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MULTILATERAL INVESTMENT FUND

MEXICO

AGRICULTURE EXTRACT AND BIOLEATHER: PRODUCT DEVELOPMENT AND BIOMASS COLLECTION SCALING

ME-G1034

DONORS MEMORANDUM

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PROJECT SUMMARY

Coastal communities in the Yucatan Peninsula in Mexico face mounting challenges from the influx of sargassum seaweed, a phenomenon intensified by climate change, nutrient pollution, and the mismanagement of organic waste. Excessive sargassum disrupts marine ecosystems, damages seagrass beds and coral reefs, and hinders fishing activities. In key tourism hubs, sargassum accumulation harms the local economy by threatening tourism-based livelihoods. The absence of a structured, multi-sectorial approach to sargassum management results in large volumes of organic waste ending up in landfills or illegal dumpsites, where it decomposes anaerobically and emits methane—a potent greenhouse gas contributing to climate change. As sargassum blooms continue to increase in scale and frequency, there is an urgent need for adaptive, nature-based solutions that turn this environmental challenge into an opportunity for sustainable development.

To address this issue, C-Combinator Mexico LLC S de RL CV (hereinafter “C-Combinator”) collects sargassum through their subsidiary Grupo Ensol and upcycles it into biomaterials. Under this project, C-Combinator will establish satellite intake points and a new, larger onshore facility near Tulum for rinsing, shredding, and screw-press separation into liquid and solid fractions. The liquid fraction will be filtered and concentrated into agricultural bio stimulant extracts, while the solids will be dried and processed for pilot bio-leather production. Key activities include installing an automated rinse system, developing short-term storage and transport logistics, performing compositional and structural analyses on the products, implementing stronger microbial controls, field trials to validate drought/heat-stress benefits for the bio stimulant, and pilot bio-leather manufacturing with coating partners — alongside workforce training and stakeholder coordination.

The project is expected to generate several key results: (i) over 27,000 tons of sargassum collected and processed into bio stimulants; (ii) over 250,000 kg of CO2e avoided by the seaweed not releasing methane in landfills; and (iii) at least 50 formal jobs created around sargassum collection and processing. It will also produce a first batch of bio-leather, divert significant volumes of organic waste from landfills, enhance coastal resilience, and demonstrate a replicable model for other Caribbean nations facing similar challenges.

This initiative contributes directly to climate change adaptation and natural capital preservation in line with the IDB Group’s Climate Change, Agriculture, and Natural Capital agenda. It promotes ecosystem-based adaptation by preventing the coastal decay of sargassum and protecting vital marine habitats. Additionally, it supports local resilience through sustainable livelihood creation. The project also aligns with the IDB Lab’s Impact+ strategy, particularly in the areas of climate action, bioeconomy, and inclusive innovation, by combining circular economy principles, technological experimentation, and social inclusion to turn an environmental threat into a regional development opportunity.

The project has a total budget of US$1,233,004, of which IDB Lab contributes 47%. The full amount is classified as climate finance according to the joint methodology of the Multilateral Development Banks (MDBs) for tracking finance for climate change adaptation.

ACRONYMS AND ABBREVIATIONS

C-Combinator	C-Combinator Mexico LLC S de RL CV
CONAPESCA	Comisión Nacional de -acuacultura y Pesca
DICI	Integrity and Institutional Capacity Diagnostic
EA	Executing Agency
IDB	InterAmerican Development Bank
IDB Lab	Multilateral Investment Fund
NRIG	Non-Reimbursable Investment Grant
R&D	Research and Development
SDG	Sustainable Development Goals
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales
SOP	Standard Operating Protocols

Agriculture Extract and Bioleather: Product Development and Biomass Collection Scaling

(EXECUTIVE SUMMARY)

Country and Geographic Location:	Mexico		
Executing Agency:	C-Combinator Mexico LLC S de RL CV, a subsidiary of C-Combinator d/b/a Carbonwave, a US public benefit corporation		
IDB Lab Vertical and Cross-cutting areas:	Natural capital, climate change, environmental sustainability.		
Coordination with Other Donors/Bank Operations:	The proposed project is complementary to the regional Technical Cooperation RG-T4374 "Integrated Sargassum Management for the Greater Caribbean: Mapping, Technological Advances, and Research Collaborations", executed by ARD. This initiative aims to promote an integrated and adaptive approach to the sargassum issue in the Greater Caribbean through multidisciplinary research and dissemination. The proposed project is part of the portfolio of projects under the Regional Innovation Facility for Sargassum (RG-O1726), which seeks to valorize sargassum as a valuable resource for various industries, with the goal of mitigating its environmental and economic impacts in the most vulnerable areas and strengthening the resilience of coastal communities affected by this phenomenon.		
Project Beneficiaries:	The project's beneficiaries include farmers in Mexico and worldwide, who will see higher crop yields and incomes using agricultural extracts, with up to 14,000 farms impacted by 2028. In Quintana Roo, it will create 50–60 local jobs in sargassum collection, processing, and product development, prioritizing women and community organizations. The project also directly supports the tourism sector by protecting one-third of Cancun's beaches, safeguarding around 15,000 tourism-related jobs and enhancing public spaces. Coastal communities, heavily dependent on fishing and tourism, benefit from increased resilience against climate and environmental shocks. Additional beneficiaries include local universities and research institutions, which gain hands-on learning and innovation opportunities. Finally, by mitigating sargassum impacts on nearly 80,000 acres of coral reefs, the project also benefits marine ecosystems, and the broader global community who benefits from GHG emissions avoided from sargassum decomposition.		
Financing:	Non- Reimbursable Technical Cooperation (NRTC)		-%
	Non- Reimbursable Investment Grant (NRIG)	US$ 575,590	47%
	Total IDB Lab Funding:	**US$ 575,590**	**47%**

	Counterpart	US$ 657,414	53%
	Co-financing (if any; include a separate line for IDB co-financing, if applicable)	-	%
	TOTAL PROJECT BUDGET	**US$ 1,233,004**	**100%**
Execution and Disbursement Period:	36-month execution and 40-month disbursement period for the NRIG.		
Conditions for the First Disbursement	Conditions prior to the first disbursement of the NRIG will be to the Bank's satisfaction: (i) selection of a dedicated employee to act as project coordinator; (ii) Procurement Plan. Special Conditions for the disbursements of the instruments are detailed in section V of this document.		
Environmental and Social Impact Review	This operation was screened and classified in accordance with the IDB's Environmental and Social Policy Framework (document GN2965-21) in March 2026. Because it could have moderate and mitigable environmental and social (E&S) impacts, the project has been proposed as a category B operation.		
Unit responsible for disbursements	CME Mexico		

I. The Problem

A. Problem Description

1.1. **Mexico and the Sargassum Threat.** The massive arrival of sargassum on Caribbean shores has intensified alarmingly over the past decade, becoming a major environmental, economic, and social problem for countries like Mexico, particularly in the Yucatan Peninsula. According to the Optical Oceanography Laboratory at the University of South Florida, the Caribbean Sea has experienced record levels of sargassum accumulation since 2011, and in 2025 alone, over 35 million metric tons were reported floating in the tropical Atlantic and the Caribbean[1]. While volume varies year to year, there has been a strong upward trend in average seaweed volume per year since 2010. This brown seaweed invades beaches, disrupts marine ecosystems, and severely hinders tourism and fishing activities—two fundamental pillars of Mexico's coastal economy.

1.2. The presence of sargassum in the open sea is generally beneficial, as it hosts a unique ecosystem known as the "golden floating rainforest." However, the problem arises with its excessive proliferation and accumulation along the coasts, which not only damages coral reefs and pollutes beaches, but also releases gases such as hydrogen sulfide as it decomposes, affecting human health and biodiversity. Additionally, it indirectly worsens the climate footprint by negatively impacting coastal ecosystems that are already under climate stress[2].

1.3. Mexico's high coastal population density, extensive tourism infrastructure, presence of rural communities living in poverty, and rich diversity of marine–coastal ecosystems make climate change one of the country's most significant challenges. The Yucatan peninsula (comprising the three states of Campeche, Yucatan and Quintana Roo) hosts a wide variety of coastal ecosystems that face threats from human activities and extreme weather events. In this context, communities are increasingly recognizing the pressing need to adapt to the impacts of climate change[3].

1.4. **The Most Affected Areas Are Critical to Quintana Roo's Economy.** The region of Quintana Roo—particularly the Riviera Maya, including Tulum, Playa del Carmen, Cozumel, Cancún, Mahahual, and Xcalak—is the area in Mexico most severely impacted by sargassum proliferation. Current monitoring data shows that beaches throughout Quintana Roo regularly experience moderate to excessive sargassum levels. In mid-2025, for instance, 68% of monitored beaches in the state reported moderate to excessive seaweed accumulation. Specific areas such as Cozumel's entire eastern coast, Tulum, Playa del Carmen, Puerto Morelos, and Benito Juárez (Cancún) were flagged under a "red alert" due to exceptionally high sargassum landings. These coastal zones persistently grapple with sargassum outbreaks, which severely affect tourism, local infrastructure, and natural ecosystems. In fact, this influx of sargassum has reduced hotel occupancy to 30-35% in the low season[4]. This directly affects the state's economy which revolves heavily around the tertiary sector (tourism and service industries). Other sectors severely

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[1] University of South Florida. SAWS May 2025 Bulletin.

[2] UN Environment Program. SARGASSUM WHITE PAPER: Turning the crisis into an opportunity | The Caribbean Environment Programme (CEP). 2021.

3 Escudero, M.; Mendoza, E. Community Perception and Adaptation to Climate Change in Coastal Areas of Mexico. Water 2021, 13, 2483.

4 Riviera Maya News. 28 Quintana Roo beaches hit by sargazo red alert.

impacted include artisanal fishing, as the massive presence of sargassum hinders navigation, entangles fishing nets, and affects marine habitats where commercially important species reproduce.

1.5. **Challenges for Effective Sargassum Management.** Implementing an efficient sargassum management system poses multiple challenges for the country and the state. There are economic limitations, as coastal and marine cleanup requires specialized equipment, sustained investment, and waste management infrastructure that many local municipalities cannot afford. Multiple authorities (federal ministries like SEMARNAT and CONAPESCA, state and municipal governments, tourism agencies, port authorities, environmental agencies) often have overlapping or unclear mandates, which slows decision-making and response. Most responses are financed ad hoc (seasonal municipal budgets or hotel/resort payments) rather than through sustained contingency funding, which limits preparedness and investment in storage/logistics. Limited intake hubs, short-term storage capacity, and appropriate disposal / valorization facilities (or permits for new ones) create bottlenecks that force landfill disposal or inefficient handling.

1.6. **Opportunities and Key Stakeholders.** Despite the challenges, managing sargassum also presents a significant opportunity for the region to turn this problem into a source of added value that generates green jobs, reduces pressure on coastal ecosystems, and promotes possibilities for expanding the circular economy and research. With the right technologies and policies, sargassum can be reused and transformed into valuable economic goods[5]. By fostering innovation in sargassum-derived products, coastal communities can turn an ongoing crisis into a sustainable and profitable industry. Stakeholders who can lead this process include a mix of local governments (municipalities) and ministries, universities, tourism, agricultural, and biotechnology companies, community organizations and non-governmental organizations, and international cooperation agencies.

1.7. Within this framework, in October 2024, both the Donor Committee of the IDB Lab (Inter-American Development Bank's Innovation Laboratory) and the IDB Board of Executive Directors approved the Regional Sargassum Innovation Facility (RG-O1726, DR-O0013), aimed at leveraging the potential of sargassum as a resource for various industries. The goal is to help mitigate the environmental and economic impact of its arrival in the most sensitive geographic regions and to strengthen the environmental and economic resilience of coastal communities affected by the phenomenon. The Facility is financed by the Inter-American Development Bank (IDB) through its innovation laboratory (IDB Lab), IDB Invest, donors, and counterpart contributions from the executing agencies, totaling US$5 million. The Facility is designed to fund projects aligned with its main objective, selected from proposals submitted by Executing Agencies that participated in the Sargassum Innovation Quest competition. One such project is the present initiative: *"Agriculture Extract and Bio Leather: Product Development and Biomass Collection Scaling",* proposed by C-Combinator Mexico LLC S de RL CV (from now on referred to as C-Combinator) for implementation in Mexico.

[5] Speede, R., Alleyne, K., & Cox, S. L. (2024). *Innovations for Sargassum Resilience.* https://doi.org/10.18235/0013107

II. The Innovation Proposal

A. Project Description

2.1. The project's objective is to develop and scale a circular economy model for sargassum valorization (via agricultural extracts and biomaterials) to improve economic opportunities for local populations and reduce the environmental impacts of Sargassum. Through the transformation of collected sargassum into agricultural extracts and biomaterials, the project seeks to provide sustainable solutions that both address a major environmental nuisance and offer tangible benefits to low-income farmers. The initiative is anchored in climate resilience, rural economic development, and sustainable innovation.

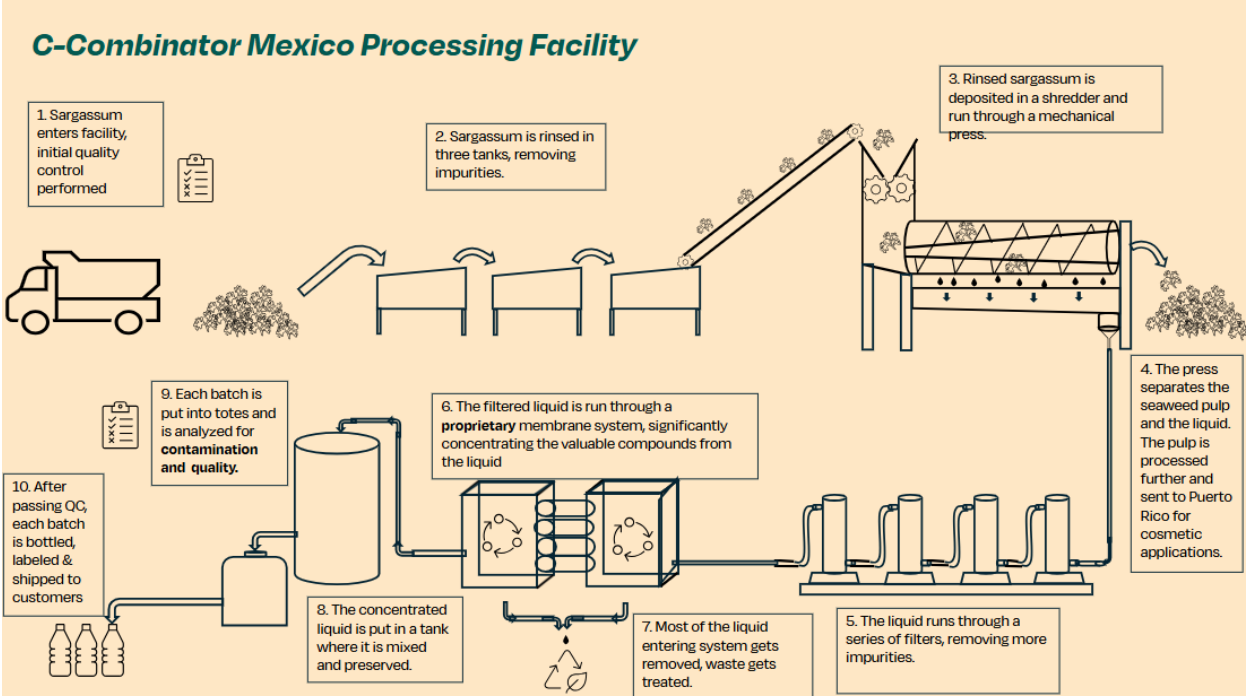
2.2. Currently, almost all collected sargassum ends up in landfills, where it emits methane and other pollutants. By expanding its processing capacity and establishing intake facilities closer to collection points, C-Combinator (the Executing Agency) seeks to drastically reduce landfill disposal and convert seaweed into high-value products, namely agricultural extract and bio-leather.

2.3. The project is also designed to increase the impact and scalability of C-Combinator's business model. With upgraded infrastructure, the company expects to process up to 27,600 tons of sargassum annually, sell 290,000 liters of agricultural extracts annually to support crop yield among farmers, and prevent 256,000 kg of CO_2-equivalent emissions from methane release. These outcomes not only offer environmental and economic benefits but also position the project for long-term growth and profitability through direct sales to multinational corporations and wider farmer adoption.

2.4. **Intervention Model.** The intervention begins with C-Combinator engineering and building a larger central facility near Tulum, which will double the organization's current capacity to process sargassum[6]. C-Combinator will evolve from a single facility with limited reach to a model using 'satellite' facilities close to the collection points which consolidate the biomass and supply the new facility as a central hub for further processing. The new facility will include an automated rinsing system that doubles hourly processing capacity, enabling the team to handle higher seaweed volumes from a broader geographical range, especially from areas that were previously too costly to reach, such as southern Quintana Roo. C-Combinator has historically sourced most their seaweed internally through their subsidiary "Grupo Ensol". Grupo Ensol's operations have provided a reliable supply of sargassum at a time when there aren't many reliable operators doing collection that the EA could rely on. On occasion, when sargassum supply is low (especially at the start and end of the season), the EA has worked with the Mexican Navy to process the seaweed they collect offshore.

2.5. The following is a diagram of the facility's process flow from sargassum intake through rinsing and cleaning, to the bio stimulant. The solids from this process are later extracted in a proprietary process to create the main material being used for the bio-leather.

[6] Their current facility is in Puerto Morelos, Mexico, with a processing capacity of 5 wet tonnes per day or 300 to 900 tonnes per year depending on the Sargassum season. The Sargassum is currently collected between Cancun and Playa del Carmen. C-Combinator processes all its bio stimulants on-site using an advanced filtration system to remove impurities and concentrate the bio actives.



2.6. The processing of sargassum will follow C-Combinator's refined intake protocol, developed over four years, which includes rinsing, shredding, and pressing the seaweed. The screw press separates the biomass into liquid and solid streams: the liquid is used to produce agricultural extracts, while the solids are dried and developed into bio-leather. Currently, they dry as much pulp as they can using open air, but when they must process more than they have the team capacity for they use a rotary drum dryer which uses natural gas. They track their natural gas usage and offset all scope 1 and scope 2 emissions using carbon credits. C-Combinator has launched 4 extracts with a ready-to-apply and a concentrated product that requires dilution, each coming with conventional preservatives and in Organic Materials Review Institute (OMRI) preservation systems. C-Combinator is in the process of expanding their product line further by formulating with other natural minerals and bio actives (e.g. amino acids). The new facility will also introduce short-term storage and transportation systems to efficiently move both fractions between intake points and the central facility, ensuring freshness and product quality.

2.7. Alongside infrastructure development, the project includes key R&D activities to ensure effectiveness and safety of the agricultural extracts. These include seasonal testing of extract composition, shelf-life assessments, polymer characterization (via FTIR and HPLC[7]), testing the effect of pulp degradation on results (currently they only use top quality pulp, limiting the pulp that can be used), and field trials to confirm the agricultural extract's role in reducing heat stress on crops. The team will also implement microbial control measures to enhance biosafety and produce the first commercial batch of bio-leather to validate its commercial viability and refine manufacturing requirements.

[7] FTIR is Fourier transform infrared spectroscopy and gives a reading of the infrared spectrum of a material which correlates to composition, and HPLC is high-performance liquid chromatography which passes a material through a packed column to separate and quantify specific target molecules

2.8. The intervention further integrates a strategy for downstream market development. C-Combinator will continue to trial its products with multinational agribusinesses and is actively testing with 35 potential corporate buyers, each with multi-million-dollar deal potential. A successful scale-up will provide the consistency and volume needed to fulfill corporate demand and reach tens of thousands of smallholder farmers via trusted distribution networks. These partnerships will help transition the company's extract line from early stage to commercially sustainable by 2029[8].

2.9. **Innovation.** This project stands out for its novel approach to sargassum valorization, leveraging an underutilized biomass to produce high-performance agricultural and material products. While seaweed extracts have long been used in commercial agriculture, they are typically derived from costly cold-water species like *Ascophyllum nodosum*. C-Combinator has developed an innovative cold-extraction method that uses sargassum—abundant and problematic in the Caribbean—to produce an extract that is at least as effective, but significantly more affordable and scalable, especially for low-income farmers in the region[9].

2.10. The cold-processing method avoids fermentation and high-heat drying, preserving the bioactivity of key compounds. The system includes advanced filtration technology that removes salt and heavy metals such as arsenic, making the product safer for agricultural use[10]. This enables C-Combinator's agricultural extract to deliver consistent results across a wider range of crops—including low-value row crops like barley and soy—where commercial seaweed products have historically failed to be cost-effective. Early trials show a 3–12.5% yield increase and up to 10x ROI for farmers.

2.11. Another innovation is the vertical integration model combining beach cleaning operations, intake, processing, and commercialization. This allows for greater control of input quality and end-to-end traceability—a major asset when working with corporate agricultural buyers who require robust quality assurance. C-Combinator's use of a decentralized intake network supported by satellite sites and a central high-capacity facility is a logistical innovation that addresses one of the biggest bottlenecks in sargassum utilization: timely and efficient handling of biomass before it degrades.

2.12. Lastly, C-Combinator is breaking new ground in sustainable materials by advancing R&D on bio-leather made from sargassum. Unlike many competitors whose bio-leather contains only 20–30% biomaterials and relies on polyurethane, C-Combinator's version is 90% biobased and has passed commercial durability standards in lab scale production and trials. The first commercial batch of bio-leather will help determine scalability and guide future facility design, setting the stage for a high-value circular product line that diversifies revenue streams while maximizing environmental impact[11].

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[8] For further details on the Go-To-Market strategy see Annex X.

[9] See Annex XI: Seaweed Agricultural Extracts Competitive Landscape

[10] C-Combinator's products are compliant with the US and Mexico's arsenic limits. Furthermore, what matters most in practical terms is not just the arsenic concentration in the liquid or in the dry matter – it's the total amount of arsenic applied to the field per hectare. Because their application rates are very low (1-3 liters per hectare per season), their concentrations of arsenic are not consequential. Reports of arsenic studies available upon request.

[11] See Annex XII: Bioleather Market Competitive Landscape

2.13. **Impact on adaptation.** This project directly supports climate adaptation in the Riviera Maya by addressing both agricultural and coastal vulnerabilities. For local farmers, the sargassum-derived extract improves crop yields and enhances resilience to drought and heat stress, which are increasingly common due to climate change. In coastal areas, the project reduces the environmental and public health risks posed by rotting sargassum, which releases methane and local air pollutants when dumped in landfills. By transforming this biomass into useful, climate-smart products, the project simultaneously contributes to sustainable agriculture, coastal ecosystem health, and economic resilience in a region highly exposed to climate-related risks.

2.14. **Component I: Scaling and automating sargassum intake (IDB Lab US$ 309,450, Counterpart US$ 370,550)**. The objective of this component is to improve the efficiency and capacity of sargassum collection and intake through infrastructure expansion and automation.

2.15. In order to achieve the objective of the component, the Executing Agency will implement the following activities: (i) engineering, construction, equipment installation, and launch of a new central processing facility strategically located closer to high-density collection zones to minimize transportation time and costs; (ii) equip the facility with an automated rinsing system to improve the decontamination process and double hourly processing throughput; (iii) establish intake protocols and short-term storage solutions for satellite collection points; (iv) train staff in the use of automated equipment and optimized workflows to reduce manual labor per tonne processed.

2.16. The expected results are (i) one fully operational new processing facility with a maximum daily processing capacity of 52.5 wet tonnes/day of sargassum; (ii) an automated rinse system installed and tested, fully integrated into the processing line; (iii) scalability and sustainability of sargassum valorization operations significantly enhanced to 6.4 labor hours per tonne; (iv) scaling to 3,242 wet tonnes of sargassum processed in year 3 of the implementation period.

2.17. **Component II: Agriculture extract R&D to scale. (IDB Lab US$ 87,957, Counterpart US$ 98,825)**. The objective of this component is to optimize agricultural extract products to meet industry and regulatory standards through robust research and development.

2.18. To achieve the objective of the component, the Executing Agency will implement the following activities: (i) conduct at least six compositional analyses of different product batches to quantify key bioactive compounds (such as fucoidan, laminarin, mannitol, alginates, phytohormones, and amino acids) and their variation by season; (ii) perform four structural characterization tests using techniques like FTIR or HPLC to understand the molecular groups and behavior of target compounds and how these correlate with product efficacy; (iii) carry out a comparative analysis between high- and low-quality sargassum to assess its impact on crop yields and define sourcing standards; (iv) conduct field trials in different environmental conditions to evaluate efficacy and resilience benefits; (v) strengthen partnerships with agricultural distributors and support them in conducting on-farm trials and promotional activities to accelerate adoption; (vi) for research steps i and iii, make adjustments to process to improve the final product and verify the effect of those changes.

2.19. The expected results are: (i) twelve detailed compositional analyses and over 50 samples of molecular characterizations of sargassum-derived agricultural extracts; (ii) one technical report summarizing the molecular and functional attributes of the current product with guidance for improvement; (iii) one technical report comparing the agronomic performance of high- vs low-quality sargassum; (iv) 35 distribution partners onboarded, retained, and actively selling the extract, demonstrated through at least two product orders each; (v) 500,000 hectares of farmland treated with the bio stimulant.

2.20. **Component III: Pilot production of bio leather. (IDB Lab US$ 178,183, Counterpart US$ 97,538)**. The objective of this component is to scale up bio-leather production from lab to pilot scale, preparing for commercial viability.

2.21. To achieve the objective of the component, the Executing Agency will implement the following activities: (i) setting up and operating equipment suitable for semi-industrial production; (ii) conducting at least three optimization tests to fine-tune critical process parameters; (iii) document a detailed Standard Operating Procedure (SOP) that outlines all stages of full-scale production—from biomass preprocessing to final finishing; (iv) secure the technical support required for performance testing and product finishing; (v) initiate marketing and product placement efforts, as well as identifying and securing early adopters an commercial partners for the first limited-release product launches.

2.22. The expected results are: (i) one pilot production batch of bio-leather completed, demonstrating the feasibility of transitioning from lab to pilot scale; (ii) a report on best application techniques, drying methods, and ingredient mixing ratios; (iii) a comprehensive SOP for full-scale bio-leather manufacturing developed, guiding future scale-up; (iv) one formal partnership with a coating manufacturer, allowing for achieving commercial-grade finish and durability; (v) at least three commercial launches featuring the bio-leather, marking an important milestone toward product validation, market entry, and long-term diversification of C-Combinator's revenue streams.

B. Beneficiaries

2.23. The primary beneficiaries of this project are Mexican and global farmers whose crops will be more productive and resilient using the agricultural extracts, the workforce of Quintana Roo through direct job creation, the tourism industry of the broader Quintana Roo's region, and the environment via avoided GHG emissions and sargassum decomposition.

2.24. C-Combinator's farmer field trial data shows the seaweed extract products result in an average improvement of 3.9%. This results in significant increases in farmer earnings with an estimated 3-10-fold ROI. The goal is to scale the distribution of the product from ~20,000 liters for 2025 to 291,667 liters by 2029. Of this, between 25-40% is likely to come from the Mexico region. It is estimated that this would benefit up to 10,000 farms[12].

[12] The INEGI 2022 Agricultura Census for Mexico reports 14 acres per farm in Mexico. At a treatment of two liters per acre, 291,667 liters can treat over 10,000 farms.

2.25. The project is designed to directly generate 50 full-time contracted jobs (filed with the Mexican government) across the expanded collections and processing facilities enabled by this project. These jobs will include roles collecting the sargassum on the beach, driving the collected sargassum, and operations at the facilities (processing, maintenance, and administrative roles). The state of Quintana Roo has a poverty rate of 35%, which is lower than the national average due to the tourism industry[13]. However, 44% of employed people in the state are in informal jobs[14], usually without access to employer healthcare or other securities of an employment contract - such as termination benefits which can be substantial in Mexico. The people C-Combinator employs in these roles typically don't have alternative formal employment in the tourism sector and would otherwise be working in informal manual labor jobs. These jobs translate into direct income to those 50 households, normally reflected in better access to basic services such as education and health.

2.26. In addition to the jobs in the collection and processing business, C-Combinator may additionally add team members in other departments. If successful, the leather team would grow from zero to 3-6 C-Combinator full-time staff over the course of the monitoring period and will increase over time as operations expand. The leather team would also be supporting additional jobs through the production process at the partner facility to start though this may come in-house over time. Lastly, the bio stimulant team may add another 4-8 full-time C-Combinator positions over the monitoring period.

2.27. Residents of coastal communities of Quintana Roo are traditionally reliant on fishing and tourism, sectors increasingly vulnerable to sargassum arrivals, environmental degradation, climate change, and economic shocks. The tourism sector alone is estimated to account for 50% of the region's GDP[15]. There are 137,000 tourism jobs in Quintana Roo (Cancun not reported separately)[16]. Cancun accounts for about 35% of tourism arrivals in Quintana Roo which translates into ~47,000 jobs[17]. Since the project will service about 6,000 meters of beach primarily in the Cancun area, and the total Hotel Zone of Cancun is ~20,000 meters of beach[18], the project will be protecting the beach for about 1/3 of Cancun and thus directly protecting beach that supports ~15,000 jobs.

2.28. All staff that will be engaged as part of the project will be employed locally, in line with a philosophy of ensuring knowledge is retained within the local community to ensure the project's longevity. Wherever possible, the jobs will prioritize members of women's groups and local environmental organizations.

2.29. C-Combinator has been improving its gender diversity which has been challenging given how male dominated the collection and manufacturing industries are. From 2023 to 2024 the percent of women working at C-Combinator improved from 26% to 36%. C-

[13] Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONVEAL).2010.
[14]Instituto Nacional de Estadística y Geografía (INEGI). Encuesta Nacional de Ocupación y Empleo (ENOE). Boletín Indicador 119/25. May 2025.
[15] https://en.travel2latam.com/news-52307-cancun-world-leader-in-gdp-generation-and-tourism-employment
[16] The Yucatan Times. Underpaid and untrained: How tourism employees work in Quintana Roo. August 2023.
[17] Pax News. Quintana Roo welcomed 21M+ tourists in 2023, marking a 6.9% increase. February 2024.
[18] Secretaría de Marina (SEMAR). *Cuestionario de CnárlO Cancún* (Cancún coastal and port information). August 2023.

Combinator has formal non-discrimination policies and company trainings about diversity and sexual harassment. Their goal for this project would be to have around 20% of the collections team associated with the project be women and over 50% of the science team working on product development and testing.

2.30. Beyond these vulnerable groups, other key stakeholders will also benefit from the project, such as local universities and research institutions that will gain hands-on research opportunities, allowing students and researchers to contribute to waste management innovations, and tourism-based businesses and community members who will benefit from cleaner public spaces, particularly in tourism-focused areas, enhancing the appeal of these destinations.

C. Project Results, Measurement, Monitoring and Evaluation

2.31. The Executing Agency will be responsible for collecting the data and reporting on results and achievements as per the Results Matrix of the project. The Executing Agency will develop a monitoring plan at the start of the project to ensure tracking and measuring of indicators. Additionally, the Executing Agency will report to the Bank every six months through a Project Status Report (PSR) and submit a Final PSR on the project's outcomes after the project is completed.

2.32. The project's key indicators, as outlined in the Results Matrix, are directly aligned with the aspirational indicators of the climate-smart agriculture focus area and contribute to both IDB Lab and IDB Corporate Results Framework (CRF) goals. First, the volume of sargassum collected annually supports IDB Lab's emphasis on circular economy solutions and contributes to the CRF goal of scaling climate-related solutions. Second, the greenhouse gas emissions avoided by diverting seaweed from landfills directly align with IDB Lab's climate mitigation priorities and contribute to the CRF indicator on GHG emissions reduced or avoided. Finally, the percentage increase in crop yields among farmers using sargassum-based agricultural extracts promotes climate-resilient agriculture and inclusion, contributing to the CRF goal of improving production or business performance among beneficiaries. Collectively, these indicators advance IDB Lab and IDB's shared vision of low-carbon development pathways and support national and regional climate commitments in line with the Paris Agreement.

III. Alignment with IDB Group, Scalability, and Risks

A. Alignment with IDB Group

3.1. This project, like others funded under the Regional Sargassum Innovation Facility (RG-O1726), is aligned with the Inter-American Development Bank (IDB) Group's 2024–2030 Institutional Strategy, known as *Impact+*. It supports one of its key objectives: addressing climate change through activities within the cross-cutting area of "Biodiversity, Natural Capital, and Climate Action." Specifically, the project's activities contribute to climate change adaptation by strengthening climate resilience and protecting vulnerable populations. Additionally, it helps mitigate the negative impacts of sargassum when it reaches the coasts, considering economic, environmental, and health dimensions.

3.2. This proposal is aligned with the 2019-2024 IDB Country Strategy for Mexico (GN-3084-1), specifically in the priority area 3 "Fostering more balanced and sustainable regional

development", which seeks to drive inclusive economic diversification beyond the dominant tourism sector, empower rural and coastal communities, and support environmental resilience. The project stimulates new value chains in underutilized coastal zones of Quintana Roo and surrounding regions. It promotes balanced growth by creating jobs in collection, processing, logistics, R&D, and distribution locally rather than concentrating benefits in metropolitan hubs. And finally, it supports IDB Group's emphasis to enhance the productivity, resilience, and integration of the agricultural sector and support climate-smart agriculture in Mexico. In doing so, it also integrates cross-cutting themes of strengthening the resilience of the private sector's capacity for climate change adaptation.

3.3. The project is complementary to the regional Technical Cooperation RG-T4374 "Integrated Sargassum Management for the Greater Caribbean: Mapping, Technological Advances, and Research Collaborations", executed by RND, and aims to promote an integrated and adaptive approach to the sargassum issue in the Greater Caribbean through multidisciplinary research and dissemination. Specifically, it supports Component 3: "Advancing Knowledge on Technological Innovations for Sargassum Mitigation and Adaptation in the Greater Caribbean," by identifying and testing cutting-edge solutions designed to mitigate the impact of sargassum in the region.

3.4. 100% of the total IDB Lab funding for this project is invested in climate change (mitigation and adaptation) activities according to the joint MDB approach on climate finance tracking. These resources contribute to the IDB Group's goal of increasing the financing of projects related to climate change (30% of the annual approval volume).

3.5. In terms of the Sustainable Development Goals (SDGs), this project aligns with:

- SDG 2 on Zero Hunger, specifically target 2.4 Sustainable food production and resilient agricultural practices
- SDG 9 on Industry, Innovation, and Infrastructure, specifically target 9.4 with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes
- SDG 12 on Responsible Consumption and Production, specifically target 12.5 Substantially reduce waste generation through prevention, reduction, recycling and reuse
- SDG 13 on Climate Action, specifically target 13.1 Strengthen resilience and adaptive capacity to climate-related hazards (in agriculture)
- SDG 14 on Life Below Water, specifically target 14.1 significantly reduces bio marine pollution of all kinds
- SDG 8 on Decent Work and Economic Growth, specifically 8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, and innovation.

B. Additionality and Scalability

3.6. **Non-financial additionality.** The results of the sargassum innovation contest, driven by IDB Lab, highlight the high demand for innovative solutions to this issue in the Caribbean. The participation of dozens of proposals and the financing awarded to five winning

initiatives emphasize the need to form a regional cluster of solutions. This cluster will enable the exchange of experiences, the creation of collaboration networks, and the strengthening of joint monitoring among affected countries, facilitating better preparation for the sargassum season. Additionally, efforts are being made to integrate this project with other conservation initiatives in the region, with the aim of advancing towards an Innovation Hub with a programmatic approach that addresses the main climate challenges of Latin America and the Caribbean.

3.7. The project's non-financial additionality lies in its ability to generate significant environmental and social benefits that would not materialize without target support. By transforming an environmental nuisance—massive sargassum influxes—into a valuable resource for the bioeconomy, the project directly contributes to ecosystem restoration and coastal health. Without this initiative, sargassum would continue to degrade coastal environments, harm marine life, reduce tourism income, and increase public cleanup costs.

3.8. Socially, the project introduces a dignified employment pathway for individuals in vulnerable coastal communities through their integration into a formalized supply chain, ensuring income generation and capacity-building in regions often excluded from global value chains. The technical components of sample testing, quality control systems, and collaboration with local institutions would not occur organically without this project, further underscoring its catalytic nature. The initiative also brings innovation in biomass processing and supply chain development that enhances the circular economy and sets a precedent for future sustainable ventures in the Caribbean.

3.9. The path to scale for this project is rooted in a combination of early corporate engagement, disruptive innovation, and strong market demand for sustainable agricultural inputs and biomaterials. C-Combinator is already collaborating with major private sector actors—such as Heineken and Produzindo Certo—who have conducted successful efficacy trials and integrated the product into their farmer guidelines. The project also responds to the growing global demand for low-cost, low-carbon agricultural solutions and sustainable materials, making it well positioned for rapid commercial uptake. Mexico's regulatory environment is increasingly supportive of bio-based and circular economy solutions[19], and the project's decentralized collection model, local workforce integration, and pilot commercialization efforts all help create a scalable blueprint that can be replicated across other sargassum-affected regions in the Caribbean and Latin America.

3.10. To support this scale-up trajectory, the project includes proactive stakeholder engagement with public institutions (such as CONAPESCA, SEMARNAT, etc), private sector actors (including hotels, agricultural distributors, fashion brands etc), and IDB Group colleagues throughout implementation. Activities will include workshops and field visits with potential buyers and distributors, policy dialogues to share lessons with coastal and agricultural authorities, and the development of knowledge products highlighting the project's environmental, agronomic, and socioeconomic impacts. The executing team will also participate in regional events (if/when available) on climate-smart agriculture,

[19] SEMARNAT (the Ministry of Environment and Natural Resources) is developing a National Circular Economy Strategy and Action Plan, which aims to minimize resource consumption, waste, and emissions, while promoting restorative production models that support climate targets within the country's Nationally Determined Contribution (NDC) under the Paris Agreement.

circular economy, and nature-based solutions to increase visibility and influence broader adoption. These efforts will not only build momentum for post-project partnerships but also create a foundation for replication in similar contexts throughout the region.

C. Project and Institutional Risks

3.11. If extreme weather events such as hurricanes reduce or delay the inflow of sargassum, then there is a risk of disruption in raw material supply, with consequences for production continuity and delivery commitments. To mitigate this risk, the EA will optimize collection operations during peak inflow periods, implementing real-time monitoring of sargassum blooms to forecast harvesting windows, and invest in scalable, low-cost storage solutions to build inventory buffers that can be used during lean months.

3.12. If sargassum harvesting, transportation, or storage activities are not conducted in full compliance with environmental safeguards, then there is a risk of unintended environmental degradation. To mitigate it, the Executing Agency will provide mandatory training for all project staff and local partners on environmental best practices, including safe handling, transport, and storage of sargassum.

3.13. If cleansing processes do not consistently reduce contaminants (salt/heavy metals such as arsenic) to safe levels, it will negatively impact the project by limiting agricultural use and commercial viability. To mitigate it, the Executing Agency will include formal testing protocols, well-defined acceptable contaminant thresholds, and potentially deploy independent testing services.

3.14. If the biochemical composition and microbial profiles of sargassum-derived extracts are not fully characterized and validated, then there is a risk of reduced trust or delayed adoption by corporate agricultural buyers, with consequences for revenue generation and scaling opportunities. To mitigate this risk, the executing agency will prioritize scientific testing, expand partnerships with research institutions, and share validated performance data with potential buyers to increase credibility.

3.15. If employees are exposed to decomposition gases or unsafe equipment operations, it will negatively impact the project through injuries, downtime, liability, reputational risk, and challenges in workforce retention. To mitigate it, the Executing Agency will include appropriate gas/contaminant monitoring where relevant, enhanced safety training, and appropriate safety protocols.

3.16. If the pilot production of bio-leather encounters scalability or quality issues, then there is a risk of missing commercial launch targets and failing to diversify product use cases, with consequences for derisking and long-term sustainability of the business model. To mitigate this risk, the EA will follow a rigorous pilot testing and SOP development process, engage early with potential commercial partners, and integrate feedback to ensure the product meets technical and aesthetic standards. The EA is already engaging with Kodak and Benefit Coating Partners to better understand their equipment requirements to produce the leathers and working on adjustments to accommodate the commercial equipment needs.

3.17. If demand from anchor corporate clients does not materialize as projected, then there is a risk of underutilization of production capacity, with consequences for financial sustainability and impact reach. To mitigate this risk, the EA will diversify the client base,

conduct ongoing outreach and marketing, and adjust production scale based on early feedback and sales trends.

3.18. If the Executing Agency faces fluctuating production costs and low demand for their products, then there is a risk on the project's economic feasibility, project implementation may stall, limiting its long-term impact and replication potential. To mitigate this risk, conduct thorough market research and establish strategic partnerships with farmer's associations and environmental groups, and actively engage them through regular progress updates and reporting.

3.19. The DICI Risk Matrix can be found in the project's technical files and the IDB Lab Risk Analysis tool has also been applied, which is also included in the technical documents of this project

IV. Instrument and Budget Proposal

4.1. The project has a total cost of US$ 1,233,004 out of which US$ 575,590 (47%) will be provided by IDB Lab, and US$657,414 (53%) by C-Combinator. IDB Lab funding will be in the form of a Non-Reimbursable Investment Grant (NRIG).

4.2. **Retroactive recognition of counterpart funds.** If the project team deems it appropriate to propose retroactive recognition of matching funds, the specific amount and date from which the funds will be recognized must be specified. Note: IDB Lab funds cannot be used for expenses prior to project approval.

Summary Budget (US$)

Project Components	IDB Lab NRIG	Counterpart		Total
		In Cash	In kind	
Component 1: Scaling and Automating Sargassum Intake	309,450	330,550	40,000	680,000
Component 2: Agriculture Extract R&D to Scale	87,957	40,447	58,378	186,782
Component 3: Pilot Production of Bio Leather	178,183	86,938	10,600	275,722
Communications and knowledge products	-	-	8,000	8,000
Project Administration	-	-	82,500	82,500
Evaluations, Monitoring and Audit	-	-	-	-
Total	$575,590	$457,936	$199,478	$1,233,004
% Of Financing	47%	37%	16%	100%

V. Executing Agency (EA) and Implementation Structure

A. Executing Agency(s) Description

5.1. **C-Combinator Mexico LLC S. de R.L. de C.V.** will serve as the executing agency for the project, responsible for overall coordination, technical development, and commercialization, and will be the signatory to the agreement with the Bank. The entity is a subsidiary of **C-Combinator**, a U.S.-based Public Benefit Corporation dedicated to advancing environmental sustainability through innovative seaweed-based solutions. C-Combinator operates under the registered trade name **Carbonwave**. Founded in the United States in 2020, the company expanded its operations to Mexico that same year through the establishment of C-Combinator Mexico LLC S. de R.L. de C.V.

5.2. Their mission is to help restore ocean and climate health by harvesting naturally occurring seaweeds—particularly sargassum—and transforming them into high-value products. The company has established a unique biorefinery model that extracts beneficial compounds from sargassum for use in agriculture, materials, and personal care products. Headquartered in the United States with operations in Mexico and Puerto Rico, C-Combinator has built significant expertise in both the science and logistics of sargassum valorization. Its multidisciplinary team has pioneered efficient seaweed processing techniques, including the development of liquid bio-stimulants for sustainable agriculture and bio-based materials like leather alternatives. C-Combinator also maintains a strong research and development pipeline and collaborates with laboratories, universities, and corporations to continuously refine its products and assess their environmental impact. C-Combinator has taken accountability for its own carbon emissions, offsetting all scopes 1 and 2 emissions since calendar year 2023. They also publish a sustainability report to provide transparency into their climate and social impacts[20].

5.3. C-Combinator has received many recognitions for its work. It has been awarded the Fast Company award in the agriculture category for the most innovative companies in the industry[21].

5.4. A central implementation partner for this project is Grupo Ensol, a Mexican subsidiary of C-Combinator co-founded with Felix Navarrete, a local expert with deep roots in sargassum management in Quintana Roo. Grupo Ensol holds the distinction of being the first organization certified to collect sargassum by Mexico's fisheries (CONAPESCA) and environment (SEMA) authorities. The group has removed approximately 60,000 tonnes of sargassum from local beaches and collaborates with about a dozen resorts, including Hyatt, Hilton, and Dreams. Beyond its commercial work, Grupo Ensol actively engages in community environmental efforts, such as cleaning mangroves and protecting sea

[20] https://carbonwave.com/blog/impact-report-2024/
[21] https://www.fastcompany.com/91033011/carbonwave-most-innovative-companies-2024

turtles during sargassum off-seasons. Grupo Ensol is also a member of the Cancun Hotel Association, which strengthens its local network and credibility.

5.5. To support the technical aspects of the project, C-Combinator will collaborate with several specialized actors. For bio leather development, they will co-develop manufacturing processes with partners like Kodak and Benefit Coatings, leveraging their expertise in textile coatings. For R&D and testing, the company will rely on a suite of labs and academic partners including Creative Proteomics for compositional analysis, WAP Sustainability Consulting for life cycle assessment (LCA), and CIATEJ for polymer characterization. Past collaborators like MicroBio, Cinaf, and Iowa University may also be involved in microbial protocols and field trials. On the client side, Heineken Mexico is a key partner in the agricultural workstream, having already incorporated C-Combinator's bio-stimulant into its best practices guide for local farmers. This growing network of implementation partners will ensure scientific rigor, market integration, and strong local anchoring of the project.

5.6. **Integrity Review.** The project team and OII found no indicators of integrity or related reputational risks for IDB Lab that merit disclosure.

B. Implementation Structure and Mechanism

5.7. C-Combinator will establish an execution unit and the necessary structure to execute project activities and manage project resources effectively and efficiently. They will also be responsible for submitting progress reports on project implementation. Details on the structure of the execution unit and reporting requirements will be annexed to the project technical files.

5.8. The Executing Agency will coordinate independently the overall project implementation, manage contracts and partnerships, and ensure that project objectives and quality standards are met. C-Combinator will lead decision-making through a project steering committee, which includes key participants as needed and defined in the beginning of the project and will report progress to IDB Lab. Key partners will contribute according to their expertise. IDB Lab's involvement in the project's governance and oversight will be defined in accordance with its standard practices and preferences, ensuring that the project remains aligned with its impact objectives and adheres to the best practices promoted by IDB Lab.

VI.Compliance with Milestones and Special Fiduciary Arrangements

6.1. **Disbursements by Results, Fiduciary Arrangements.** The Executing Agency commits to IDB Lab's standard results-based disbursement arrangements, procurement and financial management policies applicable to the private sector, consistent with the Financial Management Guide for IDB Financed Projects (OP-273-12) version of June 12, 2019 and as specified in the "Guide for Milestones-Based Management and Financial

Supervision for IDB Lab and Social Entrepreneurship Program Technical Cooperations Projects"[22].

6.2. **Results-based disbursements.** The Country Office of Mexico will monitor the Project in accordance with the performance and risk management policies (fulfilment of milestones) established by the IDB Lab in April 2008.

VII. Information Disclosure and Intellectual Property

7.1. **Access to information**. The information contained in this document shall be classified as public once approved, in accordance with the Bank's Access to Information Policy.

7.2. **Intellectual property**. The intellectual property of all work and results obtained under the Project shall belong to the Executing Agency. The Executing Agency shall grant the Bank a non-exclusive, royalty-free, and non-commercial license to use, copy, distribute, reproduce, display, and publicly perform any work or result of the Project. The Bank may disclose, reproduce, and publish any information related to the Project and may include in such information the name and logo of the Executing Agency.

[22] Guide for Milestones-Based Management and Financial Supervision for IDB Lab and Social Entrepreneurship Program Technical Cooperations Projects