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Parallel Session A8

Climate change adaptation, resilience-building and disaster risk reduction for ports

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Climate Change Adaptation, Resilience-Building and DRR for Ports

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Climate Change impacts in the Caribbean: key threats to consider

- **Temperature Rise:** The average temperature in the Caribbean has increased by approximately 1.5°C since the mid-20th century. Future projections: expected further increases of 1.4°C to 3.2°C by the end of the century depending on global emission scenarios.
- **Rainfall Patterns:** Changes in rainfall patterns have led to more intense and frequent droughts in the Caribbean, impacting water availability, agriculture, etc. The 2015-2016 drought in Jamaica led to a significant reduction in crop yields, with some areas experiencing a 30-40% drop.
- **Sea Level Rise:** SLR is increasing faster in the Caribbean , projected figures averaging 0.5 to 1.5m by the end of the century.
- **Hurricane Intensity:** The frequency of Cat 4 and 5 hurricanes in the Caribbean has increased by approximately 30%, leading to more severe storm surges, wind damage, and flooding.
- **Economic Impact:** Hurricanes alone have caused damages exceeding $137 billion over the last few decades, but droughts have also led to important calamities.
- **Coral Reef Bleaching :** About 50% of the Caribbean's coral reefs have already been lost due, projections suggest that up to 90% of coral reefs could be severely degraded by 2050.
- **Biodiversity Loss:** Estimates suggest that CC could lead to the extinction of up to 10-15% of Caribbean species by 2100.
- **Migration:** Climate change is expected to drive migration in the Caribbean. By 2050, up to 1.4 million people may be displaced due to climate impacts such as sea level rise, hurricanes, and droughts.

Adaptation and Resilience in infrastructure investments

- Investing in Adaptation and Climate Resilience Shows a Cost Benefit Ratio of Four to Seven Dollar per Dollar Invested.
- A total of USD 1.8 trillion of investment opportunities in adaptation in five sectors, with an average economic return of 4:1 (Global Commission on Adaptation, 2019). Yet, less than 2% of annual infrastructure investment has integrated climate resilience principles.
- Tracked flows of finance for adaptation by the private sector remain limited, with one estimate finding them to represent less than 3% of adaptation activities, globally (Climate Policy Initiative, 2023).

Mainstreaming Adaptation in Policy

- **Develop and Incorporate Climate Adaptation into Planning:** Embed climate adaptation goals in national development plans, sectoral strategies, and local government policies.
- **Establish Legal and Regulatory Frameworks:** Develop and enforce laws and regulations that mandate climate adaptation measures in infrastructure, land use, water management, agriculture, and other sectors
- **Allocate Funding and Resources:** Create dedicated funding streams for climate adaptation projects through national budgets, international aid, and public-private partnerships.
- **Strengthen Institutional Capacity:** Build the capacity of government institutions at all levels to understand and address climate risks. This includes training staff, hiring climate experts, and establishing dedicated adaptation units. Foster interdepartmental coordination to ensure a cohesive approach to climate adaptation across sectors and agencies.
- **Promote Stakeholder Engagement and Public Participation:** Engage communities, civil society, and the private sector in the development and implementation of adaptation policies. This ensures that policies are inclusive, locally relevant, and have broad support.
- **Integrate Climate Data and Risk Assessments:** Use climate projections, vulnerability assessments, and risk maps to inform policy decisions. Ensure that this data is accessible to all relevant stakeholders. Including EWS.
- **Monitor, Evaluate, and Report on Progress:** Establish monitoring and evaluation frameworks to track the effectiveness of adaptation policies and measures. Use indicators and benchmarks to assess progress.
- **Foster Research and Innovation:** Support research on climate impacts, adaptation strategies, and innovative technologies. Collaborate with academic institutions, research organizations, and the private sector.
- **Mainstream Adaptation in Education and Capacity Building:** Integrate climate adaptation into educational curricula and professional training programs to build a knowledgeable workforce.
- **Promote International Cooperation and Learning:** Participate in international climate forums and networks to share experiences, access funding, and learn from other countries' adaptation efforts.
- **Integrate Adaptation into Disaster Risk Management:** Link climate adaptation with Sendai Framework implementation

Mainstreaming resilience in the policy process

Data Projections

- Collect & generate data on climate change: downscale climate projections to a national and subnational level. Context is CRUCIAL for tailor made approaches that will allow for greater adaptation strategies that will increase resilience
- Conduct thorough risk assessments to identify vulnerabilities to climate change impacts such as sea level rise, extreme weather events, and temperature fluctuations.

Decision Making

- Development of a decision-making tools, for example the Blue Spot through the comparison and prioritization of alternative interventions in the transport network, taking into account the adaptation of the network to threats of geophysical origin and Hydrometeorological with climate change scenarios.

Design

- Design port facilities at higher elevations to mitigate the risks posed by sea level rise and storm surges, Implement advanced drainage systems to handle increased rainfall and prevent flooding, Use resilient building materials and construction techniques to withstand extreme weather conditions, Integrate Nature based Solutions, etc

Execution

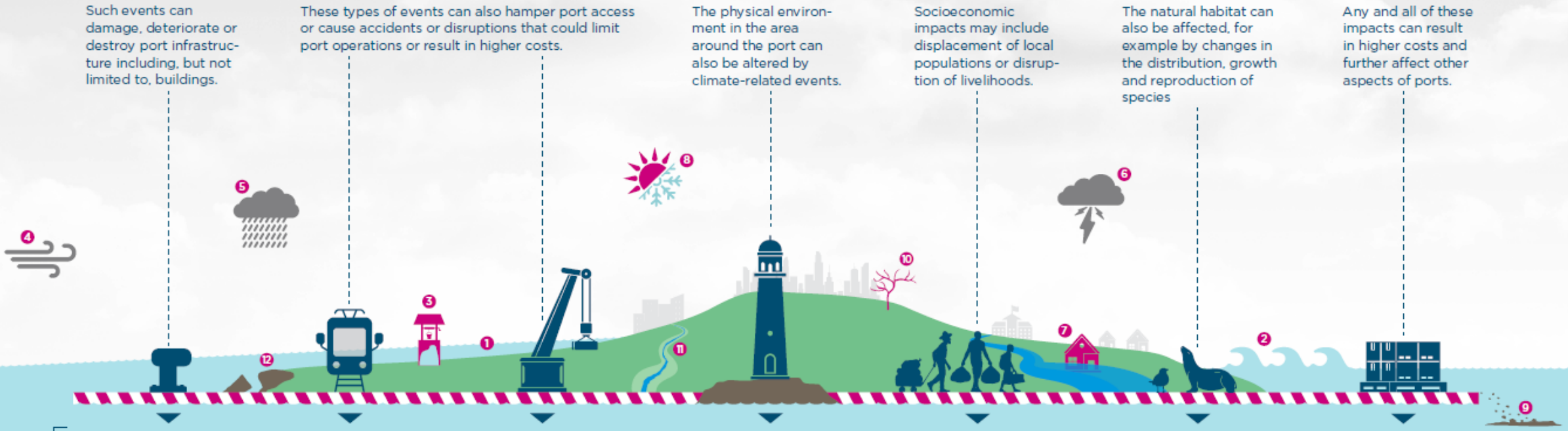
- Ensure all design and considerations are included, include a system of metrics to follow up

Maintenance

- Implement regular monitoring programs to detect early signs of wear and tear caused by climate impacts. Use sensors and remote monitoring technologies to track the condition of infrastructure.
- Schedule regular maintenance to address issues before they escalate, focusing on critical components that are most vulnerable to climate impacts.

POTENTIAL CLIMATE CHANGE EVENTS AND IMPACTS

EXAMPLES OF EVENTS THAT CAN AFFECT PORTS:
❶ sea level rise ❷ storm surge ❸ saltwater intrusion ❹ strong winds ❺ heavy rains ❻ electrical storms
❼ river flooding ❽ extreme temperatures ❾ sedimentation ❿ drought ⓫ reduced river flows ⓬ coastal erosion



ELEMENTS:	PORT INFRASTRUCTURE	PORT ACCESS	PORT OPERATIONS	PHYSICAL ENVIRONMENT	SOCIOECONOMIC FACTORS	NATURAL ENVIRONMENT	OTHERS
	Such events can damage, deteriorate or destroy port infrastructure including, but not limited to, buildings.	These types of events can also hamper port access or cause accidents or disruptions that could limit port operations or result in higher costs.		The physical environment in the area around the port can also be altered by climate-related events.	Socioeconomic impacts may include displacement of local populations or disruption of livelihoods.	The natural habitat can also be affected, for example by changes in the distribution, growth and reproduction of species	Any and all of these impacts can result in higher costs and further affect other aspects of ports.
POTENTIAL AREAS OF IMPACT:	• Breakwater • Quay • Yard • Goods storage area • Equipment • Buildings • Electrical infrastructure • Drainage infrastucture	• Roads/pavement • Railways • Inland waterways • Reduced navigability • Dredging requirements • Restrictions to vessel size	• Navigation conditions • Berthing and mooring • Loading and unloading activities • Inland transport beyond the port • Goods storage • Energy costs • More difficult working conditions	• Coastline • Estuary area/shoreline • River area/riverbanks	• Population (e.g. displacement) • Marine economic activity • Inland economic activity • Demand/ trade/market patterns • Social performance • Fisheries and related infrastructure	• Habitats • Protected habitats • Species (e.g. fish, birds) • Protected species	• Insurance cost or availability • Port reliability • Port reputation • Increased fire risk

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ADAPTATION ACTIONS IN PORTS[9]

1 COMPILE CLIMATE RECORDS, BEGIN CLIMATE CHANGE MONITORING AND DOWNSCALE CLIMAT ECHANGE MODEL TO THE LOCAL LEVEL

PURPOSE: to increase knowledge of historical data, climate trends and possible future climate conditions, so as to more accurately evaluate the likelihood, severity and magnitude of potential impacts and the timeframe required for implementing mitigation and adaptation measures.

POTENTIAL ACTIONS: search historical climate records and analyze trends; invest in data collection (buoys, thermometers, anemometers, water characteristics analysis, etc.); regularly evaluate climate change projections (IPCC or others).

USEFUL TIPS: gather several years, or even decades, of available data; collect data using different metocean variables (wind, waves, climate, ice); downscale the data as much as possible to evaluate specific impacts to key port areas; conduct continuous data collection.

2 PREPARE HAZARD ASSESSMENTS FOR INFRASTRUCTURE, ASSETS AND OPERATIONS

PURPOSE: to regularly assess possible hazards that could affect existing or planned infrastructure and assets, in order to identify possible changes and upgrades needed in design, adaptation or operations.

POTENTIAL ACTIONS: analyze design parameters for each critical infrastructure to identify thresholds; address maintenance issues; take corrective actions to reduce operational incidents and increase resilience.

USEFUL TIPS: increase the number of assets evaluated, the frequency of evaluation and the number of potential hazards considered.

3 ADJUST INFRASTRUCTURE, DESIGN, OPERATIONS AND MAINTENANCE ACTIVITIES IN LINE WITH POSSIBLE HAZARDS (I.E. SEA LEVEL RISE, STORM SURGES, STORM FLOODING, HEAVY RAIN, EXTREME WAVES, RIVER FLOODING, STRONG WINDS)

PURPOSE: to adapt, modify or strengthen existing or planned infrastructure, operations and maintenance in anticipation of future climate change conditions of sea level rise, storm surges, storm flooding, heavy rain, extreme waves, river flooding, strong winds and other hazards so as to minimize impacts.

POTENTIAL ACTIONS: raise aprons and breakwaters to protect against flooding and wave overtopping; design decks with relief slots, drain holes, valves or wave walls; raise critical assets (e.g. back-up generators, pumphouse); and relocate or raise elevation of access roads and storage facilities.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate cost reductions, including reductions in annual cost of damages related to specific hazards ($/year) and reductions in lost days of operation due to these hazards (%).

4 DESIGN ACTIVITIES, OPERATIONS AND MAINTENANCE RELATED TO COASTAL OR BANK EROSION

PURPOSE: to adapt, modify or strengthen existing or planned infrastructure, operations and maintenance in line with future climate change conditions related to coastal or bank erosion, to minimize impacts.

POTENTIAL ACTIONS: raise or strengthen bridges, decking, jetties, revetments, dams, spillways, superstructures, roads, railways; provide surface protection to banks and other structures to resist internal and external erosion, including under asymmetrical loading; use nature-based resilience, for example by creating offshore berms or barrier islands or supplementing or enhancing marsh, mangrove or other intertidal habitats; divert excess flows to flood storage areas; provide hydraulic structures of an adequate capacity to pass water under a canal; co-locate critical systems.

USEFUL TIPS:
establish appropriate indicators to monitor and evaluate the area of port lost due to coastal erosion or bank erosion per year; calculatereductions in annual cost of damages related to coastal or bank erosion ($/year) and reductions in lost days of operation due to coastal or bank erosion (%).

5 DESIGN ACTIVITIES, OPERATIONS AND MAINTENANCE RELATED TO HEAT WAVES

PURPOSE: to adapt existing or planned infrastructure, operations and maintenance to future conditions of heat waves, with benefits that include reduction of damages and improved working conditions.

POTENTIAL ACTIONS: incorporate heat- or drought-resistant vegetation; provide shade, using nature-based solutions where practicable; improve thermal efficiency; design for temperature regulation; improve insulation or ventilation; install air-conditioning or cooling systems on vessels and in offices, storage facilities, etc.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate reductions in annual cost of damages related to heat waves ($/year), reductions in lost days of operation related to heat waves (%), reductions in number of employees at high risk of heat stress (#) and variations in work productivity related to heat stress (%).

6 DESIGN ACTIVITIES, OPERATIONS AND MAINTENANCE RELATED TO SEDIMENTATION AND REDUCED RIVER FLOWS

PURPOSE: to adapt existing or planned infrastructure, operations and maintenance to future conditions of sedimentation and reduced river flows, with co-benefits such as cost optimization and port reliability.

POTENTIAL ACTIONS: remove redundant structures that promote deposits of sediment or debris; educate local communities about consequences of trash disposal around watercourses; prevent debris washing into navigable areas; introduce diversions, one-way systems or temporary closures of ports or waterways.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate reductions in annual cost of damages related to sedimentation and reduced river flows ($/year) and reductions in lost days of operation due to sedimentation and reduced river flows (%).

[9] Adapted from The World Association for Waterborne Transport Infrastructure (PIANC). (2020). Climate Change Adaptation Planning for Ports and Inland Waterways.

7 DESIGN ACTIVITIES, OPERATIONS AND MAINTENANCE RELATED TO INCREASED SALINITY, ACIDIFICATION, SEA TEMPERATURE CHANGES, SEA SPRAY AND OTHER HAZARDS

PURPOSE: to adapt existing or planned infrastructure, operations and maintenance to future conditions that result from changes in salinity, acidification, sea temperature changes and sea spray, among others, with co-benefits that include reducing the number or severity of damages to port infrastructure.

POTENTIAL ACTIONS: select construction materials tolerant to salinity and acidification; review, revise and prioritize maintenance for assets that are vulnerable to these conditions; develop contingency plans covering future loss of protective role of coral reef (wave attenuation).

USEFUL TIPS: establish appropriate indicators to monitor and evaluate reductions in annual cost of damages related to increased salinity, acidification, sea temperature changes, sea spray and other such hazards ($/year) and reductions in lost days of operation due to these hazards (%).

8 PROTECT COASTLINE AND RIVER OR ESTUARY BANKS THROUGH BOTH HARD AND SOFT ADAPTATION MEASURES

PURPOSE: to protect the shoreline or riverbanks from wave energy to avoid adverse impacts in the project area, with co-benefits that include reducing or avoiding exposure to coastal flooding or fluvial flooding, mitigating social and environmental impacts, and adding recreational and aesthetic value.

POTENTIAL ACTIONS: analyze and adopt both soft and hard engineering measures to improve adaptation. Soft engineering measures are actions that do not radically change the environment or counteract natural processes. Examples include adding sediment to beach areas with shoreline erosion; restoring natural and artificial dunes; restoring ecosystems (i.e., saltmarshes or mangroves and seagrasses) or planting riparian vegetation; and protecting coral reefs. Hard engineering measures involve human-built, rigid and complex infrastructures that intervene in coastal processes by altering wave energy. Examples include shore-parallel detached or offshore structures (breakwaters) to reduce incoming wave energy at the shoreline; dikes to protect adjacent low-lying areas from inundation under extreme conditions; and jetties at the banks of tidal inlets and river mouths to trap a portion of the longshore sediment to stabilize the inlet and prevent silting of the channel.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate reductions in annual cost of damages related to modification of coastline and river or estuary banks ($/year) and reductions in lost days of operation related to this indicator (%).

9 LOCAL COMMUNITY INVOLVEMENT

PURPOSE: to involve local communities to ensure that the project meets local requirements and enhances opportunities for employment, benefiting the local economy and improving quality of life.

POTENTIAL ACTIONS: devise plans for stakeholder and community engagement, outreach activities, regular focus group meetings and capacity-building.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate increases in local household income (%), available jobs in the port area (%), diversity of businesses (%) and growth of port-related local companies (%).

10 WORK IN PARTNERSHIP WITH OTHER RELEVANT STAKEHOLDERS

PURPOSE: to build partnerships and networks with relevant stakeholders (e.g., local governments, civil society, academia, supply chain logistic stakeholders) and collaborate in developing strategies to adapt to climate change.

POTENTIAL ACTIONS: design connected logistics hubs; create local knowledge related to climate change; develop innovation tools and practices for vulnerability and risk management. Co-benefits include resource efficiency and more effective outcomes.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate such factors as the number of collaborative strategies developed with key stakeholders and resource efficiency (in economic terms) in implementing climate change adaptation actions.

11 CREATE DIVERSIFIED PORTS THROUGH THE DEVELOPMENT OF SUSTAINABLE BUSINESS OPPORTUNITIES THAT HELP TO PROTECT THE NATURAL ENVIRONMENT AND BENEFIT THE LOCAL ECONOMY

PURPOSE: to create sustainable businesses in the port areas in order to protect the natural environment, increase awareness and provide socioeconomic benefits through new development opportunities.

POTENTIAL ACTIONS: promote the development of tourism businesses such as whale watching, scuba diving centers and boat excursions. Co-benefits include promoting environmental conservation and improving the local economy.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate the number of sustainable business created; the growth of local companies related to the port (%); the number of ecosystems and species recovered; and the increase in tourism.

12 INSURANCE MANAGEMENT

PURPOSE: to analyze financial exposure in light of the probability of climate change impacts and identify maximum loss value of assets or revenue, in order to manage insurance costs and coverage, reduce exposure and optimize costs.

POTENTIAL ACTIONS: conduct a risk assessment to analyze the potential exposure of each asset to the main potential hazards; determine acceptable levels of risk (risk tolerance) for each hazard; verify and strengthen insurance coverage, including replacement and business interruption coverage; document the port's assets via video or photo in the case of claims; establish or improve crisis management plans to take into account priority hazards.

USEFUL TIPS: establish appropriate indicators to monitor and evaluate the number of operations with insurance for extreme weather events and the percentage of uncovered risks (%).

[9] Adapted from The World Association for Waterborne Transport Infrastructure (PIANC). (2020). Climate Change Adaptation Planning for Ports and Inland Waterways.

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Thank you