# Technical Cooperation Document

## I. Basic Information for TC

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|---|---|
| ▪ Country/Region: | REGIONAL |
| ▪ TC Name: | Integrated Sargassum Management for the Wider Caribbean: Mapping, Technological Advancements, and Research Collaborations |
| ▪ TC Number: | RG-T4374 |
| ▪ Team Leader/Members: | Bucaram Villacis, Santiago Junior (CSD/RND) Team Leader; Guerrero Compean, Roberto (CSD/RND) Alternate Team Leader; Moreda Mora, Adela (CSD/RND) Alternate Team Leader; Bonilla Merino Arturo Francisco (LEG/SGO); Chavez, Elizabeth (CSD/RND); Damais, Gilles Georges (CSD/RND); Diaz Gill Virginia Maria (LEG/SGO); Garay Armoa, Pedro Vicente (CSD/CSD); Hincapie Salazar, Daniel (CSD/ACU); Luis De Los Santos (CSD/RND); Restrepo, Lisa Sofia (CSD/RND); Rojas Sanchez, Laura Natalia (VPS/VPS); Soares, Yuri Suarez Dillon (LAB/STI); Ramirez Rufino, Smeldy |
| ▪ Taxonomy: | Research and Dissemination |
| ▪ Operation Supported by the TC: | N/A |
| ▪ Date of TC Abstract authorization: | 21 Sep 2023 |
| ▪ Beneficiary: | Bank member Countries from CID and CCB |
| ▪ Executing Agency and contact name: | Inter-American Development Bank |
| ▪ Donors providing funding: | OC SDP Window 2 - Sustainability(W2A) |
| ▪ IDB Funding Requested: | US$1,000,000.00 |
| ▪ Local counterpart funding, if any: | US$0 |
| ▪ Disbursement period (which includes Execution period): | 36 months |
| ▪ Required start date: | January 2024 |
| ▪ Types of consultants: | Individual Consultants and Firms |
| ▪ Prepared by Unit: | CSD/RND-Env, Rural Dev & Disaster Risk |
| ▪ Unit of Disbursement Responsibility: | CSD/RND-Env, Rural Dev & Disaster Risk |
| ▪ TC included in Country Strategy (y/n): | N/A |
| ▪ TC included in CPD (y/n): | N/A |
| ▪ Alignment to the Update to the Institutional Strategy 2020-2023: | Productivity and innovation; Environmental sustainability |

## II. Objectives and Justification of the TC

2.1 The objective of this Technical Cooperation (TC), encompassing both research and dissemination, is to foster an integrated and adaptive approach related to the Sargassum problem in the Wider Caribbean. By channeling financial resources into multidisciplinary research, this TC will strive to uncover innovative solutions and insights that will underpin effective mitigation and adaptation strategies. The outcomes of this research are crucial for developing comprehensive policies that will guide strategic oversight and operational execution of measures to counteract the Sargassum surge in the Wider Caribbean. Our approach goes beyond addressing the immediate difficulties presented by Sargassum, extending to fortify our enduring commitment to maintaining the region's ecological equilibrium and bolstering its resilience against analogous environmental challenges in the future.

2.2 The Wider Caribbean, which includes Central America, Mexico, and the Caribbean islands among other regions, boasts an extensive 86,900 km of coastline. This coastline plays a crucial role in the area's ecological and economic stability. The coastal zones are pivotal to the region's GDP and demographic concentration, largely owing to the economic influx from sectors like fisheries, tourism, and transportation. For instance, in 2019, tourism alone contributed 14% to the Caribbean's total GDP, generating an impressive US$61.5 billion, supporting 2.75 million jobs, and accounting for 21% of total exports (World Travel & Tourism Council, 2020).

2.3 However, since 2011, this region has been grappling with an unprecedented influx of pelagic Sargassum, a variety of brown macroalgae. The year 2018 was particularly challenging, with more than 20 million tons of Sargassum swamping the Caribbean Sea (Hu et al., 2019). While Sargassum is an integral component of the marine ecosystem—offering food, refuge, and nutrients—its excessive beaching events have raised environmental and socio-economic alarms.

2.4 The reasons behind this extraordinary Sargassum bloom are complex and interlinked:

a. **Increased Nutrient Load from River Basins:** Rampant deforestation and urban sprawl in river basins like the Amazon and the Orinoco have escalated the nutrient content in these rivers, flowing into the ocean and contributing to Sargassum proliferation (Brooks et al., 2020).

b. **Sahara Dust Contribution:** The transatlantic journey of dust from the Sahara Desert is known to deposit vital nutrients into the Caribbean waters, inadvertently enhancing Sargassum biomass (Garrison et al., 2020).

c. **Shifts in Upwelling Patterns:** Oceanographic changes, particularly in regions off North-Eastern Africa, have increased nutrient accessibility, favoring Sargassum blooms (Johns et al., 2020).

d. **Abnormal Wind Patterns:** Meteorological shifts in the central eastern Atlantic have potentially set the stage for nutrient build-up, spurring Sargassum growth (Wang et al., 2019).

e. **Rising Sea Temperatures:** Climatic change, evidenced by warmer ocean waters, is known to accelerate the metabolic rates and consequent expansion of Sargassum (Gower and King, 2020).

f. **Changes in Mixed Layer Depth:** These variations can mediate the nutrient availability in surface waters, encouraging more Sargassum blooms (Foltz and McPhaden, 2020).

g. **Overfishing:** This disrupts marine food webs, possibly creating ecological niches where Sargassum can thrive uncontrolled (Oerther, 2019).

2.5 The Sargassum influx has precipitated a two-pronged crisis in the Caribbean, environmental and economic:

a. **Environmental Impacts:** The decomposition of beached Sargassum diminishes oxygen levels in the water, causing marine hypoxia, and emits sulfurous gases detrimental to marine fauna and water quality (Fromard et al., 2021).

b. **Economic Impacts:** The invasion of Sargassum, especially on tourist-frequented beaches, can repel visitors, affecting the tourism industry. For example, Quintana Roo in Mexico experienced over an 11% contraction in

economic activities due to Sargassum infestations (*Secretaría de Turismo*, 2019). The Caribbean's cleanup bill in 2018 alone was a staggering US$120 million, with locales like Quintana Roo allocating up to US$1.5 million annually for this purpose.

c. **Health Concerns:** Rotting Sargassum not only emits noxious gases but also becomes a breeding ground for bacteria, posing respiratory and dermatological risks (Olsen et al., 2019).

d. **Impact on Fishing:** Dense mats of Sargassum impede fishing operations by entangling fishing equipment and obstructing marine navigation (FAO, 2020).

e. **Coastal Erosion:** Heavy blankets of Sargassum on beaches can intensify erosion, jeopardizing the stability of coastal biomes (Webb et al., 2019).

f. **Biodiversity Impact:** An overabundance of Sargassum can disrupt marine habitats, prompting shifts in species composition and biodiversity (Milledge et al., 2020).

2.6 While Sargassum fulfills critical ecological functions in moderate quantities, its recent unprecedented proliferation in the Caribbean poses significant challenges. Addressing the root causes and mitigating the negative impacts demand a cohesive strategy involving all regional stakeholders. This initiative should encompass immediate remedial measures as well as long-term strategies, including sustainable coastal management, investment in early detection research, biotechnological applications of stranded Sargassum, and the enhancement of regional cooperation and policy frameworks (UN Environment Programme, 2021). The Sargassum issue highlights the need for proactive involvement and resilient adaptations amid the complex marine environmental challenges we face.

2.7 Nonetheless, bridging the knowledge gap related to the Sargassum phenomenon across various disciplines is a preliminary yet essential step. In essence, integrated management of Sargassum calls for a comprehensive approach that includes ecological, socio-economic, and technological considerations (Johnson et al., 2021), with thorough research forming the cornerstone of this endeavor. Accordingly, this TC will allocate funds for intensive exploration into three primary areas: (i) socio-economic impacts; (ii) natural science aspects; and (iii) technological innovations, thereby establishing a scientifically sound platform for decision-making.

2.8 In conclusion, by strategically directing financial resources to these research areas, this TC seeks to solidify the scientific groundwork required for enlightened policy-making and adaptive management approaches, ultimately contributing to the alleviation of the Sargassum crisis in the Wider Caribbean region.

2.9 This TC represents the Bank's initial action in a series of strategic operations aimed at addressing the ongoing Sargassum challenge in the Wider Caribbean. This aligns with the Inter-American Development Bank (IDB)'s primary goal of enhancing the quality of life and encouraging sustainable economic development throughout Latin America and the Caribbean. Given the diverse challenges posed by the Sargassum issue, spanning ecological impacts to socio-economic consequences, the Bank is dedicated to utilizing advanced technological solutions, promoting regional collaboration, and applying innovative methods. These efforts are geared not only toward addressing immediate concerns but also toward ensuring lasting resilience and prosperity for the regions affected.

2.10 This TC aligns seamlessly with the Second Update of the Institutional Strategy (AB-3190-2), particularly addressing the strategic priorities of "Productivity and Innovation" and “Climate Change and Environmental Sustainability”. In the case of “Productivity and Innovation” this TC aligns by investing in multidisciplinary research to unearth innovative solutions, this initiative directly fosters innovation, crucial for developing new methods and technologies to mitigate and adapt to environmental challenges. These efforts are pivotal in enhancing the productivity of affected sectors like tourism and fisheries, as effective Sargassum management strategies will restore and potentially boost their efficiency. Furthermore, the focus on formulating comprehensive policies and strategic oversight based on the research outcomes exemplifies an innovative approach to environmental management. This not only addresses the immediate issue but also sets the stage for long-term ecological balance and resilience. In essence, the TC's integrated and adaptive strategies reflect a commitment to sustainable innovation and productivity, essential for facing current and future environmental challenges in the region.

2.11 On the other hand, the TC's holistic and adaptive strategy towards the Sargassum issue aligns with the key theme of "Climate Change and Environmental Sustainability." This approach not only tackles immediate challenges posed by Sargassum but also focuses on maintaining the region's ecological balance and building resilience against future environmental threats. Central to this initiative is the emphasis on multidisciplinary research and innovative solutions, crucial in addressing the wide-ranging impacts of climate change. The project is dedicated to developing comprehensive mitigation and adaptation strategies, essential for lessening the Sargassum's effects on ecosystems and communities. Furthermore, it plays a critical role in guiding policy development and strategic planning, catering to both immediate needs and long-term sustainability goals. By bolstering the region's capacity to withstand similar future environmental challenges, the TC significantly contributes to global efforts in managing climate change effects, particularly in marine ecosystems, thus affirming its vital role in promoting environmental sustainability on a broader scale.

2.12 The TC is also aligned with the Integrated Strategy for Climate Change Adaptation and Mitigation, and Sustainable and Renewable Energy (GN-2609-3), as well as the Sectoral Framework Documents for Agriculture (GN-2709-10), Environment and Biodiversity (GN-2827-8), and Climate Change (GN-2835-13).

2.13 In addition, this TC, aimed at tackling the Sargassum challenge in the Wider Caribbean, is closely aligned with Priority Area 1 - Climate Change and Environmental Sustainability - of OC SDP Window 2 - Sustainability (W2A) (GN-2819-14). It embodies Window 2's commitment to innovative and multidisciplinary research, focusing on developing strategies for effective mitigation and adaptation. This approach not only addresses the immediate Sargassum issue but also enhances the region's ecological stability and resilience, adhering to Window 2's broader goals of sustainable development and strategic resource allocation. Therefore, the TC represents a proactive and essential contribution to Window 2's efforts in tackling pressing environmental challenges.

2.14 Finally, this TC is closely aligned with the United Nations Sustainable Development Goals (SDGs), particularly focusing on SDG 14: Life Below Water, which emphasizes the conservation and sustainable use of oceans, seas, and marine resources. Additionally, it supports SDG 13: Climate Action, which calls for urgent action to combat climate change and its impacts. This alignment ensures that the cooperation

contributes meaningfully to global efforts in preserving marine biodiversity and addressing climate-related challenges.

## III. Description of activities/components and budget

3.1 **Component 1: Advancing Socio-Economic Resilience against Sargassum Impact in the Wider Caribbean (US$360,000).** This component delves into the socio-economic consequences of sargassum influxes in the Wider Caribbean Region. Its primary goal is to foster studies assessing these repercussions, thus guiding strategies to bolster economic resilience and protect local livelihoods. The initiative sponsors several key studies: (i) Examining sargassum's impact on tourism, fishing, local economies, and coastal community health; (ii) Collaborative research with stakeholders from tourism, fishing, environmental health, community development, and coastal resource management. This study aims to define the severity and extent of sargassum events while also probing human well-being and indigenous ecological insights; (iii) Crafting best practice guidelines for fishermen and sargassum management plans for countries in the Wider Caribbean; and (iv) Designing innovative solutions to lessen economic strains on the tourism sector within the Wider Caribbean; among other studies. The latter studies are pivotal for helping to design evidence based- policies to counter the challenges sargassum presents.

3.2 **Component 2: Advancing Knowledge through Natural Science Research on the Sargassum Issue in the Wider Caribbean (US$500,000).** This component focuses on fostering knowledge generation through dedicated natural science research concerning the burgeoning issue of Sargassum in the Wider Caribbean. This initiative emphasizes the promotion of studies aimed at comprehending the biological and ecological elements propelling the excessive growth of Sargassum. Particular attention will be paid to oceanographic conditions, climate variability, and nutrient availability, which are contributing factors previously highlighted in scholarly articles (Brooks et al., 2019; Putman et al., 2018). The funded research encompasses several critical areas: pinpointing the origin areas and transport paths of Sargassum, conducting genetic and morphological studies to identify the Sargassum species reaching Caribbean shores, and investigating the oceanographic and climatic conditions that encourage Sargassum proliferation and transportation. Furthermore, the initiative supports the development of predictive models for Sargassum arrival, assesses its impact on coastal ecosystems—including beach erosion, the buildup of decaying organic matter, and effects on seagrass and corals—and examines Sargassum's interaction with pelagic fisheries in the Eastern Caribbean, thereby guiding best practices for fishermen. It also evaluates the repercussions of Sargassum waste on coastal ecosystems, involving shoreline erosion, the emergence of Sargassum Brown Tides that hinder underwater photosynthesis, the creation of oxygen-deprived environments, water acidification, and temperature escalation, among others.

3.3 For the execution of the activities of this component, a public and/or private institution with extensive experience in providing technical and scientific information will be hired. This information should contribute to the sustainable use and conservation of coastal marine resources in countries of the Wider Caribbean. Furthermore, the institution should specialize in conducting research, studies, and evaluations on the status of fishery populations, the condition and integrity of aquatic ecosystems, the biology of species, and techniques and technologies for the sustainable use of marine resources. Additionally, the institution must have the ability to engage in technical dialogues with governments from the Wider Caribbean. Through these discussions, the aim is to

support decision-making processes to establish policies, regulations, and strategies that ensure the sustainable exploitation of marine resources, the integrity of the region's marine ecosystems, and the sustainable development of activities leveraged by marine resources in the countries. Preference will be given in the selection process to an institution that possesses a research vessel, facilitating the execution of the studies outlined in this Component.

3.4 **Component 3: Advancing Knowledge on Technological Innovations for Sargassum Mitigation and Adaptation in the Wider Caribbean (US$80,000).** This component focuses on dedicated research aimed at identifying cutting-edge technologies designed to either mitigate the impact of Sargassum seaweed along the coastlines of the Wider Caribbean or adapt to this burgeoning phenomenon. For instance, there's a substantial investment in research to determine the evolution of, and utilization of, remote sensing technologies for early detection and consistent monitoring of Sargassum distribution and movements. Additionally, this component promotes research focused on identifying uses for Sargassum, such as biofuel production, fertilizers, and pharmaceuticals. By doing so, this challenge could be transformed into a multifaceted opportunity that fosters environmental resilience, economic innovation, and sustainable development within affected communities. This approach not only addresses immediate ecological concerns but also propels forward-thinking- economic and environmental strategies. To further augment our efforts, this component will finance studies aimed at establishing an innovative solutions repository to mitigate the impacts of Sargassum on tourism and fisheries. It will also fund research aimed at mapping out existing initiatives across various Wider Caribbean nations, positioning them as a collaborative force to control and mitigate the Sargassum influx.

3.5 **Component 4: Knowledge Dissemination (US$60,000).** This component aims to effectively and strategically disseminate the research results derived from the studies funded by this TC. We intend to organize workshops engaging sector specialists and government authorities, alongside with academia, think tanks, and technical officials to share and discuss the study results. To expand our reach and amplify the impact of our knowledge products, we also plan to conduct presentations for journalists and implement a comprehensive dissemination strategy across social networks.

3.6 The beneficiary countries for the sargassum studies funded by this TC will be identified in due course. The initiative will exclusively target member countries of the IDB within the CCB and CID regions. These countries must have coastlines within the Wider Caribbean region and be impacted by sargassum influxes. The allocation of resources will follow a 'first come, first serve' basis, contingent upon the requests received from these countries. Prior to initiating research activities, letters of non-objection will be requested from the selected countries.

3.7 The comprehensive research approach to be applied by the studies funded by this TC aims not only to address immediate concerns but also to pave the way for long-term solutions and collaborations. As part of this commitment, a diverse range of studies is planned; at least four will delve into the socioeconomic implications of the sargassum problem (i.e., a study will be conducted for each of the four countries, which will be selected and determined at a later stage), one will focus on its natural science aspects, and two will explore technological innovations to manage and possibly utilize this seaweed. This multifaceted approach ensures a holistic understanding and equips these nations with the knowledge and tools to tackle the challenges posed by sargassum. We believe that these investigations will provide valuable insights,

promote interdisciplinary collaboration, and drive innovative solutions to benefit both the environment and the affected communities.

3.8 In the process of identifying the studies to be financed by the Technical Cooperation (TC) and their execution, we will engage extensively with academic stakeholders and institutions across the CID and CCB countries. This collaboration is pivotal, as these academic entities possess a wealth of specialized knowledge and expertise that is crucial for determining the direction and focus of the TC. By establishing a dialogue with these institutions, we aim to identify current demands and pressing necessities in the field. This approach ensures that the TC activities are not only aligned with the latest academic research and insights but also address specific regional needs and challenges. These academic entities will play a key role in shaping the TC's agenda, offering valuable perspectives on emerging trends, technological advancements, and innovative methodologies in environmental and climate studies. Their input will be instrumental in refining the TC's objectives, ensuring that the initiatives are both relevant and impactful. Furthermore, this collaboration fosters an environment of knowledge exchange, where academic insights can inform practical applications, and conversely, field experiences can enrich academic understanding. This synergy is essential for developing comprehensive, evidence-based strategies to tackle environmental challenges effectively.

3.9 The total budget allocated for this Technical Cooperation (TC) is US$1,000,000, which will be exclusively financed through the OC SDP Window 2 – Sustainability (W2A) fund. There is no requirement for counterpart funding in this TC.

**Indicative Budget**

| Activity/Component | Description | IDB/Fund Funding | Total Funding |
|---|---|---|---|
| Component 1: Advancing Socio-Economic Resilience against Sargassum Impact in the Wider Caribbean | This component will fund comprehensive socio-economic research on the effects of sargassum influxes in the Wider Caribbean Region, aiming to bolster economic resilience and protect local livelihoods. | US$360,000 | US$360,000 |
| Component 2: Advancing Knowledge through Natural Science Research on the Sargassum Issue in the Wider Caribbean | This component will fund research focus on understanding the biological, ecological, and oceanographic factors driving Sargassum's excessive growth. | US$500.000 | US$500.000 |
| Component 3: Technological Innovations for Sargassum Mitigation and Adaptation in the Wider Caribbean | This project component focuses on funding advanced technology research to address the Sargassum seaweed crisis in the Wider Caribbean. | US$80,000 | US$80,000 |
| Component 4: Dissemination | This component seeks to strategically disseminate research findings from studies funded by this TC | US$60,000 | US$60,000 |
| **Total** | | US$1,000,000 | US$1,000,000 |

## IV. Executing agency and execution structure

4.1 This Technical Cooperation (TC) will be executed and supervised by the IDB, as it is an initiative of the Bank. Specifically, it will be overseen by the Environment, Rural Development, and Disaster Risk Management Division (CSD/RND). A Sector Specialist from RND will serve as the focal point for this project. The execution timeline for the project is established at 36 months.

4.2 Supervision and monitoring will be carried out in accordance with the terms of the Terms of Reference. No supervision costs are foreseen since this will be carried out directly from CSD/RND. Likewise, an evaluation report will be made at the close of the TC, which will identify achievements and lessons learned. The Bank, acting as the executing entity, will submit annual progress reports and a final project report through the appropriate system. These reports will detail the progress made, results achieved, the status of planned activities, challenges encountered, and recommendations for adjustments during the remaining implementation period, among other aspects. All these monitoring and reporting activities will be carried out in accordance with the policies established by the Technical Cooperation Monitoring and Reporting System (OP-1385-4).

4.3 The procurement activities to be executed under this operation have been included in the Procurement Plan (Annex IV) and will be executed in accordance with the IDB's established procurement methods. Specifically, the Bank will follow its procurement policies and guidelines related to contracting processes: (i) individual consultants will be hired according to the guidelines established in policy AM-650; (ii) consulting firms of an intellectual nature will be hired according to the "Policy for the selection and contracting of consulting firms for operational work carried out by the Bank"

(GN-2765-4) and its Operational Guidelines (OP-1155-4); and (iii) other non-consulting services in accordance with the “IDB Institutional Procurement Policy” (GN-2303-28).

4.4 The knowledge products generated from this TC will be Bank property and may be made available to the public under a creative commons license. However, at the request of a beneficiary country, in accordance with the provisions of Regulation AM-331 “Procedures for the publication of knowledge products”, the intellectual property of said products may also be licensed to one or more beneficiaries through specific contractual commitments that shall be prepared with the advice of the Legal Department. Furthermore, all publications and socializing material must obey the IDB’s institutional image and if any personal data is gathered it must follow the IDB guidelines to the personal data privacy policy.

## V. Major issues

5.1 The primary identified risks are as follows:

5.2 **Research Constraints and Variability:** The multifaceted nature of the Sargassum issue raises the potential risk of encountering disparities in research. These disparities can arise due to differences in methodologies, data sourcing, and interpretations across diverse disciplines and regions. Such discrepancies can potentially compromise the quality and consistency of the insights generated. To mitigate this, it is essential to standardize research methodologies for all funded projects. Ensuring interdisciplinary collaboration among researchers is also crucial. Organizing regular workshops and feedback sessions can further ensure alignment and promote knowledge exchange.

5.3 **Stakeholder Engagement and Cooperation:** The success of this TC hinges largely on the active engagement and collaboration of a broad spectrum of stakeholders, ranging from local communities to governmental entities. Given the extensive geographical scope of the project, there could be challenges in achieving unified and cohesive actions. To counteract this risk, it's pivotal to adopt a stakeholder-centric approach. Every major stakeholder should have a significant voice in both the planning and execution phases of the project. Regular sessions for stakeholder engagement, open channels of communication, and continuous feedback seeking will ensure the project remains inclusive and adaptable.

5.4 **External Environmental Variables:** The Sargassum phenomenon is shaped by numerous external determinants, such as climate change, oceanic temperatures, and nutrient availability. These factors could evolve unpredictably, potentially rendering some of the research outdated or less pertinent. To mitigate this, it's imperative to embrace an adaptive research model, allowing for the integration of emergent data and evolving conditions. Continuous reviews and updates of research priorities will ensure alignment with the most recent understanding of the issue.

5.5 To conclude, the Sargassum crisis in the Wider Caribbean presents multifaceted challenges. However, with a proactive, adaptive, and stakeholder-centric approach, we can adeptly manage the risks and amplify the positive outcomes of the TC.

## VI. Exceptions to Bank policy

6.1 None.

## VII. Environmental and Social Aspects

7.1 This TC is not intended to finance pre-feasibility or feasibility studies of specific investment projects or environmental and social studies associated with them; therefore, this TC does not have applicable requirements of the Bank's Environmental and Social Policy Framework (ESPF).

**Required Annexes:**

Terms of Reference_74466.pdf

Procurement Plan_38640.pdf