

GLOBAL SAND ANALYSIS SERIES

Sand Policy Review 3: Jamaica



About UNEP/GRID-Geneva

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About this document

The Global Sand Observatory initiative is UNEP/GRID-Geneva's response to requests to identify knowledge gaps under the UNEA-4 Mineral Resource Resolution (UNEP/EA.4/Res.19). During 2020 and 2021, we reviewed and assessed current terminologies, data classifications, structures, and availabilities as a contribution to orienting future actions on sand, gravel, and crushed rock extraction, transport, and use. This document is the 2nd case study of a series of 3 case study explorations. This analysis will also support academic publications currently in production at UNEP/GRID-Geneva following the UNEA-5 Minerals and Metals Management Resolution (UNEP/EA.5/Res. 12).

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Recommended citation

UNEP/GRID-Geneva. (2023). Sand Policy Review – The Case of Jamaica. GSOI-GSA-2022-006. DOI: 10.13097/archive-ouverte/unige:166917

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Layout & referencing style

This document is designed as a digital resource not intended for print. APA style (7th edition) applies for references.

Acknowledgements

This research received funding from the Federal Office of the Environment, Government of Switzerland and from the Sustainable Minerals Institute, University of Queensland.

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Abbreviations

ASM	Artisanal and small-scale mining
COVID19	Coronavirus disease
EIAs	Environmental impact assessments
GDP	Gross domestic product
GoJ	Government of Jamaica
JET	Jamaica Environment Trust

- MGD Mines and Geology Division (Of Jamaica)
- NEPA National Environmental Protection Agency (Of Jamaica)
- NGOs Nongovernmental organization(s)
- NRCA Natural Resources Conservation Authority (Of Jamaica)
- Sand The term 'sand' is used in this report to denote sand, gravel, and crushed rock resources generally.
- USD US dollar

Overview

What? This case study of Jamaica's sand and gravel resources highlights national and subnational policies, best practices and solutions currently implemented, identifying innovations that can alter the path dependencies in current sand extraction and use.

In this case study, we map a rich picture of sand resource governance, with strong contrasts between onshore and offshore sand mining, both in the regulatory framework and the end-use market governing Jamaica's sand management. In this vein, we highlight a promising substitute material, namely crushed limestone which is progressively displacing river sand in Jamaica's construction industry and exported as a raw material.

In parallel, we demonstrate how Jamaica's rich engagement of academia and civil society in the question of 1) where sand is being extracted and 2) where alternatives could be sourced from limestone quarries is leading to a healthy public debate around public policy on responsible sourcing, monitoring/surveying, and management.

Why? Identifying current governance initiatives at country, regional and global is needed for effective, equitable and coherent interventions on sand and sustainability challenges. Simultaneously, mapping the stakeholders along sand's value chain is needed to enhance connections and broker a transition to the responsible management of sand resources.

This case study frames key governance and regulatory issues in Jamaica, and considers solutions for sustainably managing sand, especially in the context of a Small Island Developing State exposed to coastal erosion and river sand depletion.

Who? The intended audience for this work is analysts and researchers, particularly in the Caribbean's, within government science institutions, academic institutions, civil society organizations aiming to support or develop research agendas on the topic of sand and sustainability.

How? Through desktop research and by engaging with Jamaican practitioners, we synthesize the latest thinking and developments in Jamaica's sand resource governance. This engagement helped identify rules governing Jamaica's sand extraction and use, a potential substitute material and the reforms needed to drive a shift to responsible sand resource management.

Limitations. While we were able to identify and frame the governance and value chain governing Jamaica's sand resources, this case study will benefit from further exchanges with local stakeholders to establish best practices for monitoring sand resources.

1. Introduction

Sand, gravel, and crushed rock (hereafter referred to as 'sand') use has tripled the last two decades to reach 40-50 billion metric tons/year globally (UNEP, 2014), with demand still growing¹. This consumption is driving environmental and social sustainability problems that are both local and global given the high number of places affected. Some countries have tailored policies for the sand extractive sector, while others have a more fragmented policy environment². Whether this situation allows for appropriate governance risks of extraction from dynamic environments like coastal, marine, and riverine sufficiently and equitably is however unclear.

1.1 Relevance

UNEA-4 specifically recognized sand's sustainability challenge in terms of its extraction³ and its use⁴ (being the major component of modern infrastructure). UNEA-5⁵ emphasizes sand's important role and that of technical standards applied to minerals sourced for construction and infrastructure development in post-COVID-19 recovery packages. In supporting this global level discussion, this case study responds to requests from UNEA-5's Mineral Resource Resolution⁶ to:

- Share knowledge and experiences regarding regulatory approaches, implementation practices, technologies, and strategies.
- 2) Identify knowledge gaps and policy options and undertake an overview of

existing governance initiatives for its sustainable management.

 Enhance connections between stakeholders along the minerals' supply chain.

In facilitating this endeavor, these case studies identify and frame common challenges and promising solutions, essential in brokering a transition to the sustainable and responsible sand sourcing and management⁷.

1.2 Case Selection

Jamaica's sand resources play a vital role in delivering ecosystem services, critical infrastructure for economic development and livelihood among communities. Yet the location, geology and geography make this Small Island Developing State prone to natural hazards (Global Facility for Disaster Reduction and Recovery, 2017), threatening Jamaica's infrastructural assets, economic development, and the resilience of its human settlements. Identifying pathways for sustainably managing Jamaica's sourcing, use and management of sand resources is critical to build the country' resilience to the impacts of climate-change. This also falls in line with its national development strategy, the 'Vision2030' calling for enhanced 'adaptive capacity towards sustainable use of natural resources' (Planning Institute of Jamaica, 2009).

¹ See (Friot & Gallagher, 2021) for an assessment of global sand stocks.

² Refer to (UNEP, 2019) for a review of regulations, policies, standards and practices regarding sand use and extraction.

³ Refer to the mineral resource governance resolution (UNEA/EA.4/L.19).

⁴ Refer to the sustainable infrastructure resolution (UNEA/EA.4/L.5).

⁵ Refer to mineral resource governance's implementation (UNEA/EA.5/L.14, 2020)

⁶ Ibid.

⁷ Refer to (UNEP/GRID-Geneva 2022a) for a review of key terms in the sand and sustainability field.

2. Background

2.1 A Rich Mining Endowment

Jamaica's mineral industry is home to:

- A well-established institutional administration structure.
- A rich mineral endowment including large deposits of sand, gravel, and limestones.
- A good export material potential, including the nearshore US.

Its main source of aggregates comes from its river systems, with approximately five significant rivers with sizeable, yet rapidly depleting sand deposits. Geological research efforts have already highlighted the impact of intensive river sand extraction on the island dating back to the 2000s (Carroll, 2008).

2.2 Economic Profile

Jamaica's economy relies heavily upon living (e.g., fisheries) and non-living (minerals) natural and/or coastal resources.

2.2.1 Mining sector

Jamaica's minerals sector is of prime economic value, providing the raw materials for the construction of Jamaica's housing, roads, agriculture, and a range of processing industries (e.g., paint manufacture, cement, plasters, fertilizer). Minerals found in Jamaica include namely: sand, gravel, and crushed limestones.

Sand mining in Jamaica is largely divided into three types of extraction:

- 1. Large-scale sand mining in terrestrial and marine environments, regulated by the Mines and Geology Ministry (MGD), and well-integrated into formal economic and legal systems.
- 2. Artisanal sand mining: "The man with a bucket and a spade by the road"⁸ is a key income source, taking place in

largely at unregulated and small-scale extraction sites. Miners place the extracted sand along the roads for a truck network to informally buy and transport the sand, gravel, and rocks away for use.

 Sand theft (without the adequate permits) from river and marine ecosystems is severe and challenging to monitor for national ministries like NEPA, both for geo-forensic reasons and because of lacking monitoring capacity⁹.

2.2.2 Beach Tourism

Jamaica's economy relies heavily on beach tourism. With increasing coastal erosion, local authorities and the tourism sector rely on beach nourishment using offshore sand to sustain the island's tourism industry. This increasing reliance on both nationally sourced and imported sand poses key questions of strategic dependence for Jamaica's supply of raw materials.

2.3 Covid-19

Covid-19 dramatically affected Jamaica sourcing and use of sand. Impacts include:

Travel and gathering restrictions, limiting local communities' ability to meet and monitor sand mining.

A battered Jamaican tourism industry and ensuing loss of economic livelihood, leading to a reduction in community-led monitoring of marine sand activities. As a Jamaican activist phrased it "those (local communities) that have had their jobs cut, they're not paying as much attention to turtles (and the impacts of marine sand mining on turtles nesting) anymore"¹⁰.

A hungry construction sector: With capital investments already in place, Jamaica's construction sector has been among the

⁸ (Interviewee 009_UG_20210322_LG, 2021)

⁹ (Interviewee 012_UG_20210422_JL, 2021);

⁽Interviewee 013_UG_20210423_JL, 2021)

¹⁰ (Interviewee 013_UG_20210423_JL, 2021); (Interviewee 014_UG_20210423_JL, 2021)

sectors the least affected by Covid-19, putting further pressure on Jamaican river sand mining.

3. The Present

With Jamaica's economic and climatechange adaption challenges in mind, we map the mechanisms governing sand in this Caribbean country.

3.1 Current Governance

Jamaica is characterized by a relatively decentralized governance system, where local authorities (officially known as Municipal Corporations in Jamaica) at the sub-national level hold regulatory powers over sand extraction. Some local authorities have sand and/or limestones sourcing explicitly integrated into their planning and procurement framework, namely for road construction. However, local authorities are acutely aware that for cost optimisation reasons, they must source resources strategically and locally where possible.

However, several issues have led to suboptimal management of Jamaica's sand resources, including:

- 1) Insufficient exploration and estimates of existing reserves.
- 2) Overlapping and outdated institutional structuring (Alec et al., 2020).
- 3) Insufficient monitoring and enforcement capacities¹¹.

3.2 Outdated legal and policy framework for EIAs

The policy and legal structures governing Jamaica's sand mining permitting, and EIA system are outdated and convoluted. Under Jamaica's sand mining permitting system, an environmental permit is mandatory depending on the project's estimated environmental impacts.

¹¹ A trend previously documented by (UNDP, 2017)

Environmental permits are required for sand mining in large-scale terrestrial and marine zones, namely when used for beach nourishment and coastal modifications. However, environmental permits are not required for sand imported from outside Jamaica's national borders. This is the namely case for sand imported from the Bahamas to enhance Jamaican beach hotels properties.

According to NEPA's Guidelines for Conducting Environmental Impact Assessments (GoJ, 2007), if an EIA is requested, the consultant who prepares the EIA should consult the residents within the community or near to the proposed site of the development and their views should be incorporated into the EIA. The NRCA may thereafter decide whether a public meeting should be held to discuss the findings of the EIA. Although fairly detailed, guidelines are discretionary. As such public participation procedures in Jamaica vary widely on a case-by-case basis. These discrepancies are also why local communities' lived experiences with air and noise pollution and insufficient restoration measures at sand mines sites have led to strong public opposition to sand mining.

Several issues undermine the efficiency of Jamaica's EIAs system:

- Conflict of interests: EIAs are undertaken by consultants contracted by the company intent on mining/quarrying. EIAs are explicitly undertaken in support of the application for an environmental permit for the proposed projects. This EIA structure throws into doubt their impartiality in assessing the potential impacts of sand mining proposals¹².
- 2) Discrepancies between EIAs' results and Jamaica's wider policy framework governing sand resources. E.g.: The EIA undertaken for the 2019 beach nourishment project at Negril Beach assessed only the project's benefits in

¹² (Interviewee 009_UG_20210322_LG, 2021; (JET, 2019b)

addressing coastal erosion on a specific section of the beach, rather the entire beach ecosystem (JET, 2019b). Moreover, this assessment didn't consider the mining and quarrying's implications for water resources and coastal vegetation in the context of future beach nourishment.

3.3 Overlapping institutional structures

Jamaica's licensing regime for river and marine sand mining is relatively well setup. However, these mining licenses' effectiveness are hampered by overlapping institutional structures and jurisdictions.

To extract sand in Jamaica, a quarry license and an environmental permit are required, each respectively issued by the M&GD under the Mining Act (1947), and by NEPA under The Natural Resources Conservation Authority Act (NRCA Act 1991). However, in the absence of an environmental permit, mining applications can be presented to Jamaica's Quarries Advisory Committee (QAC) that grants a mining right in replacement of an environmental permit. Local NGOs have long objected to this practice of allowing approval by the QAC to replace an application for an environmental permit under the NRCA Act.

3.3.1 Licensing for river sand mining

Regulations for river sand mining primarily aim to ensure that sand extraction does not cause river floods and primarily targets large-scale river sand mining. Yet, enforcement is challenging, with sand mining without the necessary permits being a recurrent issue in Jamaica.

Beyond the forensic challenges in tracking sand's extraction point in a river system,

illegal sand mining is hard to monitor. Engagement with Jamaican stakeholders¹³ confirmed that local authorities lack the resources and expertise to adequately monitor river sand mining. Local NGOs often receive reports that even licensed river mining does not adhere to the original licenses' conditions.

The Jamaica Constabulary Force (Jamaica's national police) in charge of enforcement mainly focuses on large quarries and production sites. Given ASM's livelihood importance, local authorities won't touch and police the "*little man with his bucket*"¹⁴.

3.3.2 Licensing for marine sand mining

Sand mining in marine environments is regulated under the The Beach Control Act (2004) when there is an identified need for coastal modifications and beach nourishments activities¹⁵.

In the wake of coastal erosion, onshore and offshore marine sand mining is anticipated to grow to support Jamaica's national coastal resilience strategy, as confirmed by a senior Jamaican civil servant¹⁶. **Geological research has also helped to lend support to the suitability of offshore marine sand for Jamaica's beach nourishment.**

3.3.3 The example of Duncan's Bay

The example of the sand mining process at Duncan's Bay in 2014 illustrates some of the regulatory gaps within Jamaica's national marine sand framework, including a complicated mining permitting process. In 2014, Duncan's Bay was selected for tourism development with the construction of a large-scale hotel complex, despite not receiving a license

^{13 (}Interviewee 013_UG_20210423_JL, 2021)

⁽Interviewee 014_UG_20210423_JL, 2021)

 ¹⁴ (Interviewee 009_UG_20210322_LG, 2021)
¹⁵ For a review of Jamaica's beach license application process, refer to the GoJ's national coastline and restoration guidelines: (Global Facility

for Disaster Reduction and Recovery, 2017);

⁽Government of Jamaica, 2020).

¹⁶ (Interviewee 012_UG_20210422_JL, 2021)

under the Beach Control Act. This decision to issue a marine sand mining license ignored evidence that the operation risked destroying turtle habitats, beach vegetation and mangroves. Despite community led opposition and NEPA's documentation of environmental damages resulting from excavating beach vegetation, sand mining permits were issued and later renewed.

Other issues with Duncan Bay's sand mining license include:

- Insufficient restoration measures, highlighting the M&GD's limited expertise in beach ecology.
- Public consultations held on short notice with limited stakeholder representation.

This example speaks to a national regulatory strategy to grant a sand mining permit with stringent extraction and restauration conditions rather an outright refusal to mine sand in certain areas.

3.4 A multi-stakeholder environment

Jamaica's rich engagement of academia and civil society in the question of

- 1) where sand is being extracted and
- 2) where alternatives could be sourced from limestone quarries

is leading to a healthy public debate around public policy on responsible sourcing, monitoring/surveying, and management. This speaks to the importance of an ecosystem of actors working together. Two reasons were paramount in driving this public debate: concerns with environmental degradation and an acute awareness of sand's strategic economic value.

3.4.1 Environmental degradation

There is strong public interest in sand mining's environmental impacts, in particularly for risks of flooding, earthquakes, noise and dust pollution. As several Jamaican environmental advocates mention, local communities know that sand is a finite resource with implications for coastal erosion and biodiversity conservation¹⁷.

In the case of Duncan Bay, local communities documented that this extraction site was located in a turtle nesting zone. The community attended public meetings, wrote directly to Members of Parliament, regulators, and the media. This community-led advocacy against sand mining in Jamaica are largely driven by lived experiences of environmental degradation brought about by legally permitted mining conditions.

3.4.2 Economic interests

Given marine sand's strategic importance for Jamaica's beach tourism industry and its ensuing economic livelihood, there is a strong community interest in preserving and enriching Jamaican coastlines. Beach nourishment efforts are also part of this public conversation, with strong public concern with sand extraction and beach losses' impacts for earnings arising from Jamaica's beach tourism economy.

¹⁷ (Interviewee 013_UG_20210423_JL, 2021); (Interviewee 014_UG_20210423_JL, 2021)

Jamaica's sand resource governance is characterized by:

- Outdated & convoluted legal and policy framework for EIA, including namely conflicts of interest and poor public consultation process. E.g.: Case of Negril Beach.
- Overlapping institutional structures governing sand mining permitting, in the absence of an overarching national framework, e.g.: Case of Duncan's' Bay.
- **Rich engagement of academia and civil society** in the question of 1) where sand is being extracted and 2) where alternatives could be sourced from limestone quarries. This is leading to a healthy public debate around public policy on responsible sourcing, monitoring, and management

4. Jamaica's Resource Regime

A value chain framework helps characterize the different sand resource users, highlighting the

institutions governing their actions (Figure 1).



Figure 1: Jamaica's sand value chain

Source: (Authors' Compilation 2021)

Primary & secondary sourcing: River sand is sourced from:

- Rio Cobre and Yallahs rivers 10 to 20 KM from Kingston.
- Rio Minho and Morant River, 40 to 50KM from Kingston.

The Rio Minoh was as of writing, noted as a main extraction site for river sand, a switch driven by depletion at the rivers closer to the capital Kingston. Engagement with local stakeholders confirmed that this added distance increased sand prices¹⁸. Marine sand is dredged nearshore in Jamaica (around 300 meters off coast), albeit on a smaller scale compared to river sand mining.

Processing, trade, and transport:

Transport and distance range are the prime factors in setting sand's price. The maximal distance sand travels is 60 km, or else its sourcing doesn't breakeven in Jamaica.

Sand and gravel will be extracted and transported across short to medium

¹⁸ (Interviewee 009_UG_20210322_LG, 2021)

distances in Jamaica. However, if naturally occurring sand¹⁹ and gravel are not available locally, as in Western Jamaica, local authorities switch to crushed limestones amongst other materials for their procurement. Thus, when transport economics don't support sourcing, a market-led transition to alternatives to river sand has taken place in Jamaica.

Demand: Sand and its by-products mainly serve in construction (concrete production for roads and high value buildings), beach nourishment and the food, cosmetics, and pharma industries.

4.1 Simple Resource Regime

This value chain (Figure 1) underscores that the management of sand lies in the hands of numerous institutions and actors. To capture their relationship, we draw on institutional resource regime studies (Gerber et al., 2020) to highlight the formal and informal rules governing sand resources' extraction, originating from public policies and the property-rights system. This framework help stress the

uncoordinated distribution of usage rights for sand.

The regulatory regime governing Jamaica's sand resources and its related goods and services is in place, yet it is incoherent. This resource regime is characterized by poorly defined property rights and complicated procedures for community participation in sand mining projects' assessment and monitoring. This incoherence in both property rights and policies limits efforts to regulate controlled access.

4.2 Stakeholder Analysis

To capture this fragmented governance, we map how actors are integrated into Jamaica's value chain. Who are the influential stakeholders, what are their interests and how do they leverage their power in brokering a transition? In this process, we identified elements of responsible sand sourcing, barriers to change and drivers of perceived deficiencies²⁰. We classify stakeholders by their decisional level along the vertical axis and involvement in the sand value chain (Table 1).

¹⁹ For a review of the definitions of sand, refer to (UNEP/GRID-Geneva, 2022b). ²⁰ A stakeholder analysis seems particularly suitable

for this research underscoring the multi-actor

character of sand extraction which transcends hierarchical boundaries.

Stakeholder	Decisional level	Value chain stage
MGD	National	Transversal/centralized
NEPA	National	Transversal/centralized
Local authorities & Jamaica Constabulary Force	Sub-national	Primary source; Initial processing, trade, and transport
Private sector	International	Transversal/centralized
Academic institutions	National	Transversal/centralized
NGOs	Local	Transversal/centralized
Local communities	Local	Transversal/centralized

Source: (Authors' compilation, 2021)

The Mines and Geology Division (MGD) is Jamaica's national regulatory body whose prime responsibility in the context of sand, is to assess and grant licenses for mining

exploration and extraction. In this licensing and approval process, the MGD consults with NEPA, the Water Resources Authority and the local planning authorities for environmental and planning topics.

The National Environment and Planning Agency (NEPA) is Jamaica's national environmental regulatory body, whose policy focus is increasingly turning towards coastal resilience. One of NEPA's key responsibility in the context of sand is to grant environmental permits and beach licenses.

Local authorities (Municipal Corporations in Jamaica) are a key decision-maker in how much sand is mined, transported and which end-use applications it serves. Together with the Jamaica Constabulary Force, they hold the regulatory powers to inspect, police and enforce formal rules governing sand mining activities.

The private sector and namely the construction industry, rely heavily on sand availability for concrete production, whereas the tourism industry and related hospitality industries all require a healthy coastal environment to sustain the economy. Academic institutions like the University of the West Indies, carry out essential inland and coastal zone management research. This research is key to understand Jamaica's natural environment, educate and train local communities on sustainable best practice and influence government inland and coastal policies.

NGOs are essential in implementing Jamaica's national programs related to minerals and sand sourcing, management, and use. Stronger collaboration between the GoJ and NGOs could help create improved dialogue and tackle regulatory enforcement issues. Jamaica's NGOs also provide a vital function of educating local communities, carrying out critical scientific research and monitoring.

Local communities are pivotal in any intervention targeting Jamaica's sand sourcing, management, and use. Through their monitoring work, this end-user group regularly provides knowledge which can serve in ensuring suitable interventions are chosen, providing benefits to communities.

5. Future Outlook

In brokering a transition to circular economy solutions for sand consumption and production, we evaluate Jamaica's future outlook, including substitute materials²¹ and policy options.

5.1 Substitute Materials: The Case of Crushed Limestone

Limited supply, combined with large infrastructure construction needs means that Jamaica is examining alternative materials, including crushed limestone. The material is already sourced for use in road constructions in Jamaica, particularly in localities close to limestone quarries.

Benefits:

- Large mineable reserves of high purity limestone.
- Large potential customer base for its end products (PwC Jamaica, 2020);
- A strategic location in relation to North and South America.

Challenges:

- Ensuring that limestone quarries are sufficiently isolated from local communities and water sources.
- Managing the impacts of removing forests meant for limestone quarrying on biological diversity. Solutions remain limited for restoring biodiversity in dry limestone forests.
- Limestone's mineral characteristics mean that this material cannot serve for Jamaica's growing beach nourishment activities, limiting its application scope.

5.1.1 Drivers to Substitution

Drivers to substituting to crushed limestones in Jamaica include:

River sand depletion, driving a switch to sourcing limestone instead. River sand prices are also rising, challenging the reliance on cheap river sand sourcing used in construction. **Transport cost:** When constructing in an area with low sand availability and beyond 60km, transport economics mean that companies and local authorities source crushed limestones instead of sand.

The proximity of key export markets like Florida State with a strict regulatory framework on minerals extraction, further incentivises a substitution to crushed limestones.

5.1.2 Barriers to Substitution

However, politico-economic, and technical barriers remain for this substitute material's adoption at scale²²:

Poor road and transport network

impeding the development of a solid limestone export base. A well-integrated transport network is key to give Jamaica's limestone export a competitive advantage on international aggregates markets.

Insufficient research available on alternative products like limestones and its derivatives' value-add in construction.

Poor public acceptability among local communities, leading to pushback against new limestone quarrying (e.g.: in the isolate area of Dry Harbor Mountains). Solving this public acceptability challenge will require awareness-raising and more ambitious restoration measures following sand mining sites' closure, including managing sediments run-off and the impact of forest removal for limestone quarrying on biological diversity.

5.2 Policy Options

5.2.1 Reform the EIA policy and legal framework

Jamaica's EIA decision-making process is not fit-for-purpose, with poor stakeholder

²¹ By substitute materials, we refer to by-products of economic activities that displace the use of sand sourced from the natural environment.

²² We use (Kapoor et al., 2014)'s innovation adoption framework to capture a set of interrelated hypotheses for what will influence adoption of substitute materials in accordance with motivations.

engagement, limited regulations, and low transparency in its process.

Rather than having the company intent on mining select the EIA consultant, Jamaica's national environmental regulatory authority NEPA should oversee this process. NEPA should request independently the EIA and cost recover the assessment from the company intent on mining. Our engagement with practitioners²³ confirmed that Jamaica's EIAs should also place more emphasis on the geological component of intervention sites to map sand mining sites' geological features.

5.2.2 Promote stakeholder engagement

Although potentially not the entire solution, early stakeholder engagement with communities prior to mining plans' development would allow discussion around key concerns and potential solutions²⁴.

At onshore mining sites:

Any stakeholder engagement strategy should:

- Establish consensus-agreed quarry zone, considering the proximity of human settlements and potential environmental impacts²⁵.
- Promote job opportunities for local communities at quarries.
- Institute legally required restoration activities following mining activity closures.

At offshore mining sites:

Any stakeholder engagement strategy should work with local communities including the users of the area and fishing communities to establish **comprehensive** guidelines defining:

- Inshore/offshore sand transport ranges.
- Rules-of-use applied to hard interventions like non-permeable solid breakwaters.
- Perimeters for coastal zone modification that considers seagrass' ecological importance for sedimentation and coastal systems' health.

The case of Negril beach, where permanent solid breakwaters were installed to tackle coastal erosion (JET, 2019b) demonstrated a need for:

- Stronger stakeholder engagement.
- Comprehensive guidelines underpinning beach nourishment strategies, in line with marine sand's ecological functions and supply systems ((O'Brien, 2014); (McDougall, 2017)).

Promising work has started to establish best practices engaging stakeholders in Jamaica's national beach restoration and management activities ((Government of Jamaica, 2020); (Global Facility for Disaster Reduction and Recovery, 2017)). Future interventions for responsibly managing sand offshore sand resources should build upon such efforts.

5.2.3 Map and monitor sand resources

Resource mapping across geological domains (riverine, coastal, and marine namely) is essential to understand Jamaica's resource availability and risks of river sand depletion. Currently lacking information limits the benefits of regulated sand mining activities. Only by providing data and maps can alternatives be considered, and choices made to opt for an efficient and just sand sourcing, management, and governance (UNEP, 2022).

 ²³ (009_UG_20210322_LG, personal communication, March 22, 2021)
²⁴ (009_UG_20210322_LG, personal communication, March 22, 2021); (UNDP, 2017)

²⁵ The case of Duncan Bay provides an example of how improved transparency and stakeholder involvement in the permitting process is essential for a mining project's public acceptability and success.

For river sand:

Baseline studies of river sand deposits across Jamaica are essential to estimate the adequate number of licenses for river sand extraction. Efforts are underway, but more research is needed to update Jamaica's geological database of known and predicted materials. Such monitoring efforts should be standardized through guidelines and best practices.

For marine sand:

Monitoring is required for Jamaica's marine sand deposits²⁶. As of writing, no comprehensive data exists on the quantity and volume of offshore sand suitable for use in Jamaica, a call voiced in consensus

by Jamaican academia, public sector, and NGOs²⁷. In the context of sand increasingly sourced from abroad for hotel construction and beach nourishment, knowledge sharing among national and foreign stakeholders is essential.

There are currently no mechanisms for tracing the impact of imported marine sand used in beach nourishment and hotel constructions in Jamaica.

Monitoring efforts should therefore work to establish mechanisms tracing imported sand's origins.

What now? Options for responsibly governing sand in Jamaica

- Reform the EIA policy and legal framework by namely (1) bestowing NEPA the regulatory powers undertake the EIAs, and by (2) placing more emphasis on the geological components in the assessments of mining interventions' impacts.
- **Promote stakeholder engagement** in evaluating and monitoring the impacts of sand mining, both at onshore and offshore sites.
- Map and monitor sand resources through baseline studies of sand deposits in both river and marine environments. For sand imported for hotel constructions and beach nourishment, establishing tracing mechanisms for the sand's origins is essential.

²⁷ (Interviewee 009_UG_20210322_LG, 2021); (Interviewee 012_UG_20210422_JL, 2021); (Interviewee 013_UG_20210423_JL, 2021)

²⁶ (Interviewee 012_UG_20210422_JL, 2021)

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