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 (%).

PORT INFRASTRUCTURE | PORT ACCESS | PORT OPERATIONS | PHYSICAL ENVIRONMENT | SOCIOECONOMIC FACTORS | NATURAL ENVIRONMENT | OTHERS

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.

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ADAPTATION ACTIONS IN PORTS[9]

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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