

THE MANAGEMENT OF SARGASSUM IN THE YUCATAN PENINSULA, MEXICO, TOWARDS MARINE CONSERVATION AND REGIONAL DEVELOPMENT

POLICY BRIEF 1

APRIL 2023

The Policy Brief presents a summary of the socio-economic component of the British Academy funded project the *Big Seaweed Search, Mexico (BSSMX): a citizen science approach to resolve local environmental and societal challenges in a time of global climate crisis*. It highlights the key findings and recommendations around the socio-economic impacts of Sargassum influx in the Mexican Caribbean. It explores ways to improve environmental awareness, local livelihoods, regional commercial opportunities, and places these within the wider political context. The innovative collaboration between the UK and Mexico aims to boost cultural and scientific knowledge production for academia and between regional and other stakeholders.



Photo credit: Kaysara Khatun

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KEY MESSAGES

In the Mexican Caribbean, conservation and ecosystem management are entwined with socio-economic development.

Citizen science has the potential to promote scientific learning, enthuse people towards conservation, and stimulate knowledge sharing among the non-specialised public.

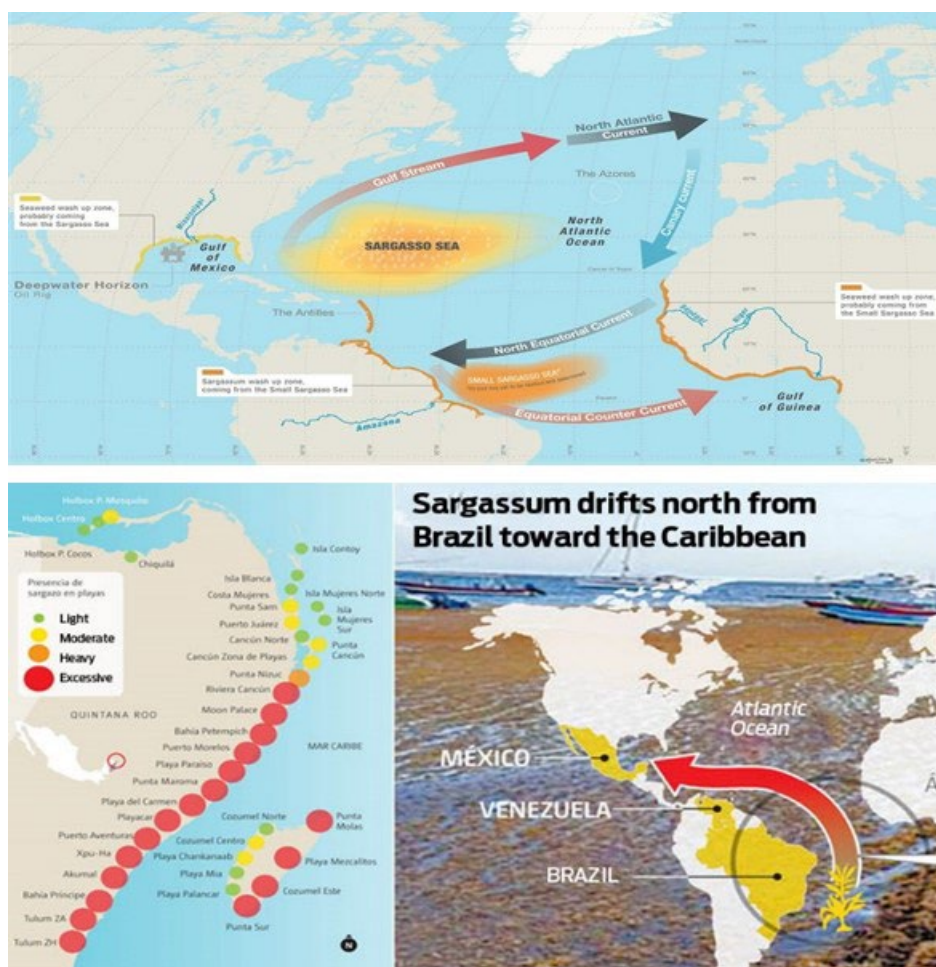
Citizen science has similarities with participatory approaches to ecosystem restoration/conservation taking place in many countries in the global south-lessons are available from Mexico and Beyond.

Awareness is needed for communities of the economic potential of Sargassum and how to access these.

There is a need to frame Sargassum management with broader regional development policy and climate change goals to access national climate funds and increase international co-operation.

OVERVIEW

Free-floating *Sargassum* - the largest seaweed bloom on the planet- has always been common in the Sargasso Sea and the Gulf of Mexico, providing an essential habitat with food sources, nursery areas, and breeding grounds for fish, sea turtles, and birds (AOML, 2020). However, as it accumulates close to the coastlines, it can smother valuable corals, seagrass beds, and beaches. Although the abundance of seaweed is a natural seasonal phenomenon, some of the effects of climate change, such as increases in sea temperature and changes in ocean currents and wind patterns, also play a role in this. One hypothesis of the origin of the phenomenon by Johns et al. (2020) is that during the winter of 2009-2010, the winds that typically blow to the east, from the Americas to Europe, strengthened and shifted to the south. This unusual shift in winds triggered a long-distance eastward dispersal of Sargassum. Once in this new and favourable tropical habitat, with ample sunlight, warm waters, and nutrient availability, the Sargassum flourished and has continued to grow (AOML, 2020) stretching from Africa to the Caribbean Sea and the Gulf of Mexico.



Figures 1 a) Sargassum originates from the Sargasso Sea in North Equatorial Recirculation Region b) Image credit: Red de Monitoreo del Sargazo Cancun

Since 2011, there has been a massive arrival of pelagic Sargassum species in the Yucatan Peninsula in south-eastern Mexico. The Policy Brief summarises the benefit of environmental awareness through education and highlights the potential uses and management of Sargassum for environmental and regional development which have community inclusiveness at its core. The phenomenon causes environmental deterioration, threatening coastal ecosystems, biodiversity, and their synergy with human activities. It is now one of the largest threats to socio-economic activities, and for livelihoods for coastal communities and local businesses (Oxenford et al., 2021). Critically, the Mexican

Caribbean coast has no other major industries besides tourism, with fishing in other parts of the Yucatan coast (Spalding et al., 2017).

PUERTO MORELOS, QUINTANA ROO: KEY SOCIO-ENVIRONMENTAL ISSUES AROUND THE SARGASSUM INFLUX

- The Yucatan Caribbean experienced a 35% drop in tourism during the first quarter of 2018, attributed to Sargassum influxes (<https://mexiconewsdaily.com/news/tourism-down-30-35-due-to-sargassum/>)
- Current management strategies, such as the use of heavy machinery accelerates beach erosion and impacts local habitats and are ineffective.
- Dumping Sargassum causes leachates. Waste in landfills decomposes, releasing methane into the atmosphere and leaching arsenic. When deposited in a forested area, there are negative impacts on natural water aquifers.
- Local people are not fully aware of the socio-economic opportunities or the environmental impacts of Sargassum.
- There are insufficient policy or governance frameworks specific to Sargassum. Regional Government has been slow to respond, and very few have implemented Sargassum management plans. Not enough interest or funds from the national government.
- International bilateral collaboration (beyond academia) between governments and the private sector appears minimal to non-existent. Neighbouring countries such as Belize and Bermuda are far more advanced in the management of seaweed.

PARTICIPATORY APPROACHES TO ECOSYSTEM RESTORATION/CONSERVATION AND SYNERGIES WITH CITIZEN SCIENCE

A key part of the BSSMX project is to highlight the significance of the citizen science approach for ecosystem management and regional management. Participation in citizen science activities can provide several benefits (refer to Policy Brief 2, Brodie et al. 2023, for more information of the citizen science approach). Studies suggest that participants may gain scientific skills and interdisciplinary knowledge, which could encourage awareness of environmental problems, ecosystem systems/processes, environmental monitoring and on broader sustainability issues, as well as skills for communicating findings, and personal transformations that are empowering (Toomey and Domroese, 2013., Daume et al., 2014). Mckinley et al. (2017) concluded that ecosystem conservation efforts would be greatly improved by encouraging public participation by building scientific knowledge. As a result, people can be motivated to engage and participate in addressing social and environmental issues affecting their communities (Cooke, Fielding & Louis, 2016). Hence, the emphasis on expanding educational opportunities through citizen science assumes that when people learn about the environment, they will become better stewards of natural resources (Fernandez-Gimenez, 2008).

When discussing the nature of citizen science, it is important to factor in that a form of citizen science is already taking place, albeit under different names and mainly in the global south. Tauginiene et al. (2020) note that citizen science offers a long history and experience in fostering relationships and co-working practices between lay people and scientists, which are used by the latter to inform policymakers under participatory management approaches to ecosystem restoration, such as pilot agroforestry, e.g., for cocoa (Khatun, 2015; Maguire – Rajpaul et al., 2020), and under climate change mitigation and adaptation initiatives e.g. Reducing Emissions from Deforestation and forest Degradation (REDD+). These benefits are increasingly recognised and can endow participants with the ability to contribute to conservation outcomes and inform policymakers using science-based evidence (Purdam, 2014). In the Yucatan Peninsula, conservation and marine ecosystem management are entwined with socio-economic development, thus, there is great potential for the citizen science

community to learn from participatory approaches to ecosystem conservation and restoration; lessons are available in Mexico itself¹ which share many characteristics with co-created citizen science, such as being action-oriented, centring citizen participation in problem definition employing systematic inquiry cycles, long-term development and partnership for data collection and analysis. Moreover, these synergise well with national inclusive and development policies and international agreements. As such, the long-term management of Sargassum lends itself well to the approach.

EDUCATION AS A KEY COMPONENT OF MANAGEMENT, DEVELOPMENT, AND POLICY

Considering the above rationale and key issues for pro-environmental behaviour, environmental knowledge gains, and skills development in science, shifting attitudes are pivotal for action and change, and to encourage engagement under current development activities. The education component of the BSSMX utilised the citizen science approach to understand the perception and environmental knowledge of local people the Yucatan Peninsula. The few opportunities for scientific education and participation in scientific projects available are designed for young people, generally excluding the adult population in the Peninsula. In this vein, young people are implicit stakeholders of the current and future issues related to the abundance of Sargassum. However, scientific education for young people is mostly provided through formal education, which, generally lacks technological infrastructure (e.g., access to computers, internet, and laboratory equipment) in schools. There are governmental initiatives to support the scientific education of young people through science clubs, support to set up modest scientific projects, and STEM career modelling for women, but these are not widespread or consolidated beyond local administration periods.

SELECTED FINDINGS

- Participants/citizens already have a high level of awareness of the ‘problem’ and have vested interests in volunteering beyond contributing data.
- The pre- and post-surveys and interviews suggest that people expanded their knowledge about the diversity and/or abundance of beach-cast macroalgae.
- Post-project, all participants enriched their initial ideas, naming uses of algae and acquired knowledge of related ecosystem services and their functions.
- Participants developed positive attitudes towards science, macroalgae and nature in general.
- Several participants reported that they shared their experiences, learning, and possible uses for seaweed with family members and/or other people in their community, with a few becoming involved post project.
- Although focused on young people, these results suggest that citizen science has the potential to promote scientific learning, enthuse people, and stimulate knowledge sharing among the non-specialised public.
- Citizen science offers long-term development and partnership for data collection and greater continuity beyond the life of a project.

CURRENT USES AND OPPORTUNITIES

There are currently a variety of commercial activities using seaweed at local and regional scale. Commercial exploitation with Sargassum in the Yucatan Peninsula includes bricks (Sargobrick), bio stimulants, and traditional local fertiliser as shown below in Figure 2. Other uses are notebooks, folders, cup holders, business cards, shoes, vegan leather, Biodiesel, etc.

¹ Searches in google scholar yield many results for a variety of ecosystems; https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Participatory+approaches+to+ecosystem+restoration+mexico&btnG=



Figure 2: Current uses of Sargassum in Quintana Roo. Image source: Kaysara Khatun (images 1&2, Ameyalli Rios (Image 3).

There is a need to explore ways communities can be involved in the types of commercial activities shown in figure 2. Our findings show that local people are only involved in small-scale activities such as fertilizers for gardening (shown above), with the commercial opportunities limited to companies, or enterprising individuals.

At a regional scale the economic importance of Sargassum management is significant. Expenditures and revenues are directly or potentially linked to anywhere between tens to hundreds

of millions of dollars (Pendleton et al. 2014). The economic impact on ecosystem services due to Sargassum remain unquantified. Valorisation of these may serve to evaluate whether the ecosystem services may compensate (partially) for the costs of harvesting the seaweed.

At sea, Sargassum is uniquely suited for absorbing and transporting carbon to the depths because it floats freely, it grows quickly and it has a high carbon to nutrient ratio, making it the leading seaweed variety sequestration possibility. In addition, to carbon sequestration & storage, CO₂ equivalents² from avoided methane released by removing beach cast Sargassum, can be valorised.

Framing Sargassum management issues and synergising with broader regional development and climate mitigation and adaptation goals by applying an ecosystem services approach may garner further interest nationally and bilaterally in the form of international projects. For example, doing so can connect to the aims of the General Law on Climate Change, 2012 (GLCC) and international initiatives and treaties, such as the Paris agreements, and United Nations Climate Change Conference (COP27 in 2022), and Biodiversity Conference (COP 15, 2022). Considering Mexico's vulnerability to climate impacts, the GLCC puts a strong emphasis on adaptation measures. The GLCC creates a climate change fund, which will channel public, private, national, and international funding projects that simultaneously contribute to adaptation and mitigation actions, such as supporting state-level actions, research and innovation projects, technological development and transfer, and the purchase of Certified Emissions Reductions.

We recommend the following (not exhaustive) priorities, with a cautious, inclusive, and equitable approach focused on co-benefits for communities.

² Benchmark exists for reducing methane emissions as CO₂ equivalents under the Gold Standard.

POLICY PRIORITIES AND PROSPECTS

- Promote regional education through citizen science when influx is low (to avoid health risks).
- Utilize Participatory approaches to ecosystem conservation. The practice, as with citizen science, helps community inclusion, long-term collation of data and access to knowledge on the environment and opportunities more broadly.
- Support research into commercial uses of Sargassum; opportunities for coastal communities as well as external companies.
- Promote awareness of the economic potential for communities and how to access these. Assist programs that invite local people to use sargassum for different purposes at home.
- Develop enabling environment for advancing responsible investment by private and political sector (taxes, company obligations, legislation, capacity building, regional processes)
- Frame issues with broader regional development and climate change goals to access national climate funds and synergise with national policy and international co-operation.
- Link co-benefits and ecosystem approach with several Sargassum monitoring programs. e. g. SARCAP, SargAdapt, SASAMS, SargCoop, C-drop, Collective View etc
- Explore incentives for better bilateral agreements/projects that factor in coastal and Sargassum management. Nearby Caribbean countries are far more advanced in the management of Sargassum- several have 'Sargassum commissions', e.g., Bermuda, Belize.
- Clarify how these activities will be carried out and by whom, and who benefits?

Lessons can be learned from participatory approaches to ecosystem conservation and restoration, and from other sectors, such as energy and forestry, where Mexico has a rich history. Along with laudable efforts by scientists and local stakeholders in actively managing Sargassum, there is a real need to involve social and political aspects to seaweed management, with clear co-ordination between them. Ignoring these aspects may lead to massive expense towards marine ecosystem preservation being for minimal results. In a place where people are highly dependent on the integrity of the natural system, which is inseparable from economic development, sustainability will only be reached through an integrative and inclusive process. Applying a 'conservation for development' paradigm is essential, where the conservation of natural capital is not an option, but a requirement. Further research is required on the ongoing dynamics of international collaboration and incorporating the Sargassum issue with the broader development and climatic issues for the country and its commitments under the Paris agreement and objectives under COP27 and COP15.

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