



*Sergio Moreno*

# Factsheet Resilience Solutions for the **Port Sector** in **Colombia**

This Factsheet is a part of the Private Markets for Climate Resilience (PMCR) project to evaluate systematically the potential market for climate resilience solutions in the private sector. Focusing on agriculture and transportation, current practices and opportunities highlight products, services and finance in six emerging markets — Colombia, the Philippines, South Africa, Nicaragua, Kenya, and Vietnam.



Nordic Development Fund



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# Port sector in Colombia

The port sector plays a key role in Colombia's economy and international trade. It is estimated that 93% of Colombia's international trade is managed via seaports, of which 90% goes through the Caribbean ports. According to CEPAL, during 2018, Colombia had the fourth highest level of cargo handling activities in Latin America, only surpassed by Brazil, Mexico and Panama. It is estimated that by 2020, Colombia's import cargo will increase by 126% and export cargo by 79%.

Climate change impacts are expected to influence the design, development, construction, operations and management of ports in Colombia. For example, sea level rise and freshwater flooding pose a risk for business continuity for several Colombian ports. Moreover, the lack and excess of rain along watersheds draining to certain port areas during El Niño and La Niña events and changes in sediment charges are also affecting the sector.

Port management is a reputational business. Ports with a good and "safe" reputation will have vessels and cargo moving constantly. On the other hand, ports that are not considered

"safe" will have vessels and companies going to the nearest safest port. Weather and climate-related events, including storms, droughts, extreme temperatures, and other, have the potential to create significant and long-term damage to the reputation of ports and, consequently, impact the profitability and sustainability of the port sector. As seaports in Colombia are managed through private concessions, there is a good opportunity to structure public-private partnerships (PPPs) and to mainstream climate resilience in the sector, particularly in the context of new development areas.

Colombian ports are ranked 58th in the Global Competitiveness Index and second in Latin America, after Panama. Colombian ports have become important hubs in the Americas, as a result of completed investments on port infrastructure and services. Moreover, due to the proximity of the Panama Canal, and being located in a region that does not experience hurricanes, the competitiveness of Colombian ports has been further strengthened. For example, when the Caribbean ports, including Miami, are closed due to hurricane warnings, the Colombian ports are open and are a key regional port hub. While significant investments are taking place in the sector, to further increase the competitiveness of the sector, significant investments are needed, particularly in modern equipment, upscaling infrastructure, technology systems, cargo handling services and efficiencies, and reducing customs-related processes. Connectivity with other transport modes within the country is another challenge that needs to be addressed by transport authorities.

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***"Identifying and implementing adaptation measurements in the port sector represents a critical aspect to guarantee the country's competitiveness in a changing climate"*** **Carlos Andrés García,**  
**Ports & Logistics Consultant**

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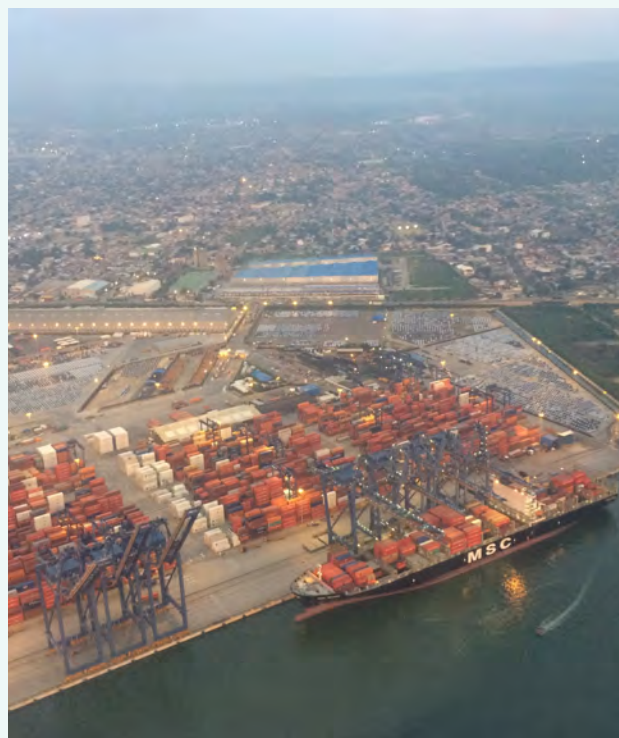
## Sector facts (2018)

### Number of seaports and terminals:

11 seaport areas, which include 54 terminals. The most important port areas are Barranquilla and Cartagena in the Caribbean (31 Terminals), and Buenaventura in the Pacific (8 Terminals).

**Total cargo handled:** 200 million tons of cargo and approximately 5 million containers.

**Type of cargo:** bulk coal (51%), liquid bulk (27%), containers (10%), bulk cargo (9%), and general cargo (3%). Out of total cargo managed, exports represented an estimated 77% and imports 23%.

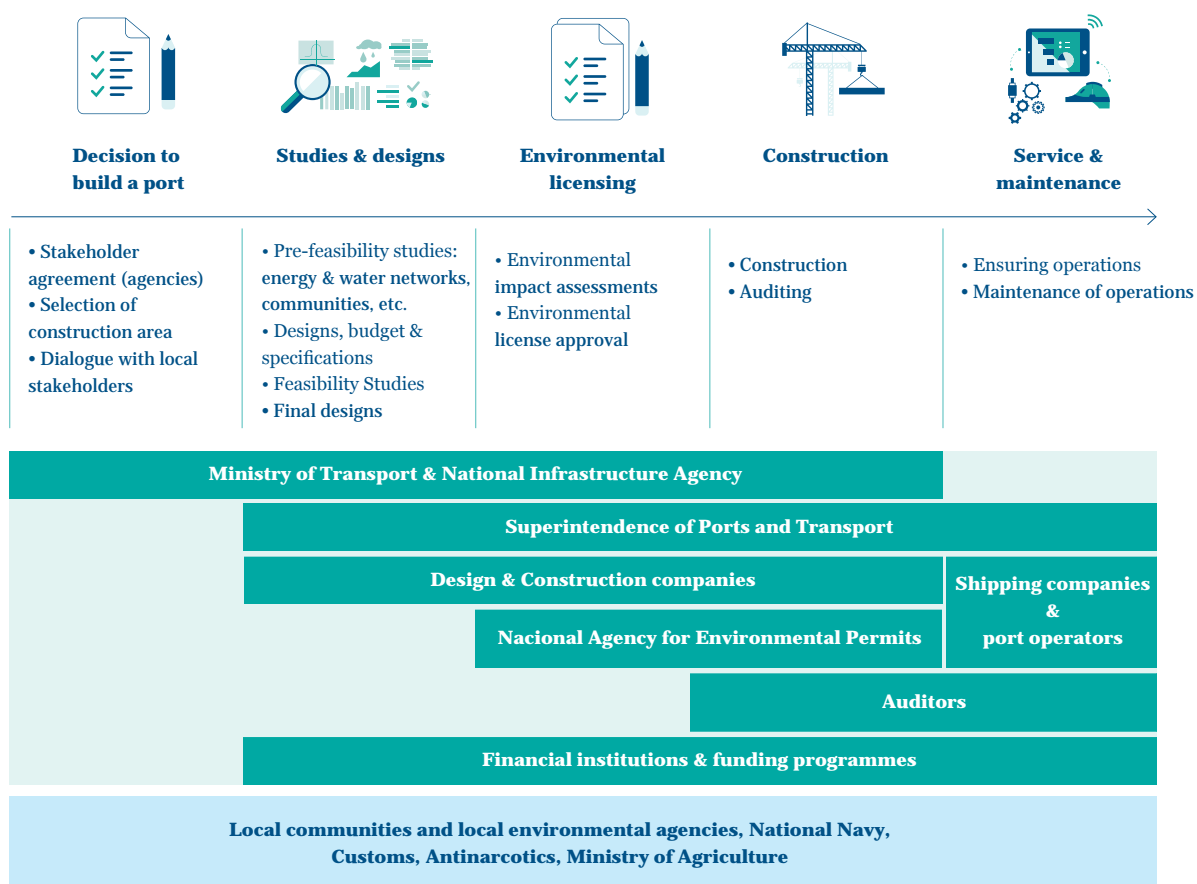


Cartagena Port from the air. Carmen Lacambra 2017

For a list of references, see the References Section of the PMCR Report.

# The port value chain

Below are presented the main decision processes, activities and actors in the Colombian port sector.



## Normal environmental conditions for operations

- Pacific region:** annual precipitation ranges between 3,000-9,000 mm, with limited seasonal variation, average annual temperature is 26-28°C, and tides are semidiurnal with an amplitude of 3-3.6 m.
- Caribbean region:** annual precipitation ranges between 500-4,000 mm in two seasons, with a drier season from January to March. Average temperatures range between 27-34°C, and tides are mixed and micro-tidal (34-60 cm).

## Changes in weather and climate conditions that could affect operations

- Changes in *rainfall patterns* have an impact on the sector, as *rains* delay construction and *droughts* hamper operations. Increased precipitation by 30% in the Caribbean region and 20% in the Pacific Region are expected. Plus, projections indicate that cyclonic surges will exceed 13-15 cm in height, which could significantly affect port operations.
- As an example of changes in rainfall patterns, during the La Niña event of 2010-2012, access to some ports was difficult due to floods. Moreover, during El Niño even in 2016, some terminals along the Caribbean coast were inaccessible due to lack of water.
- Extreme temperatures** have a negative impact on seaport operations, affecting cargo handling and deteriorating working conditions. Annual temperatures are projected to increase in all Colombian regions, from 0.7 to 1.1°C in a low-emission scenario, and from 0.9 to 1.3°C in high-emission scenario.

## Main climate-related impacts affecting the value chain

- Climate-related hazards occurring in Colombian ports include *windstorms*, *floods*, *droughts*, *coastal erosion*, *storm surges*, *sea level rise*, *coastal flooding* and *hurricanes*. Each port has different vulnerabilities to extreme events and sea-level rise depending on its location, preparation and capacity to respond.
- Port operators understand that weather and oceanographic conditions play a crucial part in their operations. *Excess rainfall*, *windstorms* and changes in *wind speeds* have an impact on cargo handling (i.e. loading and unloading activities).
- While *saline intrusion* and *ocean acidification* have been identified as potential threats to port operations related to climate change, limited attention has been given to these issues by port constructors and operators or authorities.
- Along the Caribbean region, *sea-level rise* is a concern. In addition to climate-related impacts, population growth has led to the elimination of natural barriers against flooding and erosion.

“A vessel can depart Colombia with a temperature over 40°C and arrive within a week to freezing temperatures in New York. The industry works with known extremes”. **Norman Jimenez, Chief of Operations, Navesco**



# B\*Resilient Process Model

Each decision process of the port sector was assessed using the B\*Resilient Process Model (BRPM), in order to identify the climate risks associated with each phase and the resilience options and tools available to address these risks, as well as to achieve specific resilience outcomes. The BRPM analysis of the **Construction process** is presented below.

## Resilience outcome

### Building a climate-resilient multipurpose port operating all year around

## Process Construction



#### Phase I

#### Design revision & site preparation

#### Phase II

#### Preparations for construction

#### Phase III

#### Build land and marine infrastructure

## Risks

Strong winds, excess rain, storm surge, extreme events, coastal erosion

Saline intrusion and sea level rise

Drought and heat waves

Accidents or unacceptable working conditions due to weather

## Main Actors

Port construction company, auditors, National Agency for Environmental Permits, National Infrastructure Agency & local environmental authorities

## Options & Tools

Environmental Impact Assessments  
Climate proofing of designs, material selection, checklists.  
Rising terminals, foundation underpinning, alternative routes of access, shoreline profiles, projections and simulation analysis.  
Flood maps, flood/storm surge benchmarks, understanding coastal processes.

Checklist  
Construction protocols, norms and regulations  
Acts of deliverables.  
Location of material, personnel, equipment, offices in safe areas  
Health and safety measures & protocols, adequate equipment  
Checklists, early warning systems, construction guidelines and standards  
Appropriate drainage, sea defenses, coastal vegetation, evacuation routes and protocols

**“P**orts are aware of the consequences of extreme events and have protocols and clear processes to minimize their impact. Through history, the industry has always faced extreme events and has evolved with them. If a seaport has a bad safety reputation, the ships will not arrive at that port.” **Norman Jimenez, Chief of Operations, Navesco**



Cienaga Port from the air. Carmen Lacambra 2017

# Resilience solutions

Identified resilience solutions in the port sector in Colombia vary from knowledge services to *early-warning systems*, *real-time climate monitoring* and *weather equipment*, among many others. Depending on the port cargo specialization and location, the resilience solutions were found to be different. For example, detailed assessments for ports in the Caribbean coast might prioritize other options than ports in the Pacific coast.

**Leading resilience solutions:** *Knowledge services, infrastructure refitting during maintenance works and sediment monitoring services.*

## **Knowledge services**

Knowledge services provided during the design and operations processes include creating awareness and providing advice on reducing the potential costs and impacts of climate change. The port industry is largely founded on safety and reliability. As climate-related events and their impacts threaten reliability, affecting port operations and even creating temporary disruptions. Climate-related events and their consequences can reduce this reliability when such events affect port operations or create temporary disruptions.

**Resilience contribution:** Knowledge services can provide a wide range of support and capabilities to port designers, constructors and operators, in taking short, medium and long-term measures to maintain port operability and profitability, and strengthen resilience in the sector.

## **Infrastructure refitting and upgrading**

Coastal conditions require constant maintenance of port infrastructure to ensure undisrupted operations and to maintain competitiveness. Infrastructure refitting and upgrading while performing maintenance is a cost-effective way of adapting ports to the impacts of climate change. Refitting and upgrading activities as part of regular port maintenance activities are often more economically viable than large-scale standalone projects or measures with no direct economic benefit. Port operators can choose between addressing risks related to climate change in the medium-term by upgrading and refitting port infrastructure during maintenance activities or addressing risks in the longer-term by investing in standalone projects involving adaptation solutions. The latter option involves decision-making under greater uncertainty and higher costs.

**Resilience contribution:** Infrastructure refitting and upgrading measures provide an economically viable and efficient option for strengthening the resilience of the port sector.



## **Greatest opportunities related to resilience solutions**

- There is a market for both knowledge services and infrastructure upgrading and refitting, as the entire port sector could benefit from the enhanced resilience, against expected and unexpected climate change impacts, provided by both solutions.
- The sector lacks baseline information and, consequently, sector actors operate under greater uncertainty regarding climate impacts. The lack of information leads to inaction and constraints in timeframes and size of investments. In practice, capital is more readily available for short-term adaptive management alternatives, such as the identified refitting and upgrading measures, as these are inherently smaller in scale and require less capital for shorter timeframes than larger standalone projects.
- However, while short-term upgrading and refitting projects are less costly and potentially offer more flexibility in the face of uncertainty than long-term one-off adaptation solutions, the resilience effect of the latter could be more significant.
- Public policy is rapidly advancing and there is increasing awareness and advocacy at the national government level. These trends are being documented in the Adaptation Plan for the sector and the National Dredging Plan (in the pipeline since 2016), which aims to provide guidance on sustainability, contracting, monitoring-control-planning, financing and safety.

### **Sediment monitoring services**

In terms of operational continuity, sediment monitoring is key, particularly for ports that are in or near deltas and that require regular dredging. Coastal sedimentation is mainly attributed to the deforestation and erosion of river watersheds draining into port areas. Sedimentation is further aggravated by extreme weather events and climate change that are expected to increase the magnitude of rainfall, erosion and sedimentation. Sediment monitoring programs are designed to improve the understanding on the changes in the dynamics affecting port operations and the planning of mitigating measures, by applying improved data, information and models.

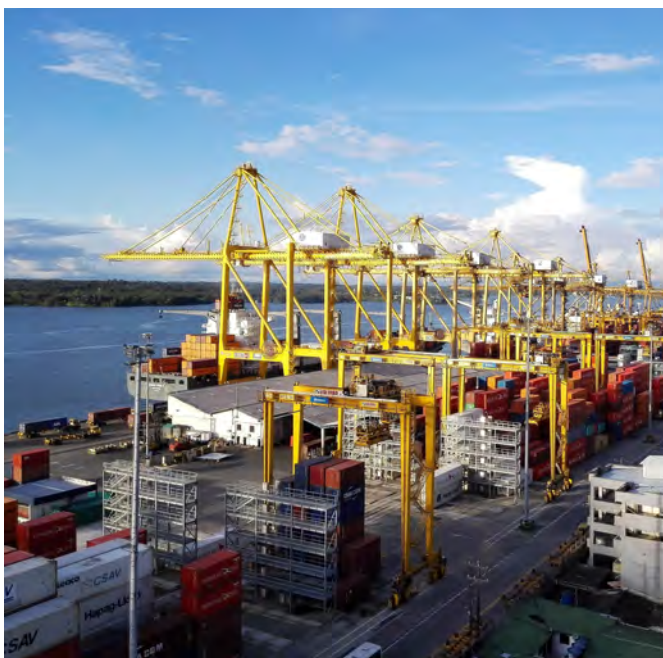
### **Greatest opportunities related to sediment monitoring services**

- By monitoring sedimentation levels, port operators are able to plan dredging procedures and avoid delays, disruptions and or expensive large-scale dredging procedures. Outputs of sediment monitoring activities consist of bathymetry maps, showing the underwater depth of sea floors, and reports that allow port operators to take relevant action.
- Accurate information allows financially efficient and sustainable decision-making. For example, a planned dredging operation costs on average 50-66% less than a non-planned responsive operation. Moreover, planned dredging can also reduce environmental impacts related to the procedure and the disposal of the dredged material.
- In the port sector in Colombia, special attention is drawn to Environmental Impact Assessments, which must include risk maps and comply with the regulations of the National Authority of Environmental Licensing (ANLA), as well as sediment monitoring and planned dredging, given the increasing need for dredging in several of the main ports.



### **Main challenges related to the resilience solution**

- The lack of information regarding climate-related risks and resilience solutions are widespread both in the context of private stakeholders and public authorities. In practice, all sector stakeholders are in a period of transition in understanding how climate change, sea level rise and climate variability impact operations in the port sector and identifying the best options to respond to these challenges.
- Small companies are the main providers of sediment monitoring and other knowledge and technical services.
- Small innovation companies have limited support from the government as regulations are generally designed to support larger companies. For example, smaller and younger local companies have difficulties in fulfilling the conditions and requirements of public tenders because project requirements, specified by government authorities, are often designed for larger companies with significant resources and a wider range of services.
- Small companies have difficulties in recruiting and retaining qualified staff.



Buenaventura Port. Carlos A. García

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**“**Year after year, we are seeing more and more accumulation and transport of sediments in the bay, we think this is the result of two processes: increase in rainfall and deforestation upriver and in the mountains surrounding the bay.” **Miriam Mosquera, Environmental Chief, Sociedad Portuaria de Buenaventura**

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