Building a more Resilient and Low-Carbon Caribbean

Report 4 : Infrastructure Resilience in the Caribbean through Nature Based Solutions

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Infrastructure and Energy Sector

Energy Division

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Social Infrastructure

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REPORT 4

Infrastructure Resilience in the Caribbean through Nature Based Solutions

Jed Bailey, Christina Becker-Birck, Devindranauth Bissoon, Ashley Fox, Christiaan Gischler, Dave Hampton, Mathew Lee, Livia Minoja, William Sloan

IDB

Background

According to the 2020 United Nations Office for the Coordination of Humanitarian Affairs (OCHA) report "Natural Disasters in Latin America and the Caribbean", between 2000 and 2019, a total of 330 storms affected the Caribbean region, including 148 tropical storms and 181 hurricanes (an average of 17 hurricanes per year) of which 23 reached category 5, impacting a total of 34 million people during that period. The 2017 hurricane season was the third worst on record in terms of the number of disasters and countries affected, as well as the magnitude of damage. The 2020 Atlantic hurricane season was the most active and fifth costliest in history. It was also the fifth consecutive above-average Atlantic hurricane season since 2016. There is a trend for which the storms affecting Central America and the Caribbean are becoming more powerful and producing more rainfall with greater frequency, reducing the time for recovery between events in the affected countries.

These events are particularly adverse for the island nations of the Caribbean, which are especially vulnerable due to their geographic and socioeconomic characteristics. In 2019, for example, Hurricane Dorian became the most powerful Atlantic hurricane to directly impact a landmass on record. In the Bahamas alone (one of the most affected countries) it caused USD 2.5 billion in losses. According to the United Nations report "Global Assessment for Disaster Risk Reduction" of 2015, on average the Caribbean has losses in infrastructure due to natural disasters (hurricanes, earthquakes, tsunamis and floods) of 12.5 billion dollars each year.

Within this context of high vulnerability and worsening Climate Change (CC) impacts, building resiliency is critical to prioritize for the Caribbean countries.

The series "Building a more resilient and low-carbon Caribbean", focuses on the resiliency, sustainability and decarbonization of the construction industry in the Caribbean. It is the result of a close collaboration between the IDB Social Infrastructure Unit (SIU), a team of architects and engineers that provide specialized technical support to programs that includes social infrastructure components, and the IDB Energy Division (ENE), that works in projects addressing the sustainability and decarbonization pathways of infrastructure projects.

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The first three reports of the series[1] analyze the economic losses caused by climate related events, the benefits of improving building resiliency to reduce those economic losses and the benefits of subsidized financing for resilient buildings in the Caribbean. The results show that increasing building resiliency is economically viable for Caribbean islands at high-risk from natural disasters, generating long term savings and increasing the infrastructure preparedness to the impacts of climate change.

This report – Report 4: Infrastructure Resilience in the Caribbean through Nature Based Solutions - extends the previous analysis to examine the potential role for nature based solutions (NBS) in the region. The report first defines NBS in the context of the Caribbean construction industry. It then considers specific NBS options that could be viable in the region. Next, the report reviews the status of NBS related projects in the Caribbean, including efforts supported by the IDB. This analysis also identifies several barriers to the development of NBS in the region. Finally, the report suggests measures that can be taken to address these barriers and increase the use of NBS in the Caribbean. The report draws from and extends analysis of NBS from the study "Infrastructure Resilience in the Caribbean through Nature Based Solutions and Sustainable Building Materials" initiated in 2020, developed by Cadmus with support from the IDB.

1 Report 1: Climate Resiliency and Building Materials in the Caribbean

Report 2: Analysis of the Benefits from Resilient Building Materials and Construction Methods in the Caribbean

Report 3: Impact of Subsidized Financing to Support Resilient Buildings in the Caribbean

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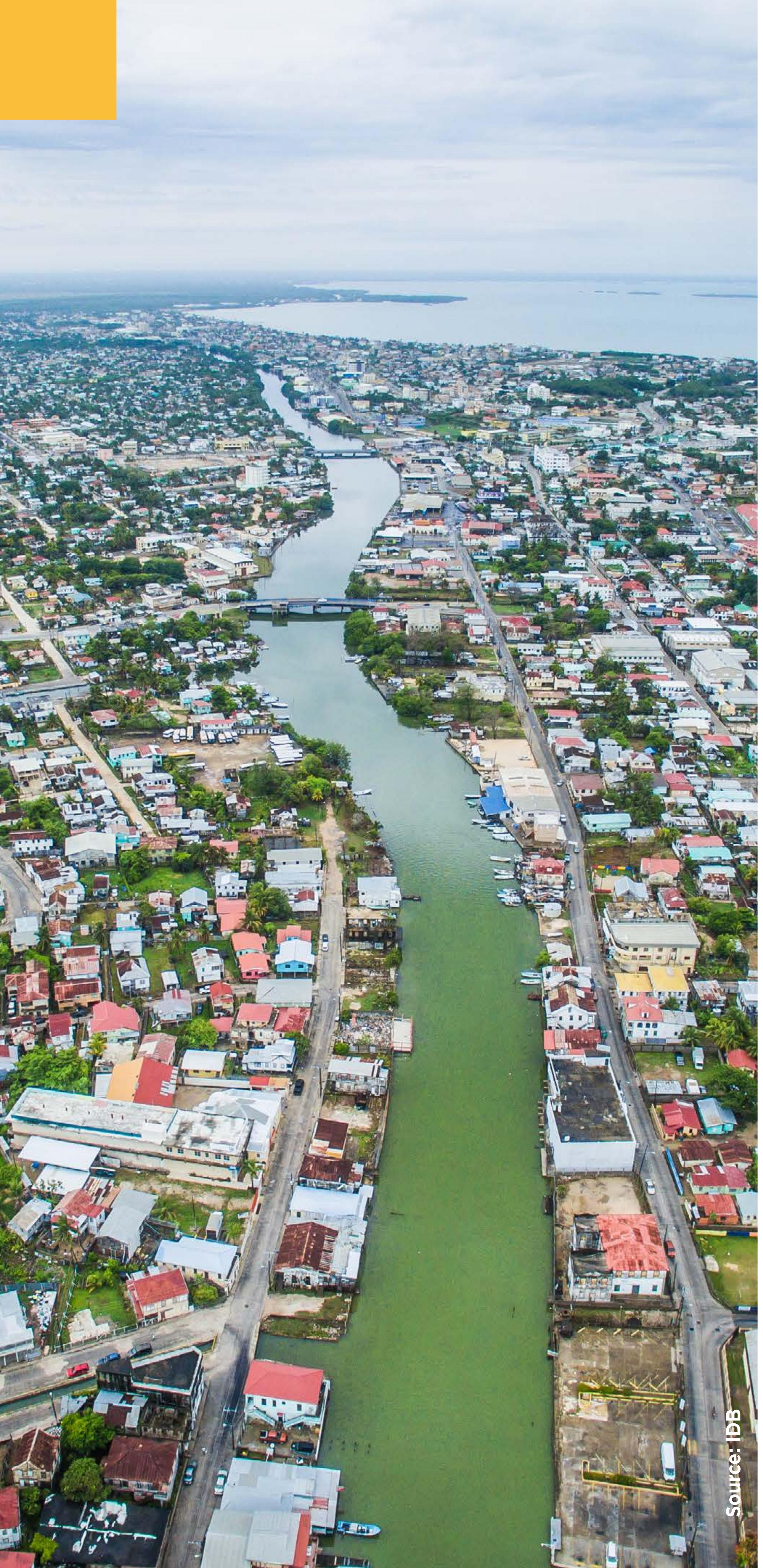
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Executive Summary

This report examines the potential role for nature based solutions (NBS) in the Caribbean construction industry, identifies barriers that NBS projects face in the region, and suggests measures that can be taken to address these barriers.

The study defines NBS as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.”[2] In the construction industry, this can include “natural features, nature-based features, and approaches that combine natural and gray elements, the latter referred to as integrated solutions.” NBS can also “compliment, substitute, or safeguard traditional gray infrastructure while delivering enhanced resilience and a series of co-benefits (e.g. supporting biodiversity, local livelihoods, and tourism and recreational opportunities).”[3]

These approaches can minimize disaster risks from flooding and storm surges, reduce resource use through improved energy efficiency and water management, and contribute to reducing atmospheric carbon concentrations through reducing carbon emissions and increasing carbon uptake and sequestration. Many NBS also provide multiple additional benefits, such as increasing wildlife habitat and improving recreational opportunities.

Examples of NBS in the construction industry context include urban green spaces, such as urban forests, bioswales, rain gardens, and green roofs; coastal protections, such as coral reefs, mangroves, and horizontal levees; and landslide protections, such as watershed restoration and management, bioretention systems, and permeable pavement. NBS options that are particularly well suited to the construction industry in the Caribbean include horizontal levees, living breakwaters, coastal mangroves, bioswales, green roofs, and bioretention rain gardens. The first three enhance a country’s resilience to storm surges and coastal erosion, a key concern for the Caribbean region. The second three reduce the risk of inland and urban flooding and improve storm water management and draining, also key concerns, particularly for islands with low-lying areas.

In addition to the direct benefits of mitigating disaster risks, improving local ecosystems, and providing recreational opportunities and enhanced urban environments, NBS can also reduce atmospheric carbon concentrations. NBS can reduce the use of concrete and other carbon-intensive materials resulting in greenhouse gas emissions reductions in building construction and can potentially reduce energy used for building cooling. NBS can also sequester carbon as the deployed vegetation grows. This is particularly true for mangroves, which are estimated to sequester 174 metric tonnes of CO_2 per square kilometer per year.[4]

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2 Silva, Mariana. What are nature-based solutions and why do they matter? Web blog post. Hablemos de sostenibilidad y cambio climatico. IDB, 18th of February 2020.

3 Silva, Mariana et.al.. Increasing Infrastructure Resilience with Nature Based Solutions. Inter-American Development Bank. 2020

4 Alongi, Daniel M. (2012) Carbon sequestration in mangrove forests, Carbon Management, 3:3, 313-322

Since 2015, NBS related projects have seen increasing support across Latin America and the Caribbean (LAC). A recent study[5] identified 168 development projects that employed NBS across the LAC region. Within this group of projects, 28 were located in the Caribbean region, including seven projects in Jamaica alone (the most for any single Caribbean country). Three-fourths of the Caribbean-based projects were focused on reducing flooding risk (including coastal flooding, urban flooding, and river flooding).

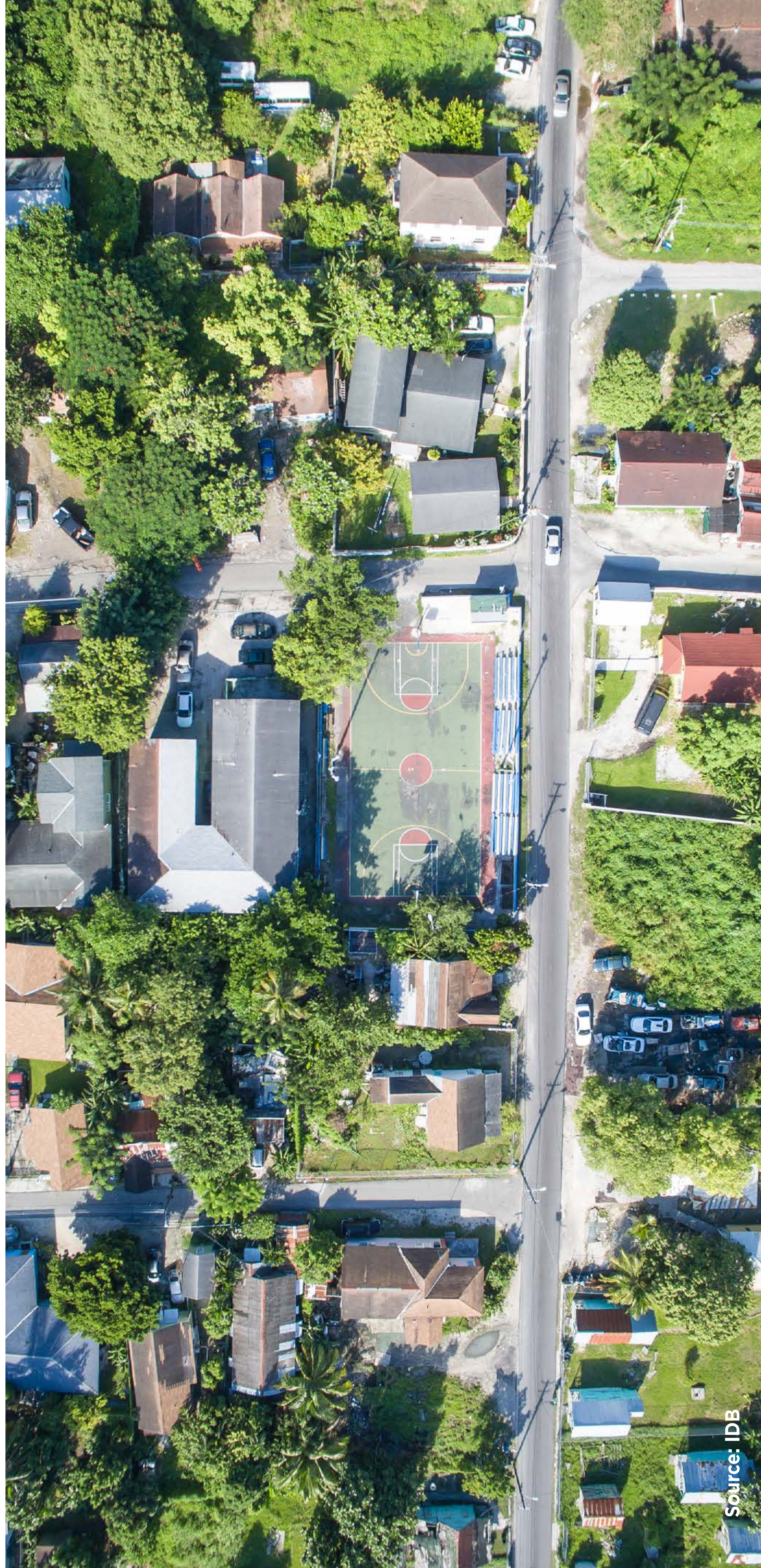
A second study[6] identified 28 NBS related projects in LAC that were directly supported by the IDB between 2015 and 2020. This study identified seven projects based in the Caribbean: the Bahamas, Belize and Haiti each hosted two projects, and Jamaica hosted one. Four of the seven projects were led by the IDB's Environment, Rural Development, and Disaster Risk Management Division, two were led by the Water and Sanitation Division, and one was led by the Climate Change Division. These projects were primarily supported through grants and technical cooperation agreements with an average size of US$12.4 million.

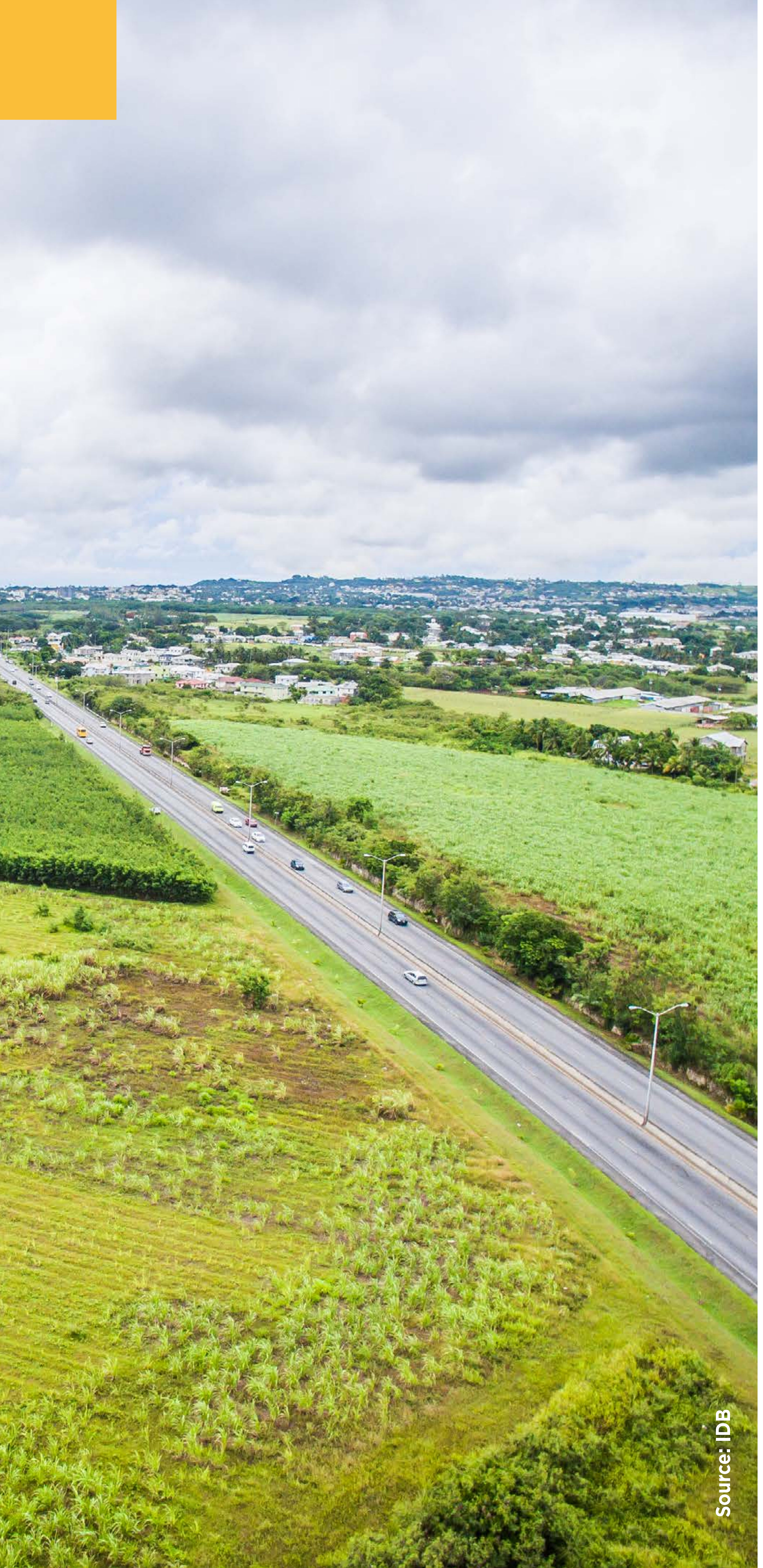
These two studies identified several barriers to NBS project development in the Caribbean. The key barriers identified related to awareness, policy, skills and tools, and finance. A lack of awareness stems from differing definitions of what should be classified as a NBS project, the limited track record of NBS projects, the need to involve a large number of stakeholders in NBS projects, and limited transparency for NBS project maintenance. Policy barriers are driven by the dominance of gray infrastructure development, a complex policy and permitting environment for NBS projects, and limited financial incentives. Skills and tools barriers can be found throughout the project lifecycle, including a lack of information and skills to value and communicate NBS benefits, to design and implement projects, and to evaluate project performance. Finance barriers include difficulty in defining the business case for NBS options, in quantifying risks and uncertainties, in quantifying co-benefits, as well as in accessing suitable financing and insurance.

There are several measures that can be taken to address these barriers and increase the use of NBS in the Caribbean. NBS can be gradually increased by "greening the gray" and integrating NBS options with gray infrastructure. This is most effective when green components are identified early in the project development process. NBS project developers should prioritize local community traditional practices and values, needs, and capabilities. This direct link to the local community's welfare builds awareness and support for NBS and ensures their long-term maintenance and viability. Robust monitoring, evaluation, and communication programs should also be included in each NBS project. Long-term management is critical to ensure NBS projects are sustainable. Continually communicating a project's status and benefits builds support among the local community and policy makers and helps build a track record that future projects can leverage.

5 Ozment, S., M. Gonzalez, A. Schumacher, E. Oliver, G. Morales, T. Gartner, M. Silva, G. Watson, and A. Grünwaldt. 2021. "Nature-Based Solutions in Latin America and The Caribbean: Regional Status and Priorities for Growth." Washington, DC: Inter-American Development Bank and World Resources Institute.

6 Oliver, E., S. Ozment, M. Silva, G. Watson, and A. Grünwaldt (2021). "Nature-Based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank." Washington, DC: Inter-American Development Bank and World Resources Institute.


Source: IDB



1. What are Nature Based Solutions and why are they important for the Caribbean?

The international Union for Conservation of Nature (IUCN) defines nature-based solutions as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."[7] In the context of the construction industry, NBS can include "natural features, nature-based features, and approaches that combine natural and gray elements, the latter referred to as integrated solutions."[8] In addition, NBS "compliment, substitute, or safeguard traditional gray infrastructure while delivering enhanced resilience and a series of co-benefits (e.g. supporting biodiversity, local livelihoods, and tourism and recreational opportunities)."[9]

Table 1 highlights NBS options that can replace or supplement traditional gray investment in water and sanitation, housing and urban development, transportation, and energy.

Across multiple infrastructure sectors, NBS can minimize disaster risks such as flooding, reduce resource use through improved energy efficiency and water management, and contribute to reducing atmospheric carbon concentrations through reducing emissions and increasing carbon uptake and sequestration. NBS are particularly important for the Caribbean owing to the region's heightened vulnerability to climate impacts and its dependence on imported materials for most infrastructure construction.

While cement is manufactured on a few Caribbean islands, virtually all other structural materials – including steel, glass, and commercial wood products[10] – are imported. Reducing these imports through NBS can have the added benefit of reducing the country's imports. This, in turn, can improve the country's supply-chain resiliency, reduce shipping-related greenhouse gas emissions, and ensure that a greater share of infrastructure spending is retained within the local economy.

7 Silva, Mariana. What are nature-based solutions and why do they matter? Web blog post. Hablemos de sostenibilidad y cambio climatico. IDB, 18th of February 2020.

8 Silva, Mariana et.al.. Increasing Infrastructure Resilience with Nature Based Solutions. Inter-American Development Bank. 2020

9 Silva, Mariana et.al.. Increasing Infrastructure Resilience with Nature Based Solutions. Inter-American Development Bank. 2020

10 With the exception of Caribbean countries within the mainland, such as Guyana, Suriname and French Guyana, that are wood exporters to the Caribbean Islands and worldwide.

Table 1. Examples of Nature-Based Solutions

Type of Investment Need	Investment Objective	Example of Nature Based Solutions	Impact
Water and Sanitation			
Urban drainage	Urban stormwater management	Urban forests, bioswales, wetlands	Reduce urban flooding by trapping storm runoff. Prevent pollutants caught by the runoff from contaminating water resources.
Housing and Urban Development			
Housing, Neighborhood upgrades, urban land planning and management, urban rehabilitation and heritage, sustainable cities	Urban landslide prevention	Forestation and vegetation on urban hillsides	Reduce landslide risk by stabilizing degraded slopes.
	Urban flood prevention	Urban wetlands, bioswales, green buffer zones, green roofing, permeable pavements, urban parks	Reduce urban flooding by increasing the ground area available to absorb rainfall and trapping storm runoff
	Riverine flood management	Urban green space	Reduce risk of riverine flood damage by conserving watersheds and protecting floodplains.
	Coastal flooding protection	Coral and oyster reefs, coastal wetlands, mangrove forests, sandy beaches and dunes	Reduce coastal erosion and protect against storm surges by managing coastal ecosystems.
	Urban heat mitigation	Urban green space, more canopy, green roofs	Reduce ambient urban heat
Transportation			
Road / railway construction and rehabilitation	Riverine flood regulation	Restore watersheds and riparian areas	Reduce riverine flood damage to road networks
	Coastal flooding protection	Manage coastal ecosystems near roads	Reduce coastal flood damage and erosion, particularly during storms.
	Landslide prevention	Manage ecosystems near roads with landslide risk	Reduce landslide risk by stabilizing soils.
Urban mobility	Urban flood prevention	Permeable pavements, bioswales, green roofs, and urban riparian areas	Reduce urban transport networks' risk of flooding.
	Optimizing walking and biking routes	Urban forests and green areas	Provide shade and protective distance from vehicles.
Airport construction and upgrades	Coastal flood protection	Manage coastal ecosystems near airports	Mitigate coastal flooding and erosion
	Stormwater management	Bioretention systems, permeable pavements, vegetated filter strips	Promote drainage of runways and other paved surface areas.
Ports and Canals	Erosion management	Inland watershed management	Reduce dredging costs by reducing the flow of sediments into ports and canals.
	Storm protection	Manage coastal ecosystems near ports	Reduce flooding erosion, particularly during storms.
Energy			
Energy transmission infrastructure construction and rehabilitation	Protection of transmission lines from natural hazards	Place NBS near vulnerable energy infrastructure, such as transmission lines.	Protect energy infrastructure from flooding, falling trees, and other hazards
Energy-efficiency building upgrades	Increase energy efficiency in buildings	Green roofs	Reduce energy required for building space cooling

Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank"

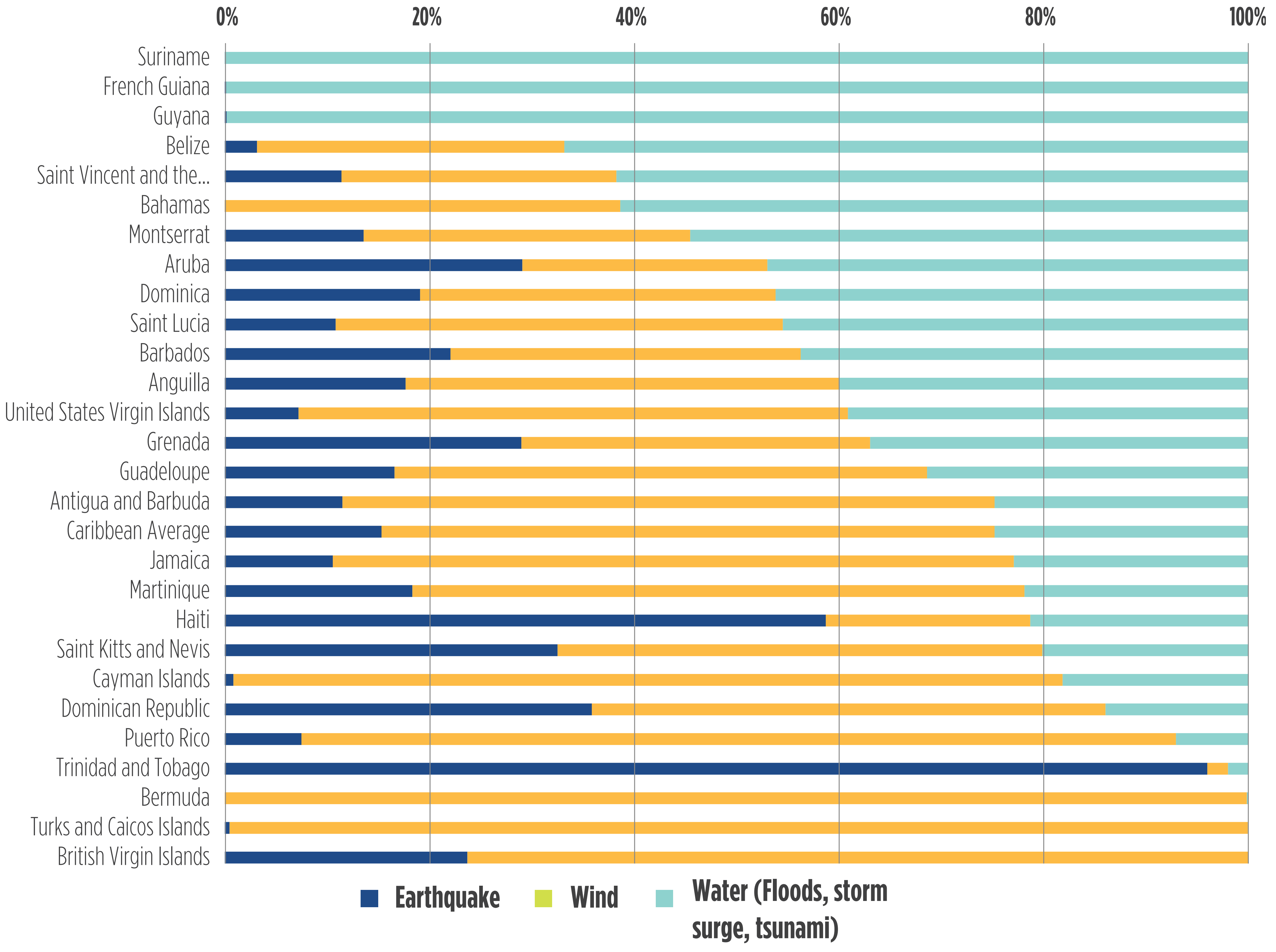
Source: IDB

2. NBS options for the Caribbean region

The Caribbean region is particularly vulnerable to natural hazards such as earthquakes, floods and tropical storms which bring high winds and storm surges. According to the UN 2015 Global Assessment Report on Disaster Risk Reduction (GAR 2015), the Caribbean region averages US$12.5 billion in economic losses from natural hazards every year. As climate change increases the strength and frequency of tropical storms, damage from winds, storm surges, and flooding is expected to increase.

Water-related hazards—such as flooding from heavy rains and tropical storms, storm surges, and, to a lesser extent, tsunami—account for US$3.1 billion in average annual losses.[11] Figure 1 below shows water-related hazards as a share of each country's total average annual loss from natural hazards.

Figure 1. Caribbean share of total average annual losses from natural hazards by source



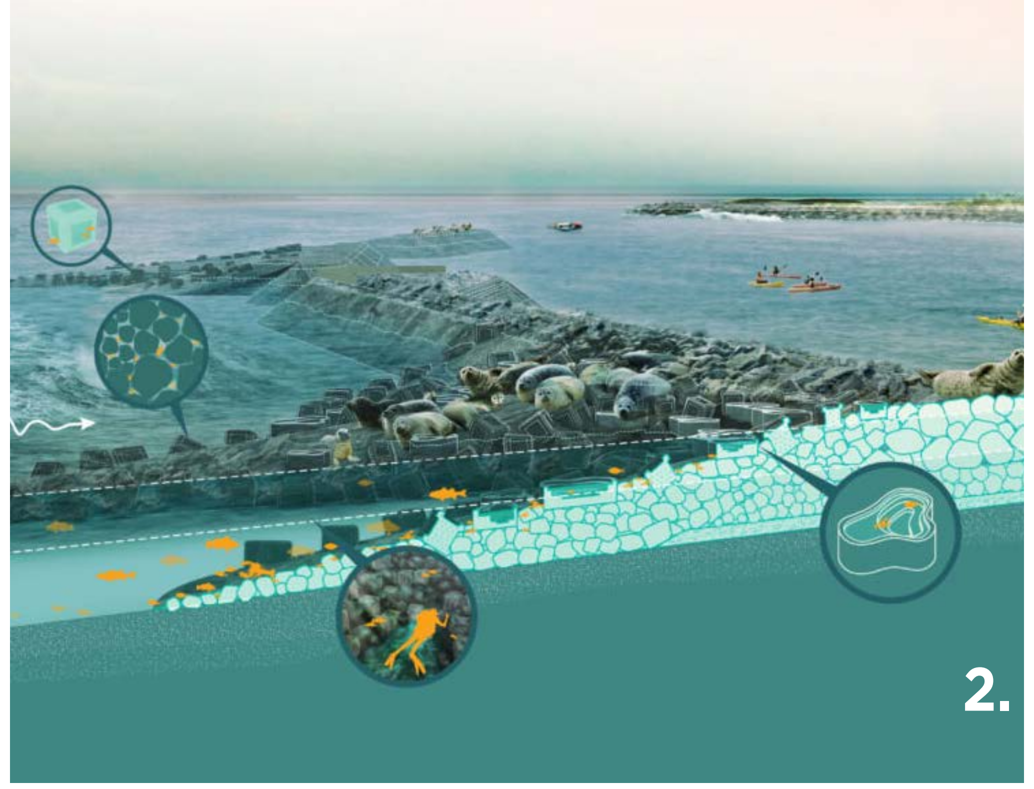
Source: Author. Data source: GAR 2015

11 UNISDR. Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland: United Nations Office for Disaster Risk Reduction (UNISDR), 2015.

The continental Caribbean nations—Guyana, Suriname, and French Guiana—are particularly vulnerable to flooding. Many of the islands are highly vulnerable to hurricanes which bring a mix of wind, storm surge, and flooding damage, particularly in low lying areas. Only Haiti and Trinidad and Tobago are more vulnerable to earthquakes than to other types of natural hazards.

NBS options are well suited to managing water-related hazards such as flooding and storm surges. Many nature-based interventions involve restoring habitat and ecosystems that naturally buffer coastlines from storm surges, absorb excess rainfall, and secure loose soil to reduce erosion and the risk of landslides. An unpublished report produced by Cadmus for the IDB identified a number of NBS options that are particularly well suited to addressing water-related natural disaster risks in the Caribbean, including:

Horizontal Levee. A horizontal levee places a wide natural buffer, such as a coastal marsh, between the coastline and a traditional levee (a sloped or raised structure to protect against storm surges). The natural buffer and distance from the coast allows the built levee to be smaller than otherwise, as the marsh absorbs a portion of the storm surge. (Photo: Oro Loma Sanitary District, Oro Loma, California)



Living Breakwater. Living breakwaters are constructed underwater but near the shore. Their function is to disrupt waves as they approach land, absorbing much of their energy so the waves have less impact once they reach the shore. This reduces coastal erosion and the risk of storm surge damage, while promoting sand and gravel accumulation between the living breakwater and the shore. Living breakwaters also provide undersea habitats and related recreational opportunities. (Photo: SCAPE, Rebuild by Design, Staten Island, New York)

Coastal Mangrove Restoration. Coastal mangroves have dense networks of prop roots. These roots absorb wave energy and stabilize coastal soil to reduce flood and erosion risk from storm surges. Mangroves also provide ecosystem services by creating habitats for wildlife and supporting local biodiversity. Growing mangroves also provide “blue carbon” services by absorbing carbon dioxide and sequestering it in coastal soils. (Photo: Pixabay)

Bioswale. Bioswales are broad vegetated troughs and depressions designed to capture and filter storm water runoff. Bioswales can absorb most typical rain runoff and direct any excess overflow to traditional storm water systems or surface water bodies. They can help to replenish underground aquafers and provide habitat. In urban areas they provide green space and can help reduce urban heat island effects. (Photo: USDA Natural Resources Conservation Service)}

Green Roofs. Green roofs combine lightweight engineered growing media with protective roofing layers to allow plants to grow on top of buildings. They can range from grasses and other low-lying plants to trees and shrubs. They absorb rainfall which reduces storm runoff and flooding risks, capture carbon dioxide while providing oxygen, reduce the building's cooling load by shading the roof, and help to reduce urban heat island effects. Given the relative space limitations of building rooftops, a high concentration of green roofs is required for significant impacts on water retention and heat island reduction. For buildings with robust structural systems, green roofs can be combined with blue roofs, which are designed to retain even greater volumes of storm water for slower release and reuse. (Photo: Citibank Data Center, Frankfurt am Main, Germany via Google Earth).

Rain Gardens (Bioretention). Rain gardens treat and retain on-site stormwater discharge from impervious surfaces, such as sidewalks and parking lots. They are typically small depressions with grasses and flowering bushes planted in a prepared soil and gravel bed. They absorb rainfall which reduces storm runoff and flooding risks, capture carbon dioxide while providing oxygen, and help provide green space in urban areas. (Photo: Massachusetts Watershed Coalition)

Soil Bioengineering. Soil bioengineering is an applied science that combines the use of engineering design principles with biological and ecological concepts to construct and assure the survival of living plant communities that will naturally control erosion and flooding.[12]

For example, the application of Vetiver System (VS) for infrastructure protection is an effective technique applied in steep areas to stabilize the soil and safeguard infrastructure from disaster and climate related impacts such as erosion and landslides.

12 Examples of soil bioengineering techniques can be found here.

Sources:

1.IDB

2. SCAPE

3. Aulia ErlanggaCIFOR-ICRAF

4. GuzzardoPartnership

5. Lamiot - Wikicommon

6. TJ Gehling - Wikicommon

7. Devindranauth Bissoon

Table 2. Assessment of Nature-Based Solutions to reduce flooding in the Caribbean

NBS Option	Description	Cost Range	Primary Benefit	Additional Benefits	Key Considerations for Implementation	Avoided Losses
Horizontal Levee	A system that combines a hardened structure (levee) with a coastal marsh. Can be 40% less expensive than traditional levees as the size of levee required is smaller due to the natural buffer.	US$2.5-US$12 million per mile	Reduce risks of coastal flooding and storm surge damage	Natural habitats are better preserved, supports recreational activities such as hiking, biking, fishing, kayaking, etc.	Infrastructure and human activity needs to be shifted away or avoided on the storm surge side of the levee.	US$15-72 million per mile
Living Breakwaters	An offshore artificial reef that creates a barrier to absorbs wave energy.	US$20,800 per linear foot	Reduce risks from storm surge and coastal erosion	Coastal habitat restoration, can support recreational and commercial opportunities	May take up to five years to establish as local reefs integrate with the structure. Materials used for the barrier must be hospitable to local wildlife.	US$124,800 per lineal foot
Coastal Mangrove Restoration	Coastal mangroves create wetlands containing dense prop roots that result in a natural ability to absorb wave energy and reduce wave heights from storm surge.	US$14,000-US$32,000 per lineal kilometer	Reduce risks from storm surge and coastal erosion	Carbon sequestration, water purification, and habitat restoration.	Mangroves are vulnerable to sea level rise and changes in temperature, tidal cycle, and salinity. Suitable water management and protection measures must be enforced to protect mangrove health.	US$84,000-US$192,000 per lineal foot
Bioswale	A vegetated area that is sloped to absorb and capture stormwater runoff. Can be up to 39% less expensive than traditional infrastructure.	US$20-US$30 per square foot	Reduce risks from flooding	Cost reduction	Regular maintenance efforts include mowing, reseeding, and weed control.	US$120-180 per square foot
Green Roofs	Supplement traditional flat roof with soil and plants.	US$10-US$25 per square foot	Reduce energy consumption for building space cooling	Reduce urban heat island effect, provide additional rain water absorption capacity, 200% extension of lifespan of roof membranes	Require regular inspection, maintenance, and plantings. Wind stabilization measures are required to prevent loss of soil during storms. Retrofitted roofs must have sufficient load tolerance.	US$60-US$150 per square foot
Rain gardens / bioretention	An area with prepared soil, gravel, and vegetation that captures and absorbs runoff from impervious surfaces up to 10-20x the size of the rain garden.	US$1-US$5 per square foot of impervious surface protected.	Reduce risks from flooding	Carbon sequestration, urban green spaces	Require regular inspection, maintenance, and plantings.	US$6-US$30 per square foot of impervious surface protected.

Source: Cadmus

The first three NBS—horizontal levees, living breakwaters, and coastal mangrove restoration—enhance a country's resilience to storm surges and coastal erosion, while the second three—bioswales, rain gardens, and, to a lesser extent, green roofs—reduce the risk of inland flooding and improve storm water management and drainage. In addition to the reduced risk of loss from natural hazards, each NBS brings other benefits including recreational opportunities and improved energy efficiency. NBS bring particular benefits in relation to atmospheric carbon concentrations as they can both sequester carbon from the air and avoid future emissions. NBS that increase green space, such as mangrove restoration, bioswales, green roofs, and rain gardens, directly sequester carbon as they grow. NBS that replace or reduce traditional gray infrastructure, such as living breakwaters, horizontal levees and bioswales, avoid carbon emissions by reducing the use of concrete and other carbon-intensive materials. NBS that reduce energy used for building cooling, such as green roofs, can also reduce carbon emissions if the electricity supply is based on fossil fuels. This is particularly effective if a sufficient number of buildings are fitted with green roofs to reduce the heat island effect from urban concentrations of concrete and asphalt.

The amount of carbon emissions that can be avoided by reducing the use of concrete is highly case specific. Avoided emissions depend not only on the specific volume of concrete that can be reduced, but also the type of concrete, as there is a very wide range of concrete specifications and materials combinations, each of which has a distinct amount of embodied carbon per kilogram of concrete. A 2013 study from the University of Leeds in the UK found that the embodied carbon in reinforced concrete ranged between 0.07 and 0.52 kgCO2eq per kg of concrete.[13] This is roughly equivalent to 170 – 1,250 kgCO2eq per cubic meter of concrete. To put this in perspective, creating a natural bioswale in the place of a reinforced concrete culvert that is 10 meters wide, 10 cm thick, and one kilometer long would avoid anywhere between 170 to 1,250 metric tonnes of embodied carbon emissions.

A 2020 review of environmental product description (EPD) documents for concrete components such as cement and aggregates found a similarly wide range of embodied carbon, ranging between 0.3 – 1.2 kgCO2eq/kg for cementitious materials and .002 - .007 kgCO2eq/kg for aggregate materials. Ready-mix concrete was measured per cubic meter rather than per kg, ranging between 200 – 700 kgCO2eq / cubic meter (roughly equal to 0.09 – 0.3 kgCO2/kg.[14]

The amount of carbon that NBS measures can sequester each year is also highly variable based on the type of plants that are included, climate factors, and age. Mangroves are estimated to be able to sequester an average of 174 grams of carbon per square meter per year, or 174 metric tonnes per square kilometer.[15] A Michigan study found that green roofs can sequester carbon nearly as well, ranging between 162-168 grams of carbon per square meter per year.[16] If the bioswale example noted above were able to achieve similar rates, it would sequester on the order of 1.6-1.7 metric tonnes of CO2 per kilometer of length per year.

Many NBS options are also lower cost than traditional gray infrastructure. For example, horizontal levees and bioswales are estimated to be up to 40% less expensive to build and maintain than traditional concrete infrastructure alone. Green roofs can extend the useable life of roof membranes by reducing degradation from solar radiation as well as reduce electricity costs by reducing the building's cooling load. Overall avoided losses from all of the presented NBS options are estimated to be on the order of six times the expected installation cost.

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13 Purnell, P (2013) The carbon footprint of reinforced concrete. Advances in Cement Research, 25 (6). 362 - 368. ISSN 0951-7197 https://doi.org/10.1680/adcr.13.00013

14 Anderson, J., & Moncaster, A. (2020). Embodied carbon of concrete in buildings, Part 1: analysis of published EPD. Buildings and Cities, 1(1), pp. 198–217. DOI: https://doi.org/10.5334/bc.59

15 Alongi, Daniel M. (2012) Carbon sequestration in mangrove forests, Carbon Management, 3:3, 313-322

16 Getter, K. et al. (2009). "Carbon Sequestration Potential of Extensive Green Roofs." Environmental Science and Technology. 43: 7564-7570.

3. Status of NBS projects in the Caribbean

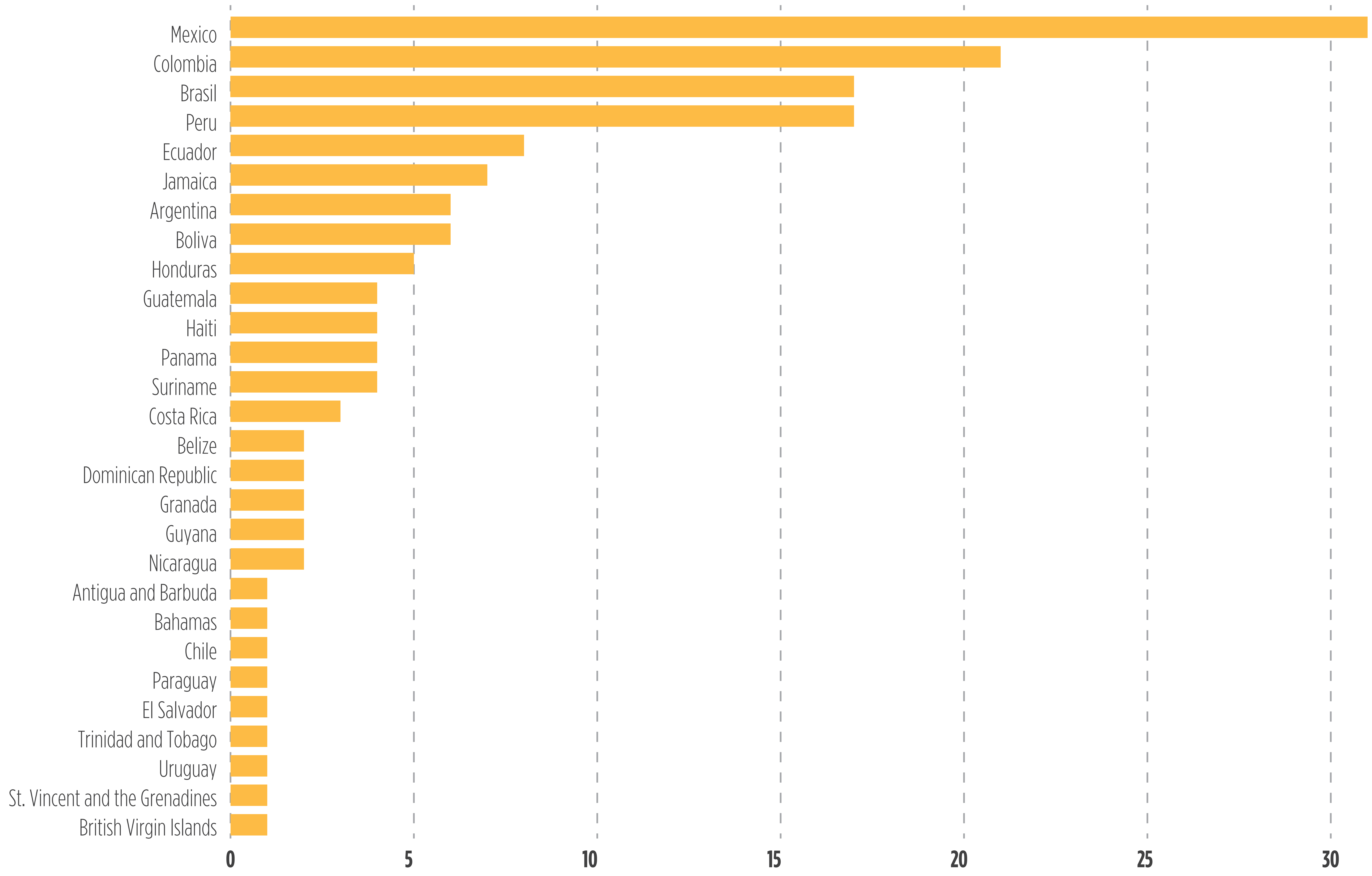
The benefits of using NBS is increasingly being recognized in Latin America and the Caribbean. A recent IDB report[17] identified development projects that included NBS components across the region based on the following criteria:

- Included NBS components on their own or integrated with traditional gray infrastructure
- In the context of climate mitigation and adaptation, focused on four priority sectors: water and sanitation, energy, transportation, and housing and urban development
- Focused on four critical challenges: flooding and erosion (coastal, urban, and riparian), landslide risk, risks to water supply, and deterioration of water quality
- Had obtained at least US$100,000 in funding and/or financing
- Are active, in the process of being developed, or were completed no more than five years before the report was published (2021)

The analysis identified 156 total projects located in 28 countries. They include projects led by non-governmental organizations, national governments, and local governments. These projects are primarily funded through loans, technical cooperation agreements, and grants from multi-lateral donors or are self-funded through tax revenues, environmental damage fees, or fees for services. Figure 2 below shows the number of projects by country.

17 Ozment, S., M. Gonzalez, A. Schumacher, E. Oliver, G. Morales, T. Gartner, M. Silva, G. Watson, and A. Grünwaldt. 2021. "Nature-Based Solutions in Latin America and The Caribbean: Regional Status and Priorities for Growth." Washington, DC: Inter-American Development Bank and World Resources Institute.

Figure 2. NBS Projects in Latin America and the Caribbean by country



Source: Ozment, S., et al. 2021. “Nature-Based Solutions in Latin America and The Caribbean: Regional Status and Priorities for Growth.” Washington, DC: Inter-American Development Bank and World Resources Institute.

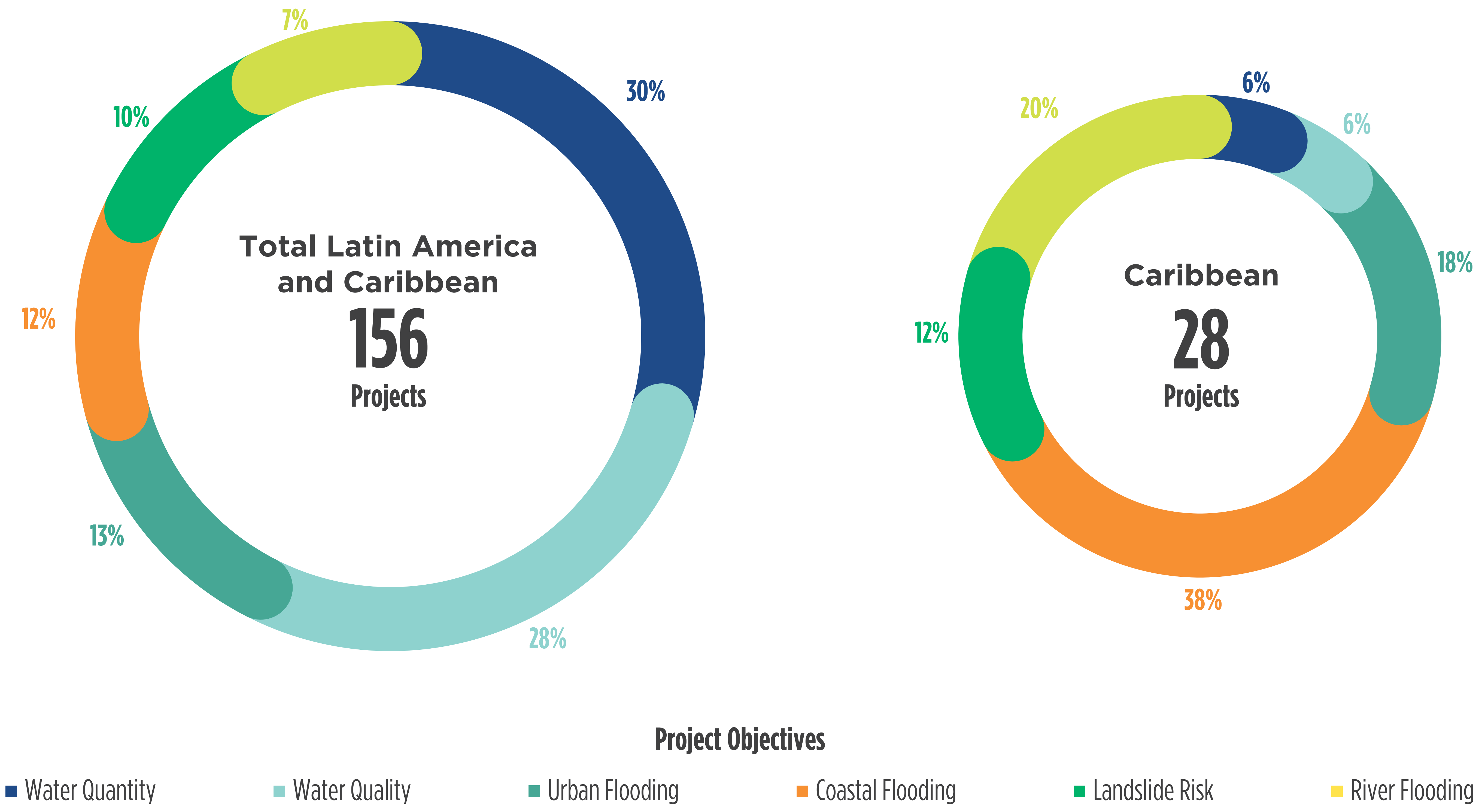
Over half of the NBS projects were located in Mexico, Colombia, Brazil, or Peru. Only 28 projects were located in the Caribbean, spread across 12 different countries. Jamaica is host to the largest number (7), while Haiti and Suriname each had four. Belize, the Dominican Republic, Granada, and Guyana have two projects, and the remaining countries had one each: Bahamas, Trinidad and Tobago, St. Vincent and the Grenadines, and the British Virgin Islands.

Overall, the Caribbean region is well represented among the NBS projects identified above. The large number of countries with only one or two NBS projects reflects, in part, the Caribbean nations’ relatively small size. Notable Caribbean countries that are missing from the list include Barbados, St. Lucia, and the smallest islands in the region, such as Montserrat, St. Kitts and Nevis, and Antigua and Barbuda.

Figure 3 below compares the project objectives that were identified for the 156 projects across Latin America and the Caribbean with the project objectives of the 28 Caribbean based projects. These project objectives include: water quality, water quantity, urban flooding, coastal flooding, river flooding, and landslide risk. Projects that impact more than one of the listed objectives were counted toward each objective that they affected.

The Caribbean region shows a significant difference in project objectives when compared to the rest of the region. Across Latin America and the Caribbean, 58% of the projects had an impact on water quality or quantity. In the Caribbean, only 12% of the project did. Rather, Caribbean projects emphasized managing flooding risk, with a total of 68% of projects addressing urban, river, or (most significantly) coastal flooding. Across the Latin American and the Caribbean region, only 35% of projects addressed flooding. Landslide risk was likewise more heavily emphasized in the Caribbean, with 20% of projects reducing landslide risk compared to just 7% for the wider project list.

Figure 3. NBS Projects in Latin America and the Caribbean by project objective

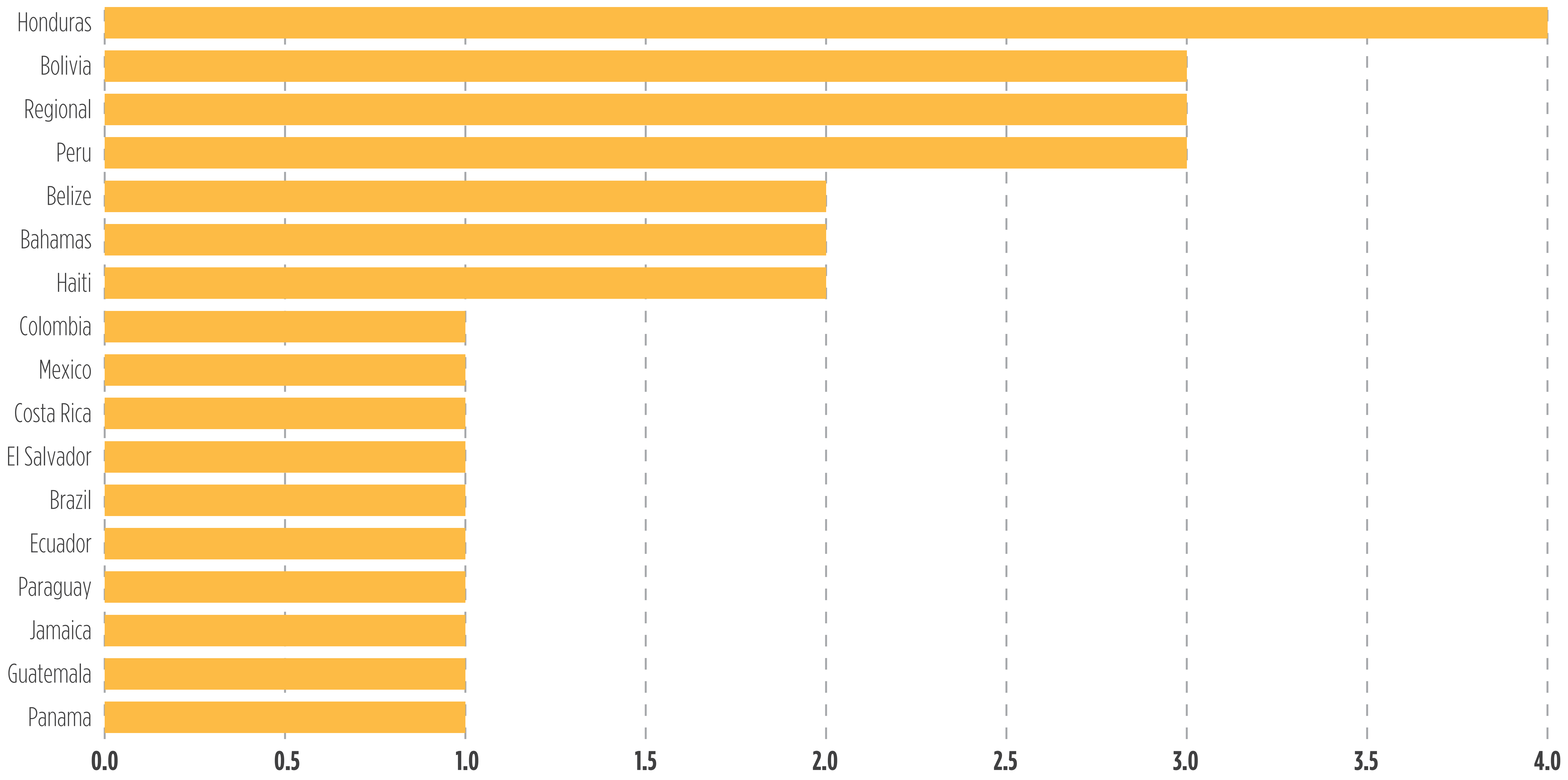


Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Regional Status and Priorities for Growth"

This shift in emphasis highlights the Caribbean region's greater vulnerability to flooding, particularly river and urban flooding in the continental states (Belize, Guyana, Suriname, and French Guiana) and coastal flooding in the island nations. The mountainous islands, such as Jamaica, Grenada, and St. Vincent and the Grenadines, are also more vulnerable to landslides, particularly during hurricane season when tropical storms bring sudden heavy rains.

The IDB performed a similar analysis of NBS projects that the Bank supported across Latin America and the Caribbean between 2015-2020.[18] This analysis identified 28 IDB-funded projects with NBS components in the region during that period, including seven in the Caribbean. As shown in Figure 4 below, the IDB's primary focus for NBS projects during this time period was Honduras, Bolivia, Peru, and regional projects focused on rehabilitating watersheds that crossed international borders. Of the 16 individual countries that hosted NBS projects in Latin America and the Caribbean, four were in the Caribbean region: Belize (2 projects), Bahamas (2 projects)[19], Haiti (2 projects), and Jamaica (1 project).

Figure 4. IDB Supported NBS Projects in Latin America and the Caribbean by country



Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank"

18 Oliver, E., S. Ozment, M. Silva, G. Watson, and A. Grünwaldt (2021). "Nature-Based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank." Washington, DC: Inter-American Development Bank and World Resources Institute.

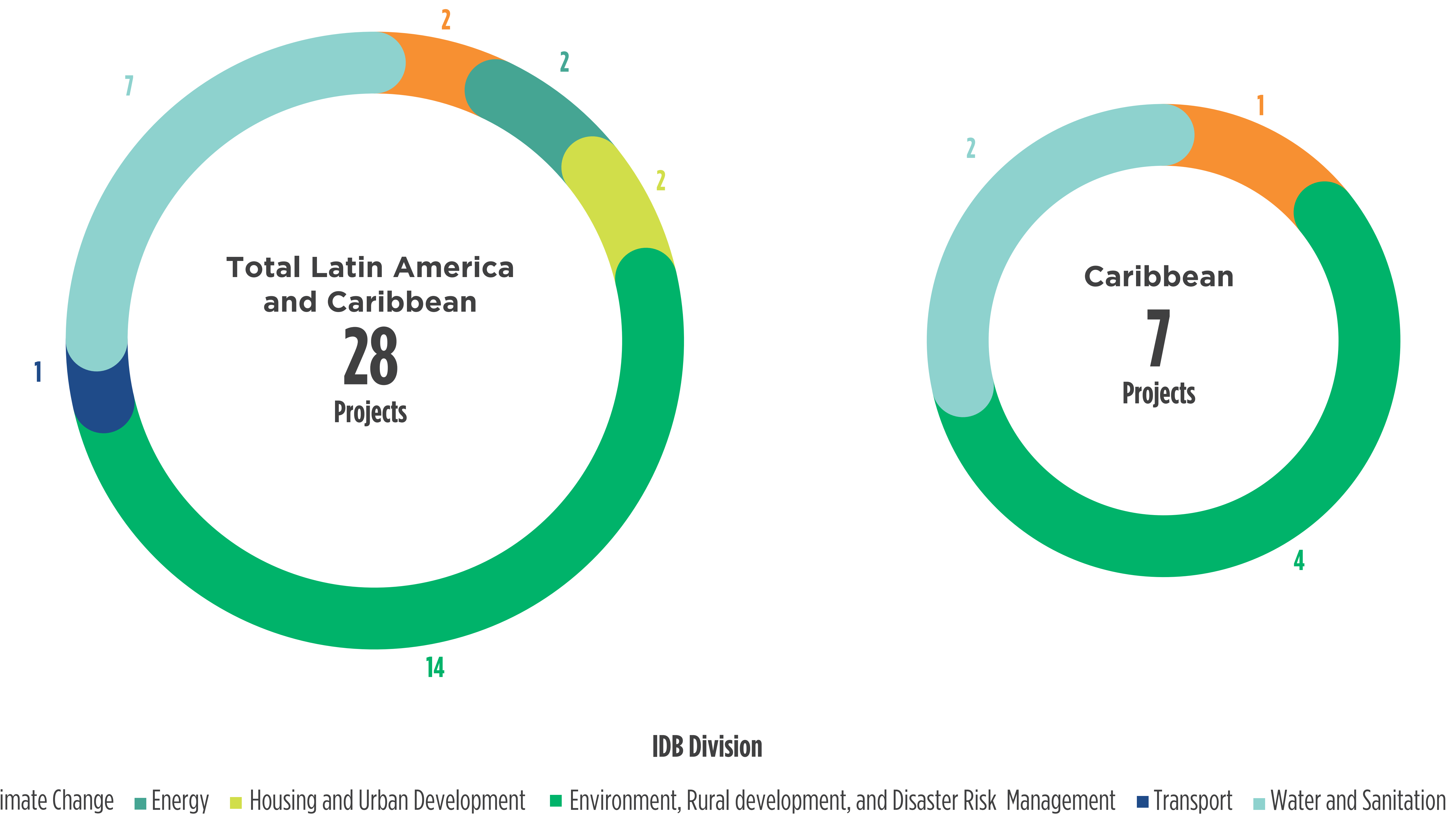
19 Note that the period of analysis for the IDB projects is different than the period of analysis of all NBS projects noted earlier. One of the IDB-supported Bahamas projects was initiated before the time period for the broader NBS project analysis.

In both the number of projects and the number of countries with NBS projects, the Caribbean represents roughly one-fourth of the IDB's effort in Latin America and the Caribbean.

The mix of IDB divisions that supported NBS projects in the Caribbean is different than the rest of Latin America. Figure 5 below shows the split of NBS projects across the Climate Change; Energy; Housing and Urban Development; Environment, Rural Development, and Disaster Risk Management; Transport; and, Water and Sanitation divisions within the IDB.

According to the study, during the period that was analyzed, NBS projects across Latin America and the Caribbean were supported by six different divisions within the IDB, with the majority supported by the Environment, Rural Development, and Disaster Risk Management division (with 14 total projects), followed by the Water and Sanitation division (with seven projects). The Energy, Housing and Urban Development, and Climate Change divisions each supported two projects during the time period, while the Transportation division supported one.

Figure 5. IDB Supported NBS Projects in Latin America and the Caribbean by sponsoring IDB Division



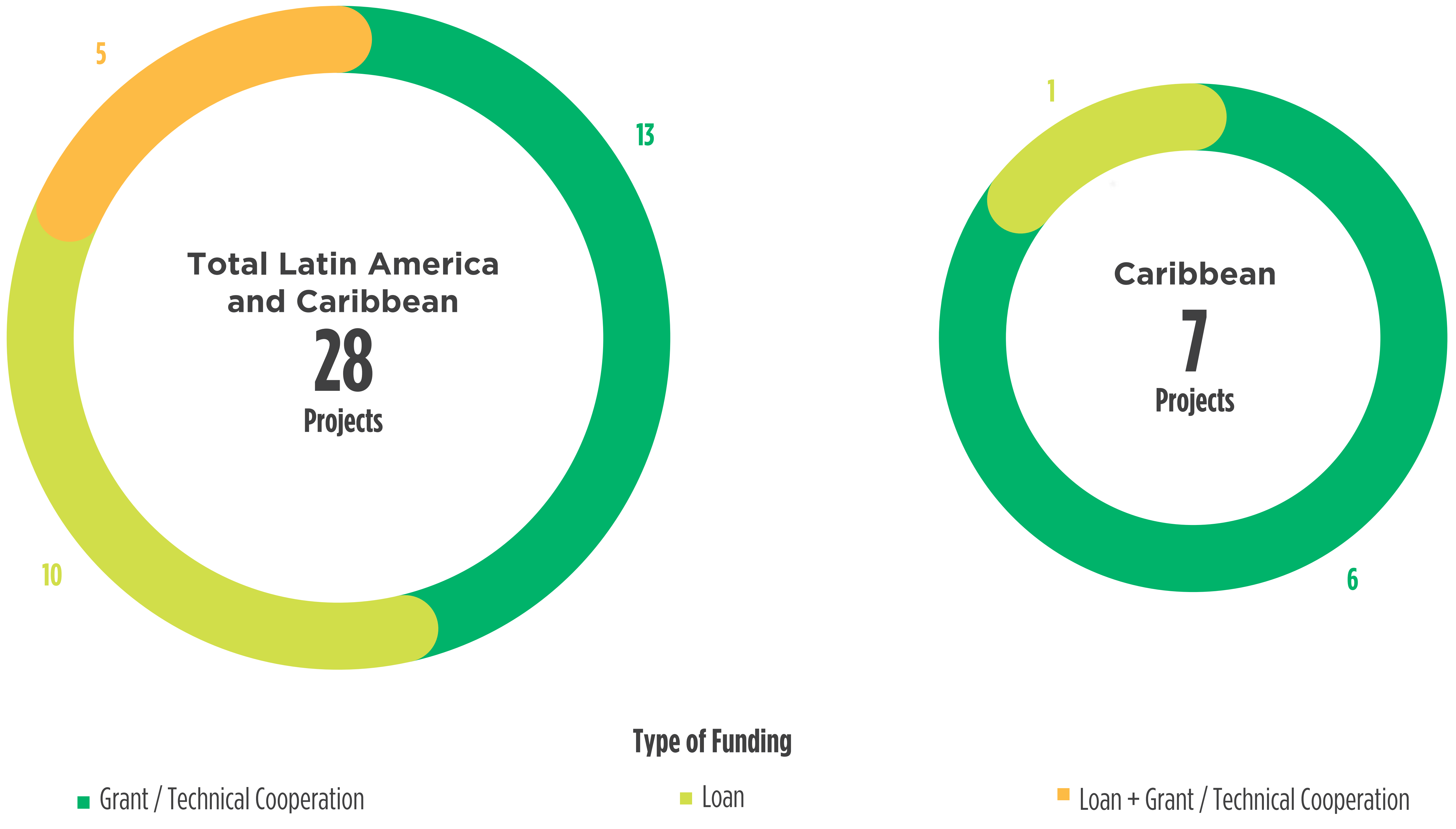
Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank"

Of this total, the seven projects that were located in the Caribbean follow a similar pattern. During the period that was analyzed the preponderance of IDB supported projects in the Caribbean were sponsored by the Environmental, Rural Development, and Disaster Risk Management division (four of the seven), followed by the Water and Sanitation division (two of the seven). There was one IDB supported NBS project sponsored by the Climate Change division in the Caribbean region during the study period, and none sponsored by the Energy, Housing and Urban Development, and Transport divisions.

The type of funding used for IDB supported NBS projects in the Caribbean is distinct from the mix of funding reported for the LAC region as a whole. Figure 6 below compares the share of loans, grants, and blended financing used in IDB supported NBS projects in the Caribbean compared to those across all of Latin America and the Caribbean during the study period.

For the 28 projects across the entire LAC region, 46% were funded through grants and technical cooperation agreements (13 of the 28 projects), a further 36% were funded through loans (10 of the 28 projects), and the remainder relied on a mixture of loans, grants, and technical cooperation (5 of the 28 projects). For the seven projects located

Figure 6. IDB Supported NBS Projects in Latin America and the Caribbean by Type of Funding

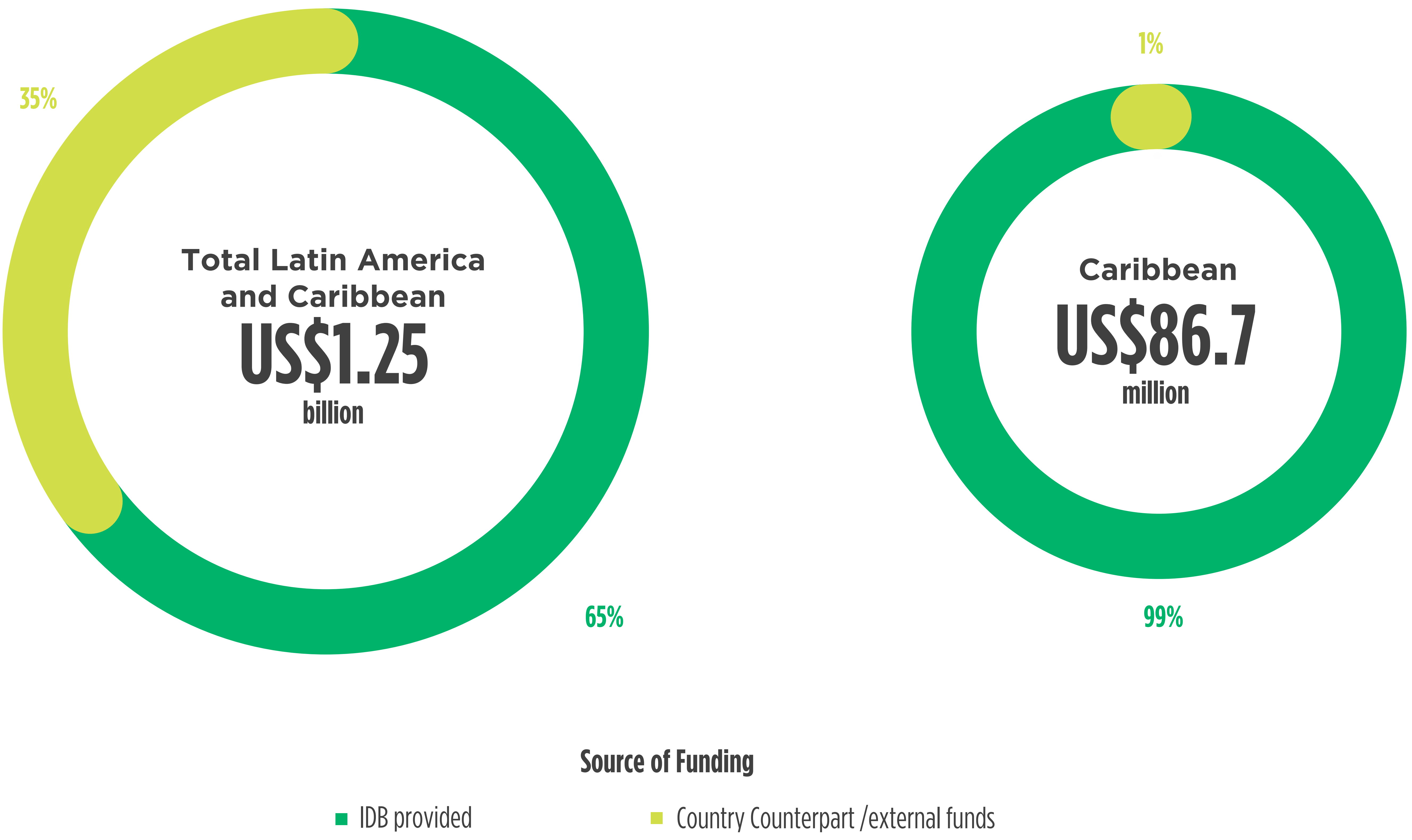


Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank"

in the Caribbean, only one of the IDB supported NBS projects involved a loan facility during the study timeframe. The other six projects were funded either through grants or technical cooperation agreements. This much greater reliance on non-reimbursable finance reflects, in part, the lack of data and experience with structuring, implementing, and maintaining NBS projects in the Caribbean region. Because NBS projects are new in the region, complicated, and require different skills than traditional infrastructure, NBS projects need additional risk mitigation and are less able to attract financial support from commercial banks. As a result, the region has a greater need for technical assistance to improve the enabling environment for NBS projects and build awareness and capacity among the various stakeholders.

Most of the IDB supported NBS projects in the Caribbean received relatively small contributions from external funds or country counterparts. As shown in Figure 7 below, only 1% of total funding for IDB supported NBS projects in the Caribbean came from external sources or country counterpart contributions. Across the LAC region as a whole, the IDB contributed $800 million toward the 28 projects and leveraged an additional $437 million in in external financing from partners, or 35% of the nearly US$1.25 billion in NBS project costs during the study period.

Figure 7. Total Funding for IDB Supported NBS Projects in Latin America and the Caribbean



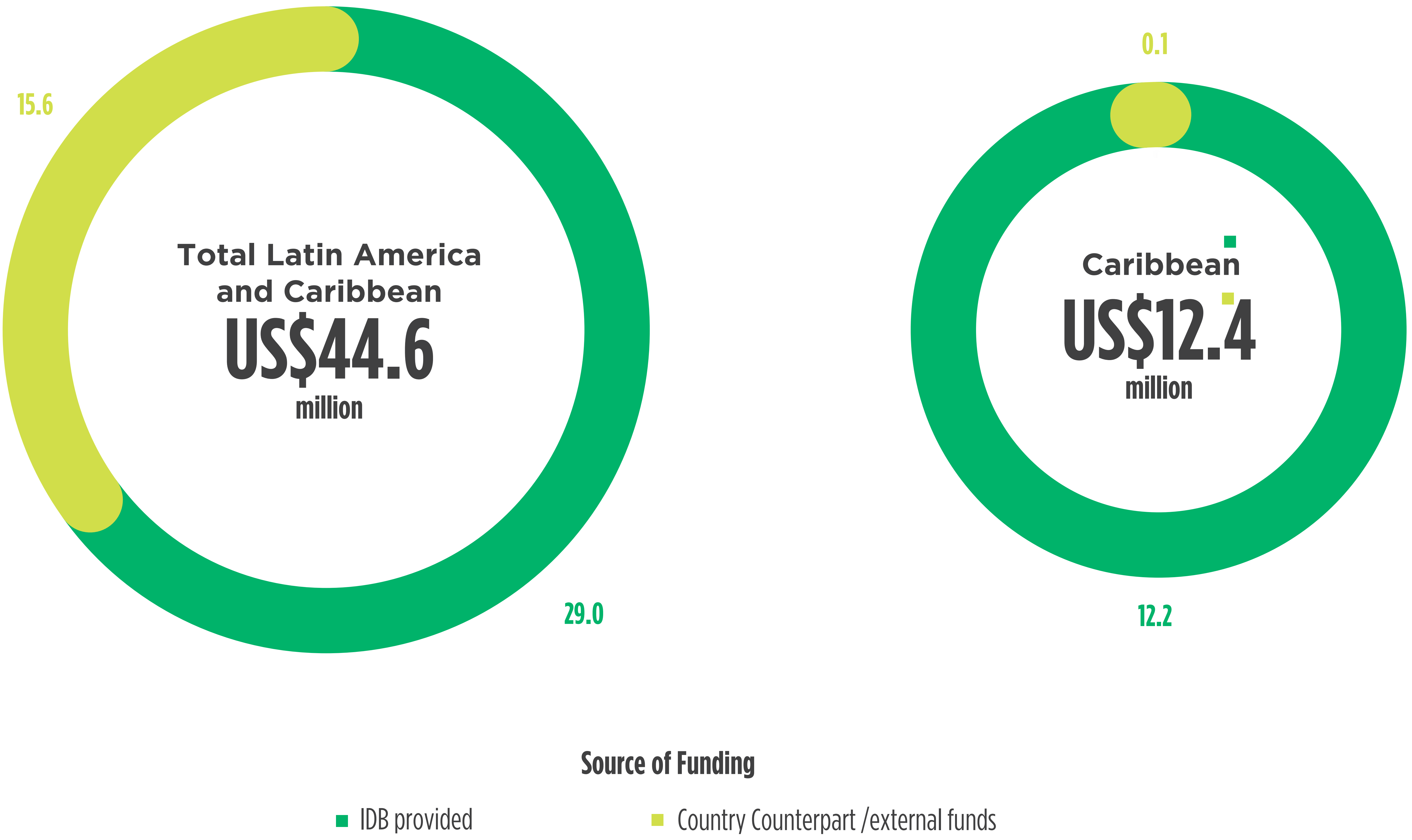
Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank"

The total amount of funding provided to IDB supported NBS projects is also much lower in the Caribbean than in the rest of the LAC region. Of the roughly US$1.25 billion invested toward IDB supported NBS projects in Latin America and the Caribbean during the study period, only US$86.7 million, or roughly 7% of the total was allocated to the Caribbean.

Figure 8 below highlights this reduced level of funding, showing the average amount of funding provided per project by the IDB and external sources. The Caribbean average project size of US$12.4 million is only 28% of the overall Latin America and Caribbean average of US$44.6 million.

While this smaller project size could reflect the smaller sized economies in the region, as well as the region's corresponding limited capacity to absorb large project spending. In addition, three of the identified projects were technical cooperation agreements that were less than US$1 million each that supported NBS planning activities.

Figure 8: Average Funding per Project for IDB Supported NBS Projects in Latin America and the Caribbean



Source: Adapted from data from IDB report "Nature-based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank"

Source: Livia Minoja

4. Overarching Challenges to NBS implementation in the Caribbean

Although the benefits of using NBS are clear, there are three overarching challenges to their implementation in the Caribbean. This section of the report reviews the overarching challenges that have been identified in the reports noted above, identifies specific barriers within the challenges, and examines the applicability of each to the Caribbean region. Broadly speaking, NBS are more challenging to implement than traditional gray infrastructure solutions because they are new, they are complex, and they require different skills.

- **NBS are new.** Policy makers and project developers have much less experience with NBS projects than with traditional gray infrastructure. Data on NBS benefits and risks is harder to acquire and there are fewer example case studies available. This makes it harder to evaluate NBS project economics, expected returns, and performance. All of this, in turn, makes access to finance for innovative projects in an already higher risk environment more challenging. Each of these points is doubly true in the Caribbean, where many countries have yet to implement their first NBS project, environmental and disaster risk data is incomplete, and project costs and benefits can be difficult to assess.

- **NBS are complex**. NBS projects often involve multiple government agencies, such as those managing the environment, agriculture, disaster preparedness, water, infrastructure, housing, transportation, tourism, and economic development. They may also require support and permitting from multiple layers of government, from the national down to the local municipality. This makes policy making and implementation more difficult and often slower for NBS initiatives than for traditional development. For project developers, questions regarding which agencies to engage, and in what order, can create barriers to implementing NBS projects. In the Caribbean, few countries have clear processes for engaging relevant stakeholders and developing NBS projects that cross traditional government divisions.
- **NBS require different skills and input materials.** Many traditional infrastructure developers do not have experience in working with NBS materials and approaches, and may not have people with relevant expertise. Alternatively, companies with NBS experience may be unfamiliar with the business and regulatory environment in new countries. Similarly, policy makers that

Table 3. NBS Implementation Barriers

NBS Implementation Challenge	Caribbean Context	Implications for	
		Policy Makers	Project Developers
Awareness Barriers			
Limited awareness of NBS options	Few countries have implemented NBS projects	Less likely to include NBS in development and procurement plans	Unsure of NBS efficacy relative to gray infrastructure
Environmental policy making is decentralized	Many countries have separate environment, coastal management, and water authorities	Efforts by different agencies may be uncoordinated or at cross purposes	Added time and cost from engaging with multiple government agencies
Many stakeholders must be involved to ensure NBS benefits are considered	Small populations mean all projects are high profile	Higher political profile and greater scrutiny than standard gray projects	Added time and cost from engaging with multiple stakeholder groups
Limited enforcement capacity or transparency for NBS project maintenance	Many supporting environmental policies are not fully enforced in the region	NBS projects have a greater need for ongoing enforcement than gray infrastructure projects	Ongoing costs to ensure project success may be higher if enforcement is weak
Policy Barriers			
Gray infrastructure development is dominant	Many countries have yet to implement their first NBS project	Development and procurement policies and standards were created for gray infrastructure	Gray solutions are available "off the shelf" and are quick to implement
NBS projects face a complex policy environment	Many countries have separate development, finance, environment, and coastal management authorities	Some policies may support NBS (environment, biodiversity) while others hinder them (planning, agriculture)	Potential policy conflicts increase uncertainty and risk, slowing project development
NBS permitting and approval is complicated	Managing land use is paritcularly sensitive for small island nations	Regulators and oversight bodies may have limited experience and expertise	Uncertainty and delays increase project risks and costs
NBS projects have few financial incentives	Many countries rely on donor funding to support projects	Difficult to structure effective incentives	Incentives are needed to offset perceived risks

are responsible for infrastructure may not have the expertise to evaluate NBS proposals or ensure they are properly maintained. This aggregated lack of experience and expertise increases the perceived risk of NBS projects in Caribbean countries that have not yet implemented an NBS project. In addition, NBS materials may not be available at the scale required in the region. For example, native plants are adapted to local growing conditions but may be more difficult to procure are less familiar to NBS developers than foreign varieties that may require greater maintenance.

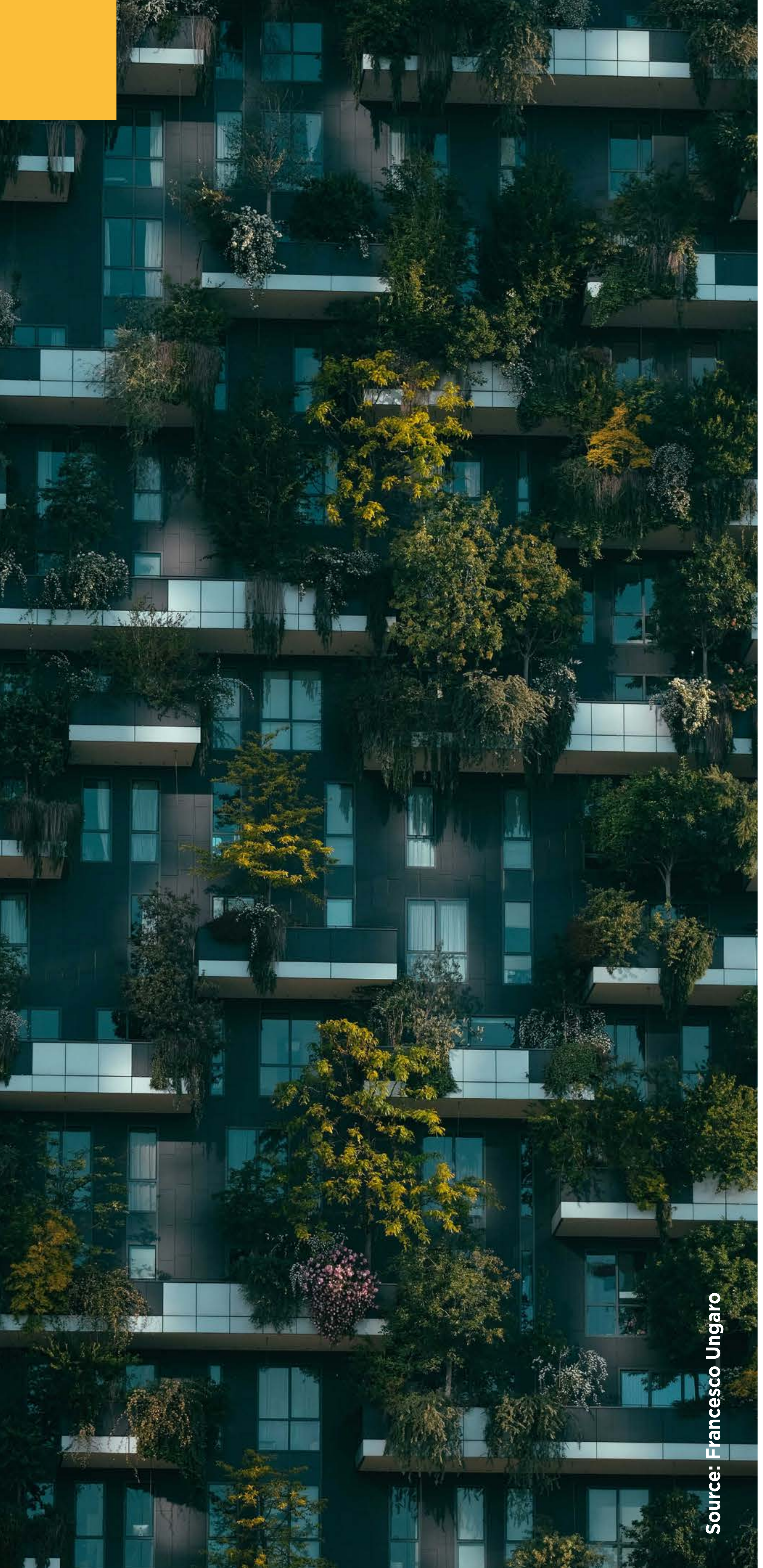
These three challenges result in barriers at all stages of NBS project implementation, from creating supporting policy and fiscal environments to project definition and design to procurement and permitting to construction and inspection to ongoing monitoring and evaluation.

Table 3 below highlights some of the barriers to NBS implementation that were identified in a recent IDB report.[20] The table places those barriers in the Caribbean context, and describes the implications for both policy makers and project developers.

20 IDB and UNEP (2021). Resilient by Nature – Increasing Private Sector Uptake of Nature-based Solutions for Climate-resilient Infrastructure. A Market Assessment for Latin America and the Caribbean.

NBS Implementation Challenge	Caribbean Context	Implications for	
		Policy Makers	Project Developers
Skills and Tools Barriers			
Lack of data and/or skills to value NBS and communicate benefits	Limited regional experience and few available NBS experts	More difficult to make the economic case for NBS and build political support	Greater uncertainty around project economics and profitability
Lack of data and/or skills to design and implement NBS	Limited regional experience and few available NBS experts	Difficult to technically evaluate NBS project proposals	May not have people with relevant skills on staff
Lack of data and/or skills to develop NBS risk profiles	Limited regional experience and few available NBS experts	Difficult to establish risk reduction benefit	Greater uncertainty around project economics and profitability
Lack of data and/or skills to evaluate NBS performance	Limited regional experience and few available NBS experts	Difficult to establish project success and lessons learned	Difficult to establish project success and lessons learned
Developers are organized around specific infrastructure sectors	Smaller sized companies active in the region may specialize in only one sector	More difficult to attract qualified bidders for cross-sector NBS projects	More difficult to organize project teams, include NBS components to gray projects
Finance Barriers			
Difficult to define business case / proof of concept	Available case studies may not be appropriate or relevant to island nation circumstances	More difficult to compare competing proposals on an even basis	NBS co-benefits more difficult to quantify than traditional infrastructure
Risks and uncertainties are hard to quantify	Disaster risk and credit risks vary significantly across the region	More difficult to set performance and maintenance standards than gray infrastructure	Greater variability in performance and risk profiles than traditional infrastructure
Co-benefits are hard to quantify financially	Tourism-related co-benefits are particularly valuable	Citizen well being benefits are hard to quantify in monetary terms	NBS co-benefits may not be bankable under traditional project financing
Limited access to finance	Many countries have high debt burdens	May be unaware of available NBS specific financing options	NBS project returns may be unattrative to standard financing sources
Limited access to suitable insurance	Small, unique markets are even harder to insure	Potential "Catch-22" cycle between limited insurance demand and available options	High insurance costs may make projects uneconomic

Source: Author


Source: Francesco Ungaro

5. Best Practices and Recommendations to increase NBS projects in the Caribbean

Experience with NBS projects across Latin America and the Caribbean suggests that the barriers noted in the previous section can be mitigated. This section describes the best practices for NBS projects that have been noted across the region, as well as specific mitigation strategies to increase NBS awareness, improve policy, build the required skills and tools, and unlock sources of finance in the Caribbean region.

Best practices noted from ongoing NBS projects in Latin America and the Caribbean include:

- **"Green the Gray" by integrating NBS options with gray infrastructure.** This can be very effective in reducing gray infrastructure costs, increasing co-benefits, and building experience with NBS projects. To maximize benefit, 'green' components must be identified early in the project development process. More successful projects integrated the green and gray components throughout, rather than including green components as add-on side projects unrelated to the main infrastructure work. In the Caribbean, this approach can help gradually build experience with NBS without risking long delays in building needed infrastructure.
- **Prioritize local community values, needs, and capabilities.** NBS projects are most successful with high levels of community engagement. This is best achieved where the project is aligned with local values, leverages local knowledge and skills, and brings clear benefits to the local community. In the Caribbean, particular care should be taken to ensure local communities are not displaced or otherwise harmed by NBS projects and that a portion of the benefits, including environmental and recreational co-benefits, visibly benefit the local community.

- **Include robust monitoring, evaluation, and communication programs.** NBS projects require ongoing maintenance and support to ensure they remain viable over the long term. In addition, the co-benefits that they bring are often longer term or difficult to quantify in monetary terms, such as increased green space for recreational opportunities. To ensure these benefits are realized and recognized, projects must include ongoing monitoring and evaluation. It is also important to continually collect, analyze, and communicate data on the project's status and benefits to the local community, country policy makers, and to broader infrastructure development stakeholders to build awareness and familiarity with NBS options. In the Caribbean, establishing project-specific funds and project execution and oversight units can help ensure project continuity across successive governments.

A 2017 IDB funded project to improve coastal climate resilience in the Bahamas exemplifies each of these broad recommendations.[21] The project, BH-L1043, provided a US$35 million loan from IDB ordinary capital to build resilience to climate risks such as coastal flooding and erosion at key locations including Junkanoo Beach, Central Long Island, East Grand Bahama, and Andros. The project included a blend of gray infrastructure, such as traditional breakwaters, groins (structures built perpendicular to the beach to limit erosion and sand drift), and upgrades to transportation infrastructure, as well as NBS, including restoring and expanding mangroves. In East Grand Bahama, an upgraded causeway will improve road access to vulnerable coastal communities and restore hydrological flows to a 35-kilometer mangrove and tidal creek. In Central Long Island, a road bypass that was damaged by Hurricane Joaquin in 2015 will be rehabilitated along with the restoration of 15 kilometers of mangroves. A further 200 hectares of mangroves will be restored in Andros.

Each of these components benefit local communities through improved transportation infrastructure and expanded tourism opportunities through the ecosystems that the mangroves will support. A local non-profit, Bahamas National Trust, was closely involved in the project design, implementation, and maintenance, including the mangrove plantings, community engagement and communication, and environmental education initiatives at local schools.

In addition to these broad best practices, many specific mitigation actions to address the NBS barriers noted above are relevant to the Caribbean. Potential actions to address NBS awareness, policy challenges, skills and tools limitations, and finance availability are noted in the subsections below.

5.1 Increasing NBS awareness

The lack of awareness of potential NBS options and their benefits on the part of both policy makers and project developers is a major barrier in the Caribbean. Section 5.3 below describes other forms of awareness building, while this section focuses on the use of case studies to demonstrate the benefits that NBS can bring as well as how barriers were overcome and projects successfully brought to completion. Options to use case studies to increase NBS awareness in the Caribbean include:

- Engaging with local communities, organizations, and entrepreneurs in the Caribbean that are actively pursuing NBS projects to learn about their experiences and further define key project success indicators and barriers that they have encountered. This direct engagement with local actors can help target support and interventions to the most critical needs. Local actors with NBS experience can also share their knowledge with developers and other organizations that are not yet involved in NBS projects through industry events and other opportunities.
- Leveraging information and data from regional organizations to aggregate and disseminate case study examples of NBS projects that have been implemented or are ongoing in the Caribbean. These case studies can provide the most immediate examples of how to successfully pursue NBS projects in the region to organizations and countries that have not yet pursued them. In addition, regional information on NBS supply chains, such as a regional inventory of NBS technologies and solutions, can help increase awareness of the available alternatives in procurement.
- Connecting local expertise in the Caribbean with broader Latin American expertise in NBS project execution to tailor case studies of NBS projects in other regions to the Caribbean context. This approach would draw upon the foundation of work already done by the IDB to identify NBS projects in Latin America

21 Oliver, E., el al. 2021. "Nature-Based Solutions in Latin America and the Caribbean: Support from the Inter-American Development Bank." Washington, DC: Inter-American Development Bank and World Resources Institute.

and the Caribbean, selecting examples that are relevant to the Caribbean and applying them to the Caribbean context.

- Reviewing NBS experience of small island nations in other regions of the world. Small island nations in the Pacific region and elsewhere outside of Latin America may have significant lessons in structuring and implementing NBS that are relevant to the Caribbean.

5.2 Reducing NBS policy barriers

Government policies, procurement practices, and permitting requirements play a central role in defining how and what projects are completed in the Caribbean. Improving policy support and reducing policy barriers for NBS projects in the Caribbean could include:

- Assessing current policy supports and barriers across government agencies and increasing policy coherence to support NBS projects. This approach is essentially a government audit of the policies, agencies, and other stakeholders that affect NBS projects to highlight areas where increase coordination and policy coherence would benefit NBS implementation. This can also include establishing codes and standards for NBS design, implementation, and maintenance, similar to traditional infrastructure requirements. A common set of NBS codes and standards would help educate stakeholders on best practices and ensure that NBS projects achieve their long-term potential.
- Include NBS requirements in relevant procurement processes. This would require any relevant procurement process to include consideration of NBS options, including green-gray integrated projects. While such a procurement process may not realistically require that all new projects include NBS options, it should require government agencies and project developers to demonstrate that NBS options were considered and were found to be uneconomic before a purely gray option is selected.
- Adopting natural capital accounting practices which better account for environmental degradation costs and NBS co-benefits can help to integrate NBS support into relevant policies. Putting a clear cost on lost habitat or disaster resilience helps to make the economic case for NBS projects that bring multiple co-benefits.

5.3 Building NBS skills and tool awareness

The lack of relevant skills and available tools to develop NBS projects, among both policy makers and project developers, is particularly acute in the Caribbean nations with small populations. These barriers can be overcome near-term through hiring outside consultants and other temporary engagements. In the medium- to long-term, the region requires mechanisms to increase available skills to mainstream and localize the use of NBS. Options to mitigate these barriers include:

- Increase awareness of existing tools among policy makers and project developers. The IDB and other multi-lateral organizations make many relevant tools available. Awareness building activities and training in their use through conferences or webinars can increase their use. For example, a consolidated catalogue of the existing tools for various stages of NBS development could be created and made publicly available. Specific tools can also be called out in project development and procurement guidelines, directing project developers to the relevant sources and building their awareness of the tools. Regional industry associations can also help to dissemination information to their members.

- Expand education and skills training related to NBS solutions, such as project implementation and project maintenance. This can include expanding university and post-graduate degree programs in the region to include NBS-related coursework, professional education and continuing educational opportunities for industry professionals and policy makers, as well as targeted "green collar" skills training (that is, manual labor skills that are relevant to NBS solutions), such as urban gardening, grounds keeping, and arborist skills.

5.4 Unlocking NBS finance

Many countries in the Caribbean face large debt burdens and tight public finances, particularly following the COVID-19 pandemic's impact on global tourism. Financial barriers can limit NBS project uptake even if project economics and expected benefits are strong. Some options to mitigate financial barriers in the Caribbean include:

- Highlight regional case studies of innovative NBS financing, such as blended financing packages that integrate grants, concessionary loans, and commercial loans; resilience bonds; or payments for environmental services.
- Integrate internationally recognized standards and credit rating approaches for sustainable infrastructure into Caribbean NBS project evaluation processes. These standards, such as the Sustainable Development Goals (SDGs), the Equator Principles, and the International Finance Corporation (IFCs) Environment and Social Performance Standards, can provide a standardized vocabulary and benchmark to assess NBS projects across the region, thereby making it easier for governments, project developers, and financing institutions to compare and evaluate specific project risks and benefits.
- Leverage regional organizations and multi-lateral organizations to aggregate smaller, country-level projects into larger programs to attract large-scale financing and reduce financing costs per project. Such regional aggregation risks increasing the project implementation complexity. Focusing on projects that can be replicated in near identical fashion in multiple locations can mitigate this risk.
- Provide training to smaller organizations in developing grant and loan funding requests to meet funders' requirements. This will make funding more accessible for organizations with limited experience in applying for donor support.

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Social Infrastructure

Building a More Resilient and Low-Carbon Caribbean

REPORT 4

Infrastructure Resilience in the Caribbean through Nature Based Solutions

IDB

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