicaciones Generales del INVEMAR No. XX. Santa Marta. https://observatorio.epacartagena.gov.co/wp-content/uploads/2017/08/plan-4c-cartagena-de-indias-competitiva-y-compatible-con-el-clima-resumen-ejecutivo.pdf

Invemar, MADS, Alcaldía Mayor de Cartagena de Indicas y CDKN. (2012). Lineamientos para la adaptación al cambio climático de Cartagena de Indias. Proyecto integración de la adaptación al cambio climático en la planificación territorial y gestión sectorial de Cartagena de Indias. Serie de Publicaciones Generales del Invemar No. 55, Santa Marta, Colombia. 227

Stein, A., & Moser, C. (2014). Asset planning for climate change adaptation: lessons from Cartagena, Colombia. Environment and Urbanization, 26(1), 166-183. https://doi.org/10.1177/0956247813519046

Case study 4: Participatory process to integrate climate change adaptation in Saebat Maeul community planning in Busan, Korea

Type of country: Developed country

Context

The Saebat Maeul community in Busan covers 0.113 km² and has 1,277 residents. Of these, 6.9% rely on government assistance, and 41.6% are elderly. Located near the Hakjang River, between a residential complex and the Sasang industrial complex, the area declined into a slum in the 1990s due to the manufacturing industry's downturn.

The community is vulnerable due to environmental and social factors. It faces flooding due to its low elevation to the river, and exposure to dust and odours from the industrial complex. It has outdated and uninhabited properties, inadequate infrastructure, low educational attainment, and a highly elderly population, increasing its vulnerability to climate change impacts.

Climate risks were assessed to create a community plan for climate change adaptation. Heat waves and heavy rain were identified as key concerns due to their negative effects. An innovative participatory approach was used to engage residents and stakeholders, making the concept of climate change adaptation accessible to those unfamiliar with it.

Principles implemented

- **Principle 4: Develop adaptation solutions informed by local vulnerabilities and capacities**

  The participatory process enabled the community plan to consider local needs and capacities. The plan includes the following actions to enhance community resilience:

  - Construction of paid parking garages with solar-powered technologies and green roofs
  - Maintenance of alleyway and surface water drainage
  - Creating cooling shelters
  - Adopting a rain-water recycling facility

- **Principle 6: Ensure participatory decision-making**

  The involvement of community coordinators and interviews with community members were strategies to facilitate communication. Community coordinators are experts appointed to oversee the execution of community revitalisation initiatives in Korea. Leveraging their networks, a framework was devised wherein the coordinators served as intermediaries between community members and planners, ensuring effective communication.

- **Principle 9: Raise climate risk awareness among decision-makers and the general public**

  To facilitate engagement, an innovative approach was employed to ensure that the concept of climate change adaptation was accessible to most residents and stakeholders.

  The term "climate change" was replaced with "more hot weather" and "more rain." By initiating a dialogue about summer weather issues affecting the community, the planning process succeeded to capture the attention of community members and stakeholders. Furthermore, the term "green infrastructure" was replaced with more accessible terminology, such as "park," "garden," and "open space," which were incorporated into the physical plan for community review at a later stage. Community development was emphasised, and adaptation strategies were incorporated with a focus on the function of facilities, as local participation in a push for climate change adaptation was unlikely.

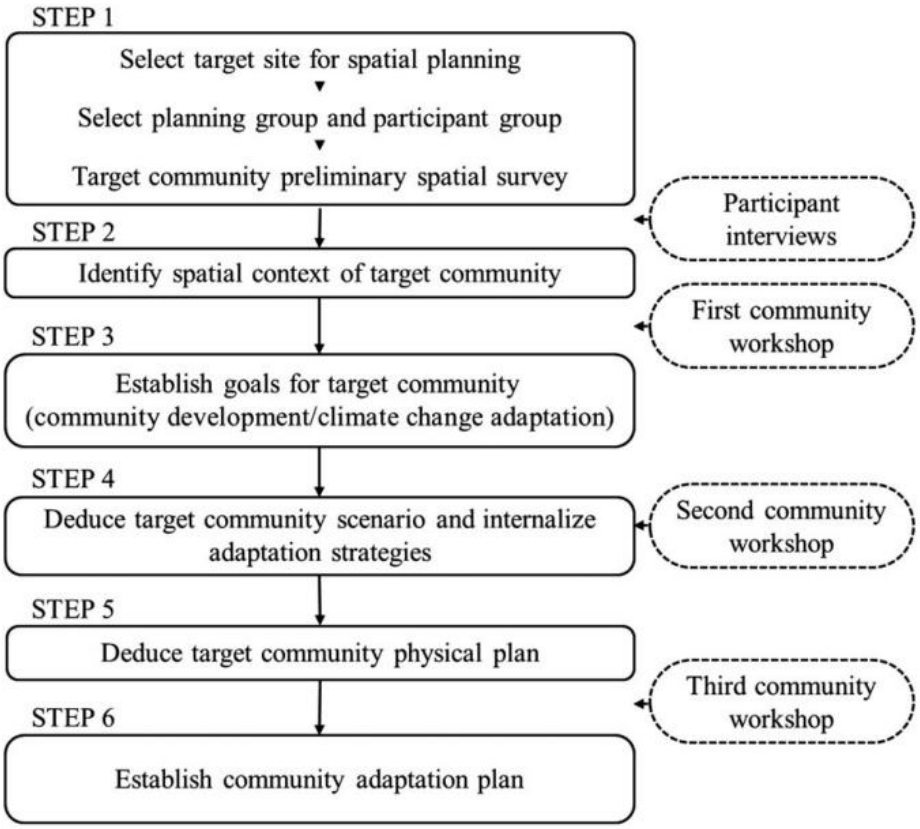


Figure 5: Steps and characteristics of the planning process

Source: Kim, D., & Kang, J. E. (2018)

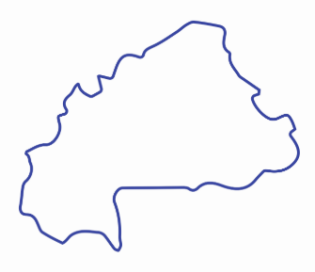
Reference

Kim, D., & Kang, J. E. (2018). Integrating climate change adaptation into community planning using a participatory process: The case of Saebat Maeul community in Busan, Korea. *Environment and Planning B: Urban Analytics and City Science*, *45*(4), 669-690. https://doi.org/10.1177/0265813516683188

Case study 5: Use of digital technologies to develop a methodology to increase climate resilience in Ouagadougou, Burkina Faso, through nature-based solutions

Type of country: Developing country

Context



Ouagadougou, the capital of Burkina Faso, is experiencing rapid population growth and urban sprawl, leading to environmental degradation and increased vulnerability to floods, droughts, heat waves, and dust storms. Green infrastructure could be used to increase the climate resilience of the city. However, areas intended for green sites in Ouagadougou are often illegally occupied (27% in 2012) and diverted from their initial use.

To address this topic, the CTCN (UN), the city of Ouagadougou, the Ministry of the Environment of Burkina Faso, and the Green Action Foundation set up a project titled *Use of Digital Technologies to develop a methodology to increase climate resilience in Ouagadougou through nature-based solutions*. Conducted by RESALLIENCE and AGEIM, the project aimed to i) develop and implement a methodology based on satellite technologies to identify sites for urban green infrastructure, ii) prepare a plan to implement and manage green infrastructure on these sites, and iii) draft a concept note to facilitate project financing.

Principles implemented

- ### Principle 3: Consider other sustainable development goals

  This project focuses on nature-based solutions. In addition to climate resilience benefits, it was estimated that the proposed agroforestry park on the outskirts of the city could deliver:

  - Economic benefits: Enhanced economic resilience, alternative income for smallholders and landowners, and increased food security.
  - Environmental benefits: Increased carbon sequestration and reduced greenhouse gas emissions; Improved ecosystem services through better soil structure; windbreaks, etc.
  - Social benefits: Gender equality promotion; New employment opportunities in crop drying, wood cutting, furniture making, etc.

- ### Principle 4: Develop adaptation solutions informed by local vulnerabilities and capacities

  The project leveraged satellite technologies to compensate for the unavailability of recent urban land-use data and maps. A geospatial analysis of Ouagadougou was performed to assess the territorial dynamics, the importance of green Infrastructure, and their state of conservation. This analysis was complemented by a geophysical study of the city to determine the spatial and temporal evolution of surface and air temperatures and to identify Urban Heat Island (UHI) in the context of climate change.

The project also leveraged the knowledge of local urban planners and NBS experts to (i) identify sites for green infrastructure development based on potential contribution to flood and heat reduction, land availability, social impact, etc., and (ii) select NBS options adapted to the local context (such as agroforestry and green corridors).

- **Principle 9: Raise climate risk awareness among decision-makers and the general public**

  To ensure long-term success and raise local acceptance, the project promoted citizen participation and awareness, particularly among children often excluded from such initiatives. An "Environmental Week" was organised in three pilot schools to raise awareness about global and local climate risks and objectives.

Environmental week in three pilot schools

Programme of the week

- Day 1: Ouagadougou in the past and future prospects with the Grand Ouaga
- Day 2: A global dynamic, the Sustainable Development Goals – part 1
- Day 3: A global dynamic, the Sustainable Development Goals – part 2
- Day 4: Meeting with local sustainability and environmental advocates
- Day 5: Games and ideas for the future

Picture of the CM1 (4th grade) classes of two of the pilot schools

Cover of the tailor-made manual

Handing over of the manual to the headmaster of the Kulwéoghin B. school, by Mr. Valentin BAYIRI (Ouagadougou City Council

Figure 6: Overview of the environmental week organised in Ouagadougou

Source: RESALLIENCE, 2022

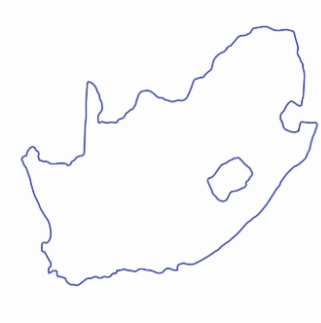
Reference

CTCN. (2022). Strengthening the resilience of cities by promoting and deploying green infrastructure in the face of climate change | Climate Technology Centre & Network | Wed, 02/17/2021 (ctc-n.org). https://www.ctc-n.org/technical-assistance/projects/strengthening-resilience-cities-promoting-and-deploying-green

Case study 6: Transformative Riverine Management in Durban, South Africa, supported by the C40 network

Type of country: Developing country

Context



Durban, a coastal city in South Africa with 18 major river systems, has faced deteriorating river water quality and increased flooding over the past decades, leading to rising costs for the city, businesses, and citizens. To address this, Durban launched the Transformative Riverine Management Programme (TRMP) to enhance climate resilience by rehabilitating 7400 km of degraded rivers and streams. The TRMP incorporates nature-based solutions, community ecosystem-based adaptation, and circular economy considerations, to scale up existing riverine management initiatives.

The project, estimated to cost over USD 500 million over 20 years, received support from the C40 Cities Finance Facility to build a strong business case.

C40 is a global network of nearly 100 cities united to confront the climate crisis. Mayors of C40 cities commit to an inclusive, science-based, and collaborative approach to achieve climate mitigation goals and build equitable, resilient communities. C40 supports its members in raising climate ambitions, scaling up climate action, and accessing financing. Durban joined the C40 network in 2015.

Principles implemented

- **Principle 6: Ensure participatory decision-making**

  According to C40, the project aimed to foster collaboration between city departments, citizens, businesses, and non-profits. A core group of city officials, the Business Case Sub-Committee, handled the technical work for developing the TRMP business case. They reported progress to the Durban Climate Change Strategy (DCCS) Technical Task Team, composed of leaders from relevant city units (including road and drainage departments) responsible for implementing the DCCS. In addition to the city officials, the project worked with an informal grouping of interested stakeholders known as The Riverine Community, which includes academia, civil society, and concerned residents involved in riverine management. These stakeholders regularly attend meetings focused on the environment.

- **Principle 8: Leverage multi-level cooperation and governance**

  The city of Durban benefited from C40 technical support to build a business case for the TRMP, a form of international cooperation between cities committed to tackling climate change. In addition, C40 published documents (on the C40 Knowledge Hub) to provide learning and best practices to help other cities inside and outside the C40 network perform similar activities.

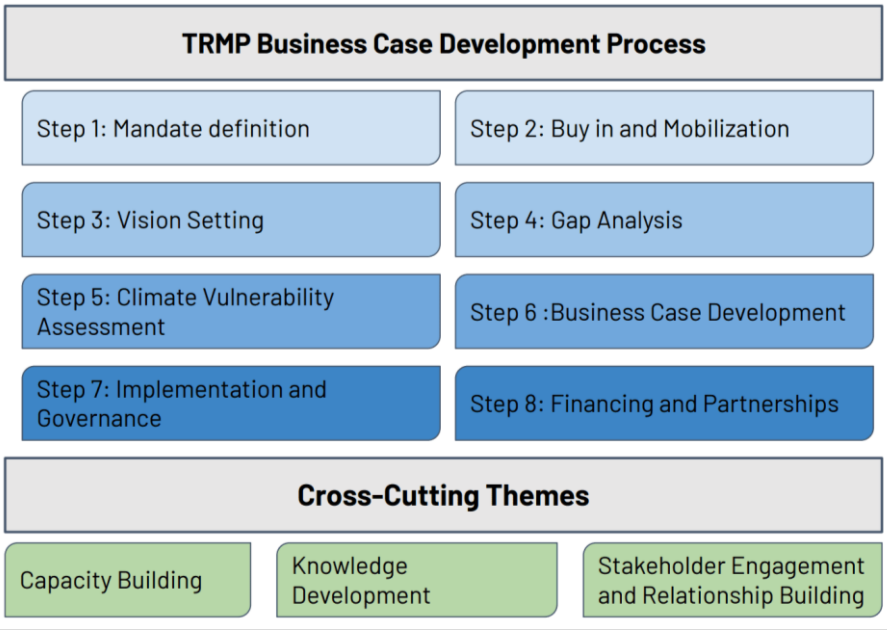


Figure 7: Overview of the TRMP Business case

Source: C40 Knowledge Hub, 2022

References

C40. (2022). Durban's transformative riverine management programme: Background, structuring, and the business case. https://www.c40knowledgehub.org/s/article/Durban-s-transformative-riverine-management-programme-Background-structuring-and-the-business-case?language=en_US

C40 Cities Finance Facility. (2019). Transformative Riverine Management Projects in Durban: Background and structuring. https://c40.my.salesforce.com/sfc/p/#36000001Enhz/a/1Q000000geZs/suaKR0uDxnpADfcTvUvvYczY8E_VPVqYKCn9yn8oIzA

C40 Cities Finance Facility. (2022). A guide for cities to Durban's TRMP Business Case development process. https://c40.my.salesforce.com/sfc/p/#36000001Enhz/a/1Q000000geZt/8c8Tid2VQOlGREsnAPwY6TIKvANSczSEaL4rvZkx6Kk

Case study 7: The disaster preparedness and business continuity approach of Toyooka, Japan

Type of country: Developed country

Context

In Japan, natural disasters caused by typhoons are becoming increasingly frequent and severe. Japanese cities, such as Toyooka in October 2004, have experienced significant flooding, disruption of services and the destruction of material assets. These cities decided to implement structural resilience measures (for example, digging and strengthening canals, and reinforcing dykes) and develop crisis management measures. This includes pre-disaster action plans and measures to create a 'flood prevention and disaster awareness society'.

Principles implemented

- **Principle 1: Build resilient infrastructures and operations**

  In the transport sector, a system was put in place to ensure that station staff and crews are informed and that standards are set for the suspension and resumption of service after a disaster. Bus companies have also prepared relocation plans and parking spaces to evacuate their vehicles to higher ground, allowing vehicles to escape damage and resume operations at an early stage.

  Principle 2: Support response and recovery activities via infrastructure and operations

  The Toyooka City Action Plan aims to enhance crisis management for large-scale flooding. The plan relies on predicting typhoons and rainfall using monitoring tools that combine cumulative rainfall data, six-hour rainfall forecasts, and Maruyama River levels. It outlines three scenarios based on current and forecasted precipitation, considering the river's characteristics and potential water levels. When cumulative rainfall and forecasts exceed set thresholds, corresponding disaster prevention and mitigation actions are implemented.

- **Principle 5: Adopt a holistic approach considering other urban systems**

  The Toyooka City Action Plan is based on a holistic and collaborative approach. Seventeen organisations, including Toyooka City, Hyogo Prefecture, the Kobe District Meteorological Observatory, Hyogo Prefectural Police, local railway and bus operators, telephone companies, and electricity companies, collaborated to define each entity's actions during a disaster.

  The private operator of Toyooka's bus network (Zentan) is involved in the planning and monitoring crisis management, along with the national train company (JR), the town hall, the prefecture, the fire brigade and others. Zentan communicates its business continuity and disaster evacuation efforts to stakeholders. Key procedures include:

  (i) Monitoring Maruyama River levels and risks of flooding, typhoons, and landslides

(ii) Buses to replace rail services when needed.
(iii) Informing bus passengers and residents via local radio.
(iv) Evacuating rolling stock to planned sites (e.g., Tajima Airport outside the city) if the river reaches a certain level (3.8m).
(v) Ensuring passenger safety and communicating with emergency services if a bus is blocked.
(vi) Prepare a damage report post-crisis and analyse the situation to improve procedures.

Figure 8: Emergency sandbag storage area at Itabashi Ward station (Tokyo).

Source: Toyooka city, 2024

References

Ministry of Land. Infrastructure, Transport and Tourism. (2017). Preventing flood damage: Case studies of initiatives. https://www.mlit.go.jp/river/bousai/shinsuihigai/pdf/171225_zentai_lo.pdf

Toyooka City. (2024). Disasters and Disaster Prevention (website). https://www.city.toyooka.lg.jp/bosai/index.html

5. Way Forward

The principles outlined in this document provide a comprehensive framework for integrating climate adaptation into urban mobility planning and infrastructure development. As climate change intensifies, cities must adopt strategies that enhance urban mobility resilience, ensure sustainable development, and protect vulnerable communities. These principles emphasise the importance of risk-informed planning, cross-sector collaboration, and participatory governance to create adaptive urban environments that withstand future climate uncertainties.

Applying these principles within the Sustainable Urban Mobility Plans cycle ensures that climate adaptation becomes a core consideration in transport and mobility strategies. The iterative nature of the SUMP cycle allows for continuous monitoring, learning, and adjustment, making it an ideal framework for embedding resilience into urban mobility systems. A separate topic guide outlines how SUMPs can incorporate climate change adaptation and identifies the relevant principles for each step within the SUMP cycle.

Integrating these principles into urban mobility planning and adaptation strategies will help cities transition towards a more resilient and sustainable future. Given the uncertainties associated with climate change, prioritizing low-regret and no-regret measures ensures immediate benefits while preparing for long-term risks. A separate topic guideline outlines concrete actions and measures that cities can implement to adapt urban mobility to climate change.

By embedding climate adaptation within the SUMP cycle and its measures, cities can transform their transport systems into resilient infrastructures capable of withstanding climate shocks and enhancing urban sustainability.

Bibliography

Alcaldía de Cartagena de Indias, MADS, INVEMAR, CDKN y Cámara de Comercio de Cartagena. (2014) Plan 4C: Cartagena de Indias Competitiva y Compatible con el Clima. Resumen ejecutivo. Editores: Zamora Bornachera, Anny Paola; López Rodríguez, Ángela; Martínez, Claudia y Lacoste, Mathieu. Cartagena de Indias. Serie de Publicaciones Generales del INVEMAR No. XX. Santa Marta. https://observatorio.epacartagena.gov.co/wp-content/uploads/2017/08/plan-4c-cartagena-de-indias-competitiva-y-compatible-con-el-clima-resumen-ejecutivo.pdf

C40 Cities Climate Leadership Group. (2016). *GOOD PRACTICE GUIDE: Climate Change Adaptation in Delta Cities*. C40 Cities. https://www.c40.org/wp-content/static/good_practice_briefings/images/5_C40_GPG_CDC.original.pdf?1456788885

C40 Cities Finance Facility. (2019). Transformative Riverine Management Projects in Durban: Background and structuring. https://c40.my.salesforce.com/sfc/p/#36000001Enhz/a/1Q000000geZs/suaKR0uDxnpADfcTvUvvYczY8E_VPVqYKCn9yn8oIzA

C40 Cities Finance Facility. (2022). A guide for cities to Durban's TRMP Business Case development process. https://c40.my.salesforce.com/sfc/p/#36000001Enhz/a/1Q000000geZt/8c8Tid2VQOlGREsnAPwY6TIKvANSczSEaL4rvZkx6Kk

C40. (2022). Durban's transformative riverine management programme: Background, structuring, and the business case. https://www.c40knowledgehub.org/s/article/Durban-s-transformative-riverine-management-programme-Background-structuring-and-the-business-case?language=en_US

City of Cape Town. (2021). *CITY OF CAPE TOWN CLIMATE CHANGE ACTION PLAN*. Communications Department, City of Cape Town. www.capetown.gov.za/ClimateChangeActionPlan

CTCN. (2022). Strengthening the resilience of cities by promoting and deploying green infrastructure in the face of climate change | Climate Technology Centre & Network | Wed, 02/17/2021 (ctc-n.org). https://www.ctc-n.org/technical-assistance/projects/strengthening-resilience-cities-promoting-and-deploying-green

Ferguson.B.K. (nd.). Reports: Permeable Pavements in Liveable, Sustainable Cities. National Parks Board. https://www.nparks.gov.sg/-/media/cuge/ebook/citygreen/cg5/cg5_03.pdf

GCA, CEF, & FEE (2022). Case Studies on Adaptation and Climate Resilience in Schools and Educational Settings. [(L. Hickey, J. Shah, S. Singh, S. Joshi, H. Trivededs (eds.)]. GCA. https://gca.org/reports/case-studies-on-adaptation-and-climate-resilience-in-schools-and-educational-settings/

Invemar, MADS, Alcaldía Mayor de Cartagena de Indicas y CDKN. (2012). *Lineamientos para la adaptación al cambio climático de Cartagena de Indias*. Proyecto integración de la adaptación al cambio climático en la planificación territorial y gestión sectorial de Cartagena de Indias. Serie de Publicaciones Generales del Invemar No. 55, Santa Marta, Colombia. 227 p.

IPCC. (2022). Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33, doi:10.1017/9781009325844.001

KFW. (2024). Project information: Mozambique Urban Development. https://www.kfw-entwicklungsbank.de/Global-commitment/Subsahara-Africa/Mozambique/Project-information-Urban-development/

Kim, D., & Kang, J. E. (2018). Integrating climate change adaptation into community planning using a participatory process: The case of Saebat Maeul community in Busan, Korea. *Environment and Planning B: Urban Analytics and City Science*, *45*(4), 669-690. https://doi.org/10.1177/0265813516683188

Lagos State Government. (2021). Lagos Climate Action Plan: Second Five Year Plan 2020-2025. Lagos: Lagos State Government. https://moelagos.gov.ng/wp-content/uploads/2021/09/C40-Lagos_Indesign-Document-Full-Report-Revert-2_Update-2.pdf

Ministry of Land. Infrastructure, Transport and Tourism. (2017). *Preventing flood damage: Case studies of initiatives*. https://www.mlit.go.jp/river/bousai/shinsuihigai/pdf/171225_zentai_lo.pdf

OCDE (2023), *« Climate adaptation: Why local governments cannot do it alone », OECD Environment Policy Papers*, n° 38, Éditions OCDE, Paris, https://doi.org/10.1787/be90ac30-en.

Piggott-McKellar, A.E., Nunn, P.D., McNamara, K.E., Sekinini, S.T. (2020). *Dam(n) Seawalls: A Case of Climate Change Maladaptation in Fiji*. In: Leal Filho, W. (eds) Managing Climate Change Adaptation in the Pacific Region. Climate Change Management. Springer, Cham. https://doi.org/10.1007/978-3-030-40552-6_4C40 Cities Climate Leadership Group. (2016). *GOOD PRACTICE GUIDE: Climate Change Adaptation in Delta Cities*. C40 Cities. https://www.c40.org/wp-content/static/good_practice_briefings/images/5_C40_GPG_CDC.original.pdf?1456788885

Resilient Cities Network (2024, October 18). Our Story. https://resilientcitiesnetwork.org/our-story/

Shin.J, and Kustar. A. (2024). *Oslo's 'Climate Budget' Is Building a Cleaner City*. World Resources Institute. https://www.wri.org/insights/oslo-climate-budget

Stein, A., & Moser, C. (2014). *Asset planning for climate change adaptation: lessons from Cartagena, Colombia.* Environment and Urbanization, 26(1), 166-183. https://doi.org/10.1177/0956247813519046

Toyooka city. (2024). *Disasters and Disaster prevention* (website). https://www.city.toyooka.lg.jp/bosai/index.html

TPF. (2020). Green Infrastructure Park in Beira City. https://tpf.pt/obra.php?n=drenagem-e-protecao-contra-cheias&p=parque-de-infraestruturas-verdes-na-cidade-da-beira&lang=en

Transport Infrastructure Ireland. (2022). *TII Climate Adaptation Strategy*. https://www.tii.ie/media/bpvf2gms/climate-adaptation-strategy-2022_v2.pdf

Transport Infrastructure Ireland. (2022). TII *Climate Adaptation Strategy: Appendix* https://www.tii.ie/media/tarh1z5n/tii-climate-adaptation-strategy-2022_appendix.pdf

University of Notre Dame Global Adaptation Initiative-NDGAIN (2023). *ND-GAIN Adaptation Brief: Cities and Climate Change Project 3CP: Rio Chiveve and Green Urban Infrastructure Project*. https://gain.nd.edu/assets/565162/nd_gain_adaptation_brief_mozambique.pdf

World Bank Group. (2023). *Flood Risk Management in Argentina: An evolutionary road to an integrated approach.* Results Briefs. https://www.worldbank.org/en/results/2023/12/19/flood-risk-management-in-argentina-an-evolutionary-road-to-an-integrated-approach

List of Figures

List of Tables

Mobilise Your City

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE
Liberté
Égalité
Fraternité

ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

Codatu

RESALLIENCE