THE POTENTIAL ECONOMIC IMPACT OF SARGASSUM INUNDATIONS IN THE CARIBBEAN

PART 1: INSIGHTS FROM THE LITTERATURE

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Executive Summary

This report provides a comprehensive overview of several branches of literature that provide insight into the potential economic impacts from sargassum events in the Caribbean Region. Recognizing that understanding the scope, magnitude, and distribution of the economic consequences of sargassum events is an important prerequisite for appropriate planning and mitigation efforts, the overarching purpose of this review is to develop a framework and research agenda for market and non-market valuation efforts directed at quantifying economic losses from sargassum.

A review of the theoretical foundations of measuring value suggests that the appropriate measure for the loss of economic value created by sargassum events is lost economic surplus. This review also points to the need for measuring baseline economic activity prior to sargassum events, carefully defining the spatial extent of the market, accounting for resource substitution by producers and consumers and being mindful of halo effects.

The extent literature on the impacts sargassum events on coastal and marine ecosystems and ecosystem services suggest that sargassum events are likely to have the largest impacts on intertidal zones (beaches and seawater), followed by coral reefs, seagrasses, and mangroves. Impacts on beaches are expected to occur primarily due to biomass effects associated with accumulation of sargassum on shorelines. Adverse impacts on corals are expected to occur primarily due to water quality effects including reductions in light penetration, oxygen availability, and increased temperature, coupled with increased turbidity, eutrophication from nutrient loading and release of toxic ammonia and hydrogen sulphide. Impacts on seagrasses and mangroves are also mostly associated with these "brown tide" effects on water quality, primarily affecting the health and productivity of these ecosystems.

For seagrasses the damage occurs largely because of shading and nutrient loading in the water column. For mangroves the damage appears to be from nutrient loading in sediments leading to anoxic conditions. Given these impacts on ecosystems, the effect of sargassum on human wellbeing will vary spatially according to coastline orientation, bathymetry and the proximity of resources and economic activities.

The literature concerning economic effects of macroalgae inundations and HABs suggests that both residents and tourists are willing to pay for programs that reduce the duration and impact of algae events, mostly associated with minimizing visual disamenity associated with biomass on shorelines and reduced coastal water quality. This finding points to a potentially important source of revenue for sargassum management activities

Results from this literature also suggest that algae events will have negative impacts on coastal property values that are more pronounced with the duration of events and may create larger negative impacts on properties located slightly further inland due to the relatively robust nature of beachfront property values. Our review also suggests that impacts on coastal businesses such as restaurants and lodging along affected shorelines are likely to be significant, potentially exceeding the magnitude of impacts from tropical storms. Accurate estimation of lost economic value and activity will require granular data collection from businesses and recreational sites before, during and after sargassum events, a careful delineation of the geographical scope of impacts, and measurement of consumer and tourist substitution effects.

Our review of the research on the economic value of coastal and marine ecosystems in the Caribbean suggests that the value of coastal and marine recreation and tourism tends to outweigh other ecosystem values, with possible exceptions of the shoreline protection service afforded by reefs and the carbon sequestration service provided by seagrasses and mangroves. Not surprisingly, ecosystem service values are found to vary widely by location, ecosystem scale and socioeconomic conditions, suggesting that caution is in order when attempting to transfer value estimates across locations. Estimates of economic losses due to sargassum events derived from the benefits transfer approach are likely to be insufficient for sargassum management on the national scale.

Numerous studies in the literature find that willingness to pay for fee-based recreation in coastal and marine areas often exceeds actual (market) prices paid, which suggests that market prices and quantities will underestimate economic losses from sargassum impacts on recreation. Our findings also suggest that estimates of the value of improvements in resource quantity tend to be significantly lower than estimates of the value of equivalent losses. Using welfare estimates derived in the context of environmental improvements is therefore likely to underestimate economic losses from sargassum. We also highlight notable gaps in the literature regarding the value of ecosystem services that may be impacted by sargassum, including numerous provisioning, regulating, and supporting services provided by reefs, mangroves and seagrasses, and non-use values for all coastal and marine ecosystems.

Collectively, this review suggests a great deal of information regarding the potential economic consequences of sargassum influxes is at hand, but important gaps remain. Policy recommendations regarding appropriate spending for sargassum mitigation and management will be improved with targeted data collection and directed valuation efforts designed to accurately measure economic losses.

Introduction

Sargassum seaweed (comprising the two holopelagic species Sargassum natans and S. fluitans) first arrived on Caribbean and West African shorelines in unprecedented quantities in 2011 (Franks et al., 2012; 2016; Smetacek and Zingone, 2013). It continues to cause disruption to various sectors of national economies (particularly tourism and fisheries) and extensive impacts on ecological and human health (Resiere et al. 2018; Chávez et al., 2020; UNEP-CEP 2021). While the exact causes of these recent events are still being debated (e.g., Brooks et al., 2018; Putman et al., 2018; Oviatt et al., 2019; Johns et al., 2020; Lapointe et al., 2021), there is general agreement that this phenomenon is the result of a combination of biophysical and climatic factors of anthropogenic origin which encouraged an extraordinary proliferation of the seaweed in a new source region across the Equatorial Atlantic (UNEP-CEP 2021).

This seasonally variable blooming of sargassum, coined by Wang et al. (2019) as the 'Great Atlantic Sargassum Belt' is now considered part of a 'new normal' to which the region must learn to adapt (UNEP-CEP 2021). Adaptation requires learning from new knowledge and understanding of the issue, and although vast progress has been made through significant scientific research efforts over the last decade, there are still many gaps. Among these gaps is a comprehensive understanding of the potential impacts of sargassum inundation of coastal ecosystems, including impacts on their myriad valuable ecosystem services, and the economic implications of this for the Caribbean.

To mitigate adverse effects on environmental quality and human wellbeing from sargassum inundations, appropriate responses must be designed, developed, and implemented. An understanding of the potential scope, nature and magnitude of economic costs that results from these events is an essential prerequisite to directing the appropriate resources toward prevention or mitigation of future losses (Hoagland and Scatasta, 2006). That is, to determine whether the costs of various management approaches to sargassum management are worth incurring, we must compare those costs to the benefits derived from management and mitigation measures (Risén et al., 2017). These benefits are primarily associated with avoiding the losses in economic value that are created by sargassum events.

Despite the widespread impacts and obvious economic damage to the region, funding for sargassum management remains elusive for most countries in the Caribbean (Oxenford et al., 2021). In addition to its relatively new impact on the region, part of the reason for shortcomings related to sargassum management and financing is the relative dearth of information regarding the economic consequences of sargassum events (JICA-CRFM, 2019). To fill this gap, market and non-market economic valuation methods can be used to assess economic losses from sargassum to fisheries, recreation and tourism and other ecosystem services.

Understanding the magnitude, scope and distribution of economic losses induced by sargassum will allow policy makers to proactively weigh the costs and benefits of alternative management actions, direct scarce budgetary resources to their most impactful outcomes and thereby enhance the efficiency of efforts to mitigate impacts on livelihoods (Larkin and Adams, 2007). Value estimates can also be used to identify appropriate and efficient financing mechanisms and can enhance community engagement by illustrating the impact of sargassum on economic opportunities and human wellbeing in terms that are easily understood.

The purpose of this two-part report is to provide a comprehensive overview of the potential scope and magnitude of economic impacts from sargassum events in the Caribbean Region and to provide a framework for valuation efforts directed at quantifying economic losses.

Part 1 provides a review of several branches of literature that are pertinent to understanding economic impacts from sargassum in the Caribbean, including the theoretical foundations of measuring value from neoclassical and ecological economics, research into the impacts of sargassum events on key Caribbean coastal ecosystems (coral reefs, mangroves, seagrass meadows and beaches) and associated ecosystem services, estimates of economic losses from similar natural hazard events, such as other beach-cast seaweeds and harmful algal blooms (HABs), and empirical estimates of the economic value of coastal and marine ecosystem goods and services in the Caribbean region. We attempt to draw insights from this literature on the potential economic implications for sargassum inundations in Caribbean coastal environments. In Part 2, we use scenario analysis and results from the literature to illustrate the potential scope and magnitude of economic impacts from sargassum events at select sites in the Caribbean (Barbados, Dominica, Grenada, St. Lucia and St. Vincent and the Grenadines) and provide recommendations for data collection efforts and directed valuation research aimed at improving the accuracy of value loss estimates.