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MONA CAMPUS
JAMAICA, WEST INDIES

CIF CLIMATE INVESTMENT FUNDS

IDB Inter-American Development Bank

Consulting mandate for the procurement of LIDAR (bathymetric and topographic) scoping and monitoring.

Site Selection Report

PILOT PROGRAMME FOR CLIMATE RESILIENCE (PPCR)

University of the West Indies, Mona

Investment Plan for the Caribbean Regional Track of the Pilot Program for Climate Resilience

Consulting Mandate for the Procurement of Lidar (Topographic and Bathymetric) Survey Scoping and Monitoring

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Deliverable # 2 – Selection Criteria

Version 2

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1 Management Summary

This document constitutes the second deliverable to result from the consulting mandate for the "Lidar (Topographic and Bathymetric) Surveys Scoping and Monitoring Consultancy" and includes a recommendation for the site selection criteria.

Within the Pilot Program for Climate Resilience (PPCR), 3 nearshore coastal areas in each targeted country can be surveyed. Different stakeholder have different areas of interest and need new geodata for different applications. As the sum total of all stakeholder requests for data exceed the data collection budget of the project, objective and transparent site selection and ranking criteria are presented in this document in order to identify the top three zones in each target country where topographic and bathymetric Lidar data collection enables the highest benefits.

Key recommendations:

- The areas for the data collection should be nearshore coastal zones with high climate change vulnerability where both topography and bathymetry data is needed and will be used.
- Use "**must criteria**" for the site selection to make sure that the selected areas are nearshore coastal zones where topographic (for Jamaica) and bathymetric (for Jamaica and Haiti) data is needed.
- Use "**rating criteria**" for the prioritization of the areas.
- Use as main rating criteria the natural vulnerability of the areas. Risks from storm/hurricane damage, flooding and coastal erosion are considered higher than the risk of earthquake and the risk of landslide/mudslide. Where available, use a hazard map to aid in the objective rating.
- Prioritize areas with high population, critical infrastructure, environmental significance and projected areas of significant infrastructural/residential/commercial/mining development as the potential damages are highest here.
- If the valuation using the above described rating leads to the same result for more areas, choose the area with the largest number of possible stakeholders.
- Define the exact boundary of the selected priority areas in consultation with the stakeholders. Limit the boundary extent using a maximum water depth of 10 m sea-side and a maximum elevation above mean sea level (MSL) of 50 m or a distance of 3 km inland - whichever is closer to the shore line - land-side.

2 Background

As described in the inception report (document *Lidar_Consultancy_01_InceptionReport_v1*, dated September 29th 2017), near-shore Lidar data is available or will be available shortly for the target countries of Grenada and Saint Vincent and the Grenadines. This leaves Jamaica (topographic and bathymetric) and Haiti (bathymetric only) for potential data collection campaigns under this project.

The following considerations regarding the types of risks in these two countries constitute the basis for the subsequent formulation of the site selection criteria (chapter 3).

2.1 Jamaica

Jamaica's geographical location makes it vulnerable to hurricanes and to earthquakes. The island's terrain also makes it prone to landslides in its hilly areas, and to flooding on its plains during heavy rainfall. Climate change impacts are expected to include increased rainfall and drought events, as well as sea level rise and an increase in frequency and intensity of hurricanes.

The country has felt the full effects of major weather systems, such as Hurricanes Ivan and Charley in 2004, Vilma, Dennis and Emily in 2005, Dean in 2007, Sandy in 2012, Tropical Storms Gustav in 2008 and Nicole in 2010, which caused extensive damage in various sections of the island.[1]

Five candidate sites have been identified by 25 stakeholders from 13 agencies during a one-day workshop on August 25th 2017. Team discussions in five groups aimed at the identification of potential survey sites along the coast including a ranking based on pre-defined selection criteria, and defining the needed products in these areas.

2.2 Haiti

Throughout its history, Haiti has suffered cyclones, hurricanes, tropical storms, torrential rains, floods and earthquakes.

Haiti suffered dire flooding in 2002, 2003, 2006 and 2007. During the hurricane season in 2008, Haiti was hit by four storms – Fay, Gustav, Hannah and Ike – which killed more than 800 people and devastated nearly three-quarters of its agricultural land. In January 2010, a devastating earthquake killed at least 90,000 people and displaced more than 1.5 million. The last hurricane (Hurricane Matthew) was in October 2016 and caused a catastrophic flooding and storm surge. More than 580 people died and more than 35'000 were left homeless by the storm.

The Haitian Ministry of the Interior and Local Authorities through the World Bank financed Disaster Risk Management and Reconstruction Project launched the 'High Resolution Risk Data Initiative'. For the entire national territory of Haiti, the Lidar data collection was finished in May of this year. The data delivery should take place before the end of 2016.

Within this project only Lidar Bathymetry data will be collected for the near-shore coastal zones of Haiti. Lidar Bathymetry data is primarily used for seabed mapping.

In Haiti, the stakeholder consultation showed, that existing navigational charts in Haiti are very old (1940-1950) and incomplete. The need for new bathymetric data and update of the navigational charts is very high for the entire coast.

Four candidate sites have been identified through telephone and email interviews with 3 agencies in August/September 2017.

[1] Source: Rowan Kelleher, Suzanne: How Often Do Hurricanes Hit Jamaica?; https://www.tripsavvy.com/how-often-do-hurricanes-hit-jamaica-4053190 [accessed on 8-09-2017]

3 Selection Criteria for Sites

The selection process for identifying the three target sites per country out of the current pool of candidate sites is designed as a three-step procedure:

1. Eliminate sites that do not fulfill the qualification criteria as defined in the project ToR (see chapter 3.1).¨
2. Rate the remaining candidate sites according to a list of selection criteria and scoring system (see chapter 3.2). Select the three highest-scored sites per country.
3. Define the exact area of interest boundary, taking into account stakeholder input and pre-defined "near shore" definition criteria (see chapter 3.3).

3.1 Qualification criteria ("Must criteria")

As per the project goals, the areas for the data collection must be nearshore coastal zones with high climate change vulnerabilities where both topography and bathymetry data is needed and will be used; These are the "must criteria" for the site selection.

A "nearshore coastal zone" is defined as "the zone extending seaward from the low water line well beyond the breaker zone; it defines the area influenced by the nearshore currents"[2].

Table 1: Qualification („must") criteria for site selection

Nr	Must Criteria	Ranking method	Fulfilled?
1	**Nearshore coastal zone**	Must criteria (area is excluded, if not fulfilled)	
2	**Topographic Lidar data needed (only for Jamaica)**		
3	**Bathymetric data needed**		

3.2 Rating criteria

The site selection criteria are based on the concept of risk impact assessment. In this approach, the probabilities and consequences of risk events are analysed.

Risk = Event probability * damage potential

Sites with high exposure to natural hazards and high damage potential are considered to have the highest risk ranking and thus the most urgent need for up-to-date high resolution elevation data.

Estimated event probabilities (= site vulnerability to natural hazard events) should be based on the frequency and severity of past occurrences and on predictive models for future trends (where available). The risks storm/hurricane damage, flooding and coastal erosion are weighted higher than the risk of earthquake and the risk of landslide/mudslide, because they lead to high vulnerability in heavily populated, built-up and industrialised areas along the shoreline and Lidar data can be better used for prevention of the damages caused by these 3 risks than by earthquake and landslide/mudslide.

In addition to the vulnerability, the damage potential at each site is assessed based on present and predicted population, infrastructure and landscape/habitat protection.

[2] Source: Mangor, Karsten (2008): Definitions of coastal terms; http://www.coastalwiki.org/wiki/Definitions_of_coastal_terms [accessed on 8-09-2017]

Table 2: Rating criteria for site prioritisation

Nr	Rating Criteria	Rating method	Rating	Weight	Score*
4	**Natural hazard vulnerability**				
	a. Risk of storm/ Hurricane damage	*Rating:* *0=low* *5=medium* *10=very high*		*30%*	
	b. Risk of flooding			*30%*	
	c. Risk of earthquake			*5%*	
	d. Risk of landslide/mudslide			*5%*	
	e. Risk of coastal erosion			*30%*	
	Total vulnerability score (TVS)				
5	**Damage potential**				
	f. Population (of the city)	*Rating:* *0=low* *5=medium* *10=very high*		*25%*	
	g. Critical Infrastructure	*Rating:* *Yes=10* *No=0*		*25%*	
	h. Protected landscape			*25%*	
	i. Planned projects			*25%*	
	Total damage potential score (TDPS)				
Total score = TVS x TDPS					

$*Score = \frac{Rating\ x\ Weight}{100}$

The product of the scores for criteria 4 and 5 will deliver the end result of the evaluation. The three areas with the highest score, which fulfil the qualification criteria will be selected for the data collection. If the score for different areas is the same, the area with the higher number of involved stakeholders will be selected.

3.2.1 Natural vulnerability

For the rating of the site selection in Jamaica I recommend to use the Natural Hazard Atlas of Jamaica written at the Mona GeoInformatics Institute (MGI) in 2011. The authors (Parris Lyew-Ayee Jr and Rafi Ahmad) have designed an atlas of Jamaica focusing on the four principal natural hazards of earthquakes, hurricanes, floods and landslides in order to increase government and public awareness of hazards in the context of the island's developmental and environmental problems.

The MGI has derived an index for natural durability profile of Jamaica's shoreline (http://blue.monagis.com/?coastal-hazard=case). I recommend to use this index for the rating of the "coastal erosion".

For the rating of the site selection in Haiti I recommend to use the Hazard Map for Haiti (February 2014) http://reliefweb.int/sites/reliefweb.int/files/resources/Multi%20Hazards%20Map.pdf.

3.2.2 Population of Jamaica

Population in Jamaica was estimated at 2.8 million people in 2015. According to the World Bank collection of development indicators, compiled from officially recognized sources, 45.21% of the population lives in rural areas. The percentage of rural population living in areas where elevation is below 5 meters MSL is 1.34%.

Four cities in Jamaica have a population larger than 100'000. 12 cities have a population less than 100'000, more than 10'000 (Source: http://worldpopulationreview.com/countries/jamaica-population/cities/).

I recommend to use the following rating for the population of the candidate sites:

- *1=low : population less than 10'000*
- *2=medium: population more than 10'000, less than 100'000*
- *3=very high: population more than 100'000*

3.2.3 Population of Haiti

Population in Haiti was estimated by the United Nations at 10.98 million people per end of June 2017. Compiled from officially recognized sources, 60% of them live in urban areas.

Eleven cities in Haiti have a population larger than 100'000. 20 cities have a population less than 100'000, more than 10'000 (Source: (http://worldpopulationreview.com/countries/haiti-population/).

I recommend to use the following rating for the population:

- *1=low : population less than 10'000*
- *2=medium: population more than 10'000, less than 100'000*
- *3=very high: population more than 100'000*

3.2.4 Critical infrastructure

Critical infrastructure is infrastructure that is essential for the functioning of a society and economy. Under this selection criteria, the following facilities are included:

- Water supply (drinking water, waste water/sewage, stemming of surface water (e.g. dikes and sluices));
- Electricity generation, transmission and distribution;
- Public health (hospitals, ambulances);
- Transportation systems (road and railway network, airports, harbours);
- Telecommunication;
- Gas and oil production, transport and distribution;

3.2.5 Planned projects

"Planned projects" includes projected areas of significant infrastructural/residential/commercial/ mining development that would significantly profit from up-to-date high resolution elevation data.

3.3 Definition of exact areas of interest

The exactly boundary of the selected areas will be defined in consultation with the stakeholders. However, the areas of interest for bathymetric data acquisition should not include areas with a water depth deeper than 30 meter, for the topographic data collection areas with an elevations more than 50 meter above mean sea level (MSL).