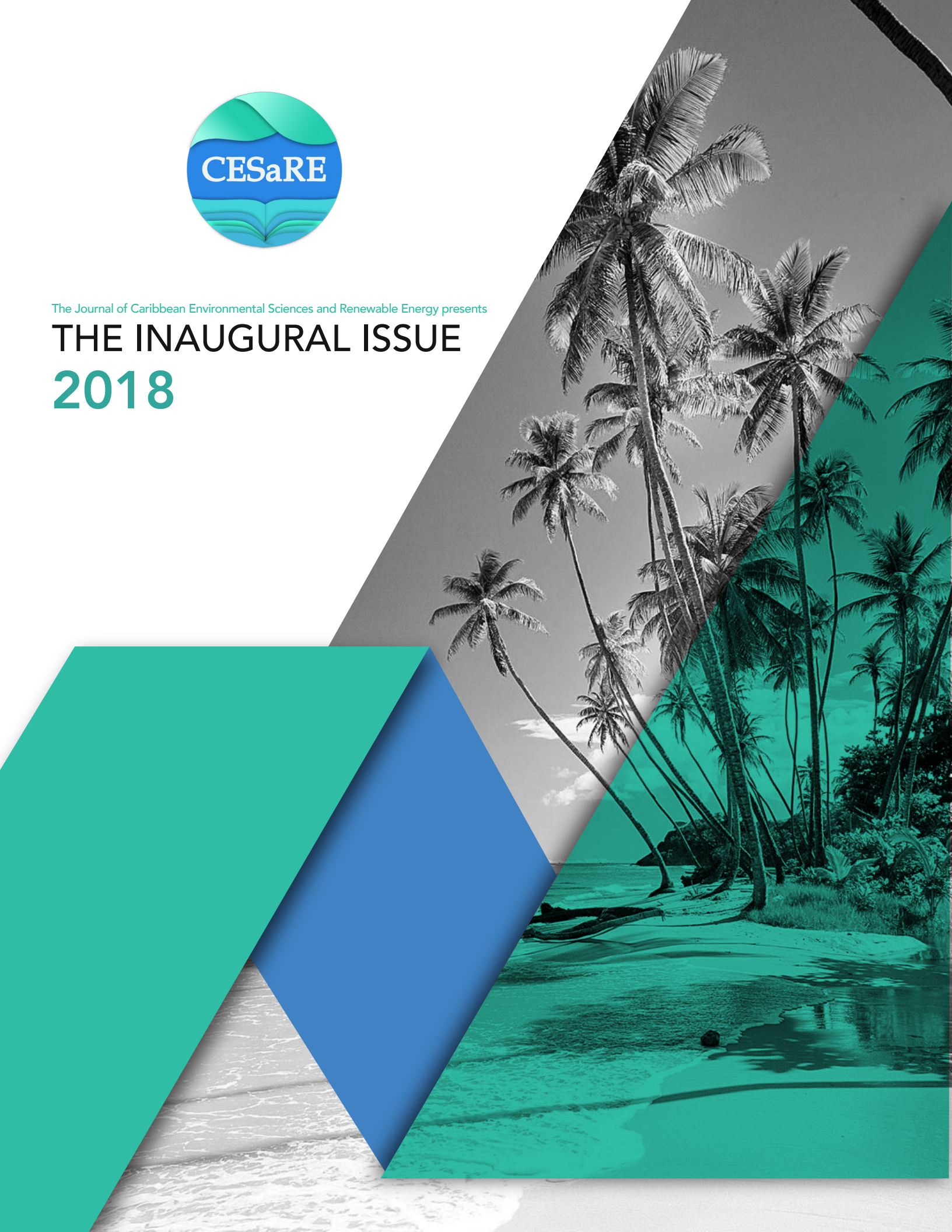




The Journal of Caribbean Environmental Sciences and Renewable Energy presents

THE INAUGURAL ISSUE 2018



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CONTENTS

PAGE 1-4

ALTERNATIVE ENERGY & INDUSTRY - Dr. Randy Koon Koon

PAGE 5-9

MARINE ECOSYSTEMS & FISHERIES - Dr. Robin Mahon, Dr. Patrick McConney, Dr. Lucia Fanning

PAGE 10-14

POLICY - Dr. Peter W. Schuhmann

PAGE 15-17

CLIMATE CHANGE & SUSTAINABILITY - Dr. David Smith

MESSAGE FROM THE DIRECTORS

Welcome to our Inaugural Issue!

It has been a long road but our journey has led to great reward. Through many months of effort, CESaRE is able to present to you our very first academic Issue, comprising of four articles from leading researchers within the region. Focus has been given to the following themes falling under our research scope: **Alternative Energy & Industry**, **Marine Ecosystems & Fisheries**, **Policy**, and **Climate Change & Sustainability**. CESaRE has a strong mandate to increase not only access to information, but the very accessibility of that information. Each of our featured articles has been carefully disseminated into three versions, **The QuikEZ**, **The Detailed**, and **The UpCycle**, with each serving to increase the impact of our online publications.

Where did it all start?

The Journal of Caribbean Environmental Sciences and Renewable Energy (**CESaRE**) was incorporated as an NGO in 2017 out of a recognised need to modernise and revolutionise the Caribbean's scientific research publishing. As of date, there are an extremely small number of well-established scientific Journals hosting articles and research specific to the Caribbean region. Moreover, they are mostly geared towards very niche fields, and for the most part, are not current or in keeping with global Journal standards.

Development of a **CESaRE Edu App** for instance is one of many novel ways CESaRE intends to change the academic landscape of the Caribbean. Our App will allow academics, researchers, and other interested parties to remain abreast with the latest research findings in the Caribbean, pushing the boundaries of conventional academic publication. The CESaRE Edu App will also be readily available and marketable to upcoming generations, promoting active participation across a diverse range of backgrounds and access.

We are not done just yet ...

CESaRE will also bring **Author Highlights**, leading researcher interviews through our **Podcast Series**, and a dynamic **Online database** to foster environmental change through a portal for job postings, blogs, and professional networking.

This is just the beginning of our mission and it will evolve to truly make CESaRE a leading body in academia.

We hope you enjoy our first Issue!

The CESaRE Board of Directors

BOARD OF DIRECTORS



MASAŌ ASHTINE

Director of Communications & Outreach
PhD. MSc. BSc.

Masaō is Lecturer at the University of the West Indies and has recently completed his doctorate at the University of Cambridge in Geography (climate change implications for the wind energy sector). This follows 6 years at York University in Toronto where he gained his Undergraduate and Masters Degrees in Environmental Sciences and Geography (Climate Science) respectively. With two academic publications (pending submissions as well), Masaō is an experienced young academic and professional. His new Lectureship appointment to lead the Alternative Energy Group at the University of the West Indies, Mona (Jamaica), demonstrates his commitment to research within the Caribbean region.

MICHAEL DE SOUZA

Director of Marketing & Design
BSc.

Michael de Souza has an academic background in the field of Applied Science and Mechanical Engineering from Queen's University in Kingston, ON. His work experience includes designing and implementing PV-solar systems for homes and small businesses, working as a project coordinator and site supervisor as well as a background in marketing and brand awareness.

STEPHANIE WARREN-GITTENS

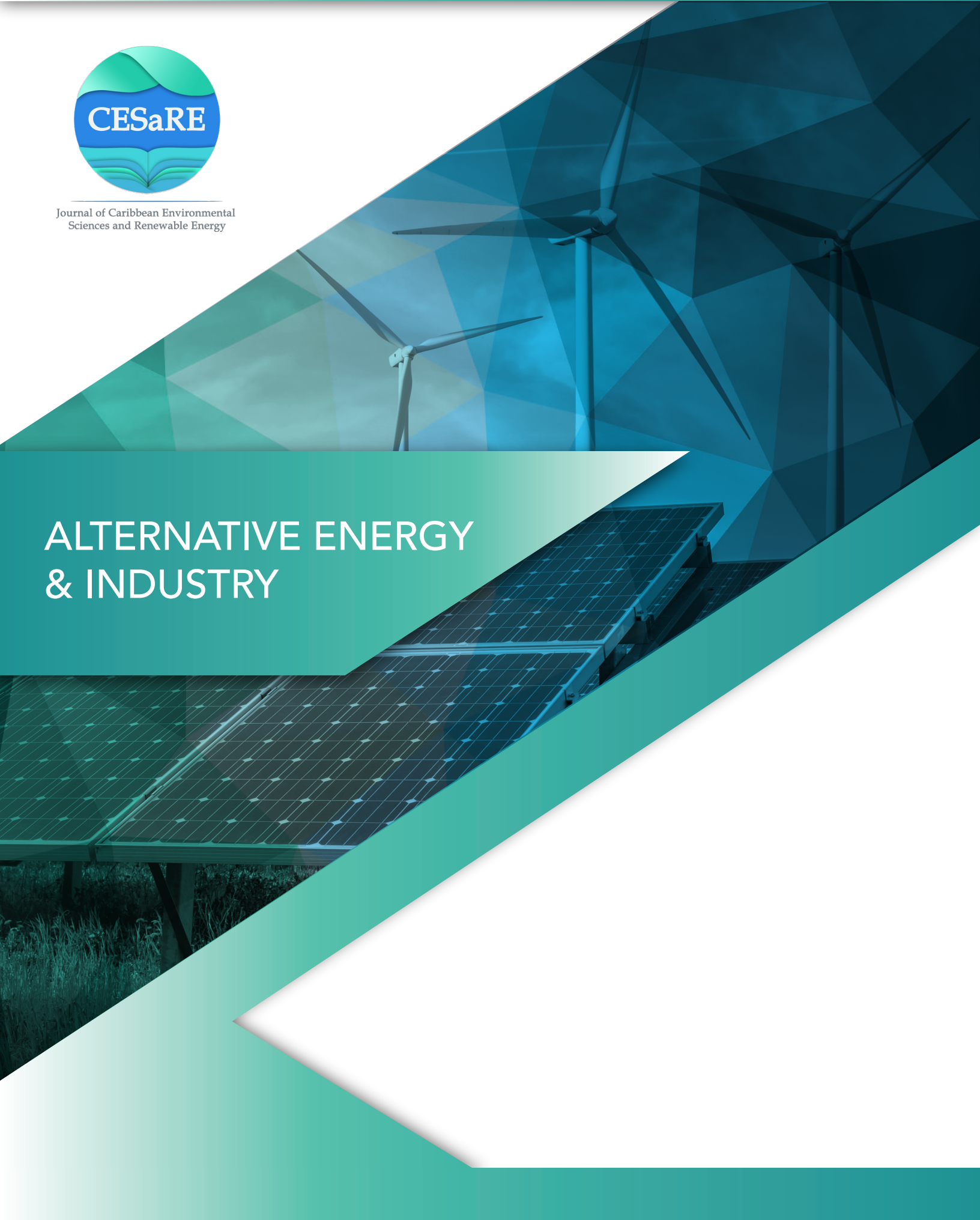
Director of Operations & Development,
MSc. BSc.

With an academic background in Environmental and Natural Resource Management, specializing in Marine Biology and Coastal Marine Resources respectively, from the University of the West Indies (both St. Augustine and Cave Hill campuses), she has gained exposure to environmental issues specifically as they relate to the Caribbean. Further to this, she has gained work exposure across a multitude of sectors, inclusive of project co-ordination.



Journal of Caribbean Environmental
Sciences and Renewable Energy

ALTERNATIVE ENERGY & INDUSTRY





RENEWABLE ENERGY: A Caribbean Crossroad

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INTRODUCTION

The Caribbean Community (CARICOM)

The Caribbean Community consists of a total population of just over seventeen million people and fifteen members of state, from Antigua and Bermuda, to Suriname and Trinidad and Tobago, encompassing geographic, cultural and economic diversity. Energy consumption and generation are the two pivotal challenges that have continuously confronted Caribbean nations. All fifteen CARICOM nations rely on the importation of fossil fuels, some more than others, and as such, all are susceptible to the volatile nature associated with oil prices. The cost of domestic retail electricity rates in the Caribbean islands is averaged at USD \$0.35/kWh.^[1] Once more, the rate of retail electricity price depends heavily on the extent of fossil fuel importation. Collectively, the CARICOM members total roughly USD \$4.9 billion for annual fossil fuel import costs.

Why transition to carbon-free and climate-sensitive nations?

There exists an overwhelming necessity for the transition away from fossil fuels and towards the realm of sustainable energy. The unrelenting pursuit of energy security has yielded a regional Energy-Policy in 2013.^[2] Through climate-compatible development, efficient utilization of renewable resources, and carbon dioxide emission targets, CARICOM has charted an era of true regional change. Hence climate change discussions are frequently positioned close to the area of renewable energy. The physical and observable effects of climate change have continued to affect nations globally and the Caribbean nations are particularly vulnerable. In the context of

global carbon dioxide emissions, CARICOM nations account for quite a small proportion (0.24% in 2012). Among the fifteen CARICOM member states, the twin island republic of Trinidad and Tobago considerably leads the carbon dioxide emissions from energy consumption. In addition, Trinidad and Tobago is also the third highest nation per capita of carbon dioxide levels globally^[3]. The Caribbean has experienced warmer-than-average temperature conditions during 2016, and Trinidad and Tobago clearly exhibited record-breaking temperatures.

In 2016, Trinidad and Tobago recorded its second-warmest (28.4°C) year, with its second-highest annual mean maximum temperature of 31.7°C. Furthermore, monthly mean temperatures (July; 33.4°C, October; 34.3°C) and daily extreme temperatures (April; 36.3°C, October; 36.2°C) were also recorded^[4]. The tropical Caribbean islands are among the vulnerable areas to experience the immediate and enhanced effects of climate change. Low latitudes and exposure to the fertile expanse of the Atlantic sea, generates not only increased frequency of hurricanes visiting the Caribbean but also higher categories of these furious climatic occurrences. Hence Caribbean nations must collectively combat the intimate relation of increased carbon emissions and its link to worsening climatic conditions, through an increased number of installed larger scale renewable energy systems to produce carbon-free form of energy. The incorporation of renewables into the energy mix can inevitably tilt the scale and yield favorable benefits on both an economic and environmental scale.



What is sustainable energy?

Renewable energy (RE) is a clean form of energy that derives its power through a resource that is naturally replenished on a human timescale, and the by-products are inherently carbon-free. The extent to which energy is captured to maximize the power output (useful work) of a resource while minimizing the loss of power through heat or other forms can be termed as energy efficiency. It is the combination of both RE and energy efficiency that breeds life to sustainable energy.

The major forms of renewable energy across the Caribbean

The major forms of renewable energy across the Caribbean are Solar, Wind, Hydropower and Geothermal energy, with hydropower notably leading the charge globally and regionally. Belize and Jamaica collectively account for 126.1 MW of hydropower potential, holding an 82% utilization overall. There exists a maximum of 800.4 MW of untapped wind energy potential throughout the Caribbean, however, except for Jamaica that leads the way with a maximum potential of 1,313 MW and having 34% utilization.^[6] The immense untapped power beneath the islands of Dominica, Grenada, and St. Kitts all contribute towards 3,770 MW of potential geothermal energy. Furthermore, this collective power potential is approximately 28 times more than their power capacity requirement as of 2015, therefore such islands can become energy exporters. And finally, solar power stands at a maximum power potential of 2525.9 MW, however, only around 1.2% of the solar resource has been utilized. Jamaica leads the solar power frontier with the Content Solar farm, a 20 MW solar park that is one of the largest of such a facility within the Caribbean.^[5]

The mutual challenges encountered by all Caribbean nations are dwarfed by the abundance of unexploited renewable energy resources. If such an encouraging

possibility was to be fulfilled, it will undoubtedly position the Caribbean as one of the many beacons of change combatting global efforts towards climate change, while promoting sustainable energy development and securing the economic and societal needs of their nations.

Implications – Renewable energy hindrances

Although these actions previously mentioned for the introduction of renewables are highly commendable, there still exists challenges at hand for such a transition. Notable reasons for such a tentative nature exhibited by many nations arise from, uncertainty in the energy prices (as such projections are coherent in regard to the oil and gas industry prices), a lack of energy diversification and review of business models, and replacement of decommissioned baseload systems. Furthermore, technical (isolated grid networks, incapable to produce present and future energy demands), socioeconomic, and environmental challenges act as the major hindrances for the CARICOM region.^[2]

Looking ahead to the future

Most Caribbean nations lack the size to self-sufficiently challenge for large-scale renewable energy projects that attempt to attract volume-oriented international financial markets. Hence the allure to establish innovative financial opportunities on a regional scale can provide an alternative to enhance the development of renewable energy projects of such scales. However, as previously mentioned, recognizable progress has been made throughout the Caribbean nations to foster and integrate renewables into the energy mix. Furthermore, CARICOM's sustainable energy programs have been introduced through the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREE) organization created on February 2015.^[2] The realization of renewable energy technology and applications have been ongoing across



Caribbean nations through academia, private sector organizations and governmental programs. The continued efforts at a regional, governmental, and societal level plays a crucial role to assist nations, to meet established renewable energy targets. No longer on the periphery, renewable energy, through efforts of dissemination, application, and integration, is now distinguishably carved into the energy mix of Caribbean nations.

REFERENCES



To access any closed-source references used in this article, please contact the author for an original manuscript.

1. Energy Chamber. 2017. "Understanding the Electricity Subsidy in T&T" Accessed on August 10, 2018. <http://energynow.tt/blog/understanding-the-electricity-subsidy-in-tt>
2. Ochs, A., M., Konnold, K., Auth, E., Mosolino and P., Killen. 2015. Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS): Baseline Report & Assessment. Washington, DC: Worldwatch Institute.
3. The World Bank, IBRD-IDA. 2018. "Carbon dioxide emissions (metric tons per capita)." Accessed June 27, 2018. <https://data.worldbank.org/indicator/EN.ATM.CO2E.PC>.
4. Blunden, J., and D. S. Arndt, Eds., 2017. State of the Caribbean in 2016. Bull. Amer. Meteor. Soc., 98 (8), Si-S277, doi:10.11175/2017BAMSStateoftheClimate. I.
5. Renewables Now. 2015. "Content Solar starts work on 20-MW project in Jamaica." Accessed June 27, 2018. <https://renewablesnow.com/news/content-solar-starts-work-on-20-mw-project-in-jamaica-483843/>
6. World Watch Institute: Vision for a Sustainable World. 2015. "Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS), CARICOM Member Country Energy Profiles." Accessed June 27, 2018. <http://www.worldwatch.org/sustainable-energy-roadmaps>.



Journal of Caribbean Environmental
Sciences and Renewable Energy

The background of the cover is a collage of marine-related images. On the right, a diver in full gear is visible. On the left, there are images of colorful fish, including a large blue and white striped fish. The collage is overlaid on a dark teal geometric pattern of triangles. A large teal diagonal band cuts across the middle of the page, containing the title text.

MARINE ECOSYSTEMS & FISHERIES

The Way Ahead for Coastal and Ocean Ecosystems in the Wider Caribbean

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INTRODUCTION

Why bother about coastal and ocean ecosystems?

There is an urgent need for all stakeholders in Caribbean coastal and ocean ecosystems to get on the same page to ensure that these critical transboundary resources are managed sustainably. Coastal and ocean ecosystems are critical for the well-being of Caribbean people. They provide food, employment, recreation and are part of our very ethos.^[1] The threats to these ecosystems are many and severe. They include overexploitation of living resources, pollution from land-based and marine-based sources and direct physical degradation from inappropriate development and practices.^[2] Add to this the increasingly evident but still largely uncertain impacts of climate change and there is a strong chance that we may lose many of the benefits that we take for granted from coastal and ocean ecosystems.

Less well understood is the extent to which these resources and their threats are transboundary and require a cooperative approach to addressing the problems that they face. This transboundary nature means we need to pay attention to the multiple geographical levels at which action is needed to address coastal and ocean ecosystem degradation. These levels are determined by the nature of resources which range in distribution from ocean-wide (e.g. in the case of large pelagic fishes), through sub-regional (e.g. in the case of flyingfish or lobster) to just a few adjacent countries (e.g. in the case of coral reefs ecosystems). Dealing with this multilevel nature requires that we be able to strategise, plan and act locally, nationally, sub-regionally and regionally

according to the problem being addressed. Further, for these strategies and plans to work, we need to connect these levels so that each can play its role and information can flow up and down between them. This has to happen across the entire Wider Caribbean region (Figure 1).

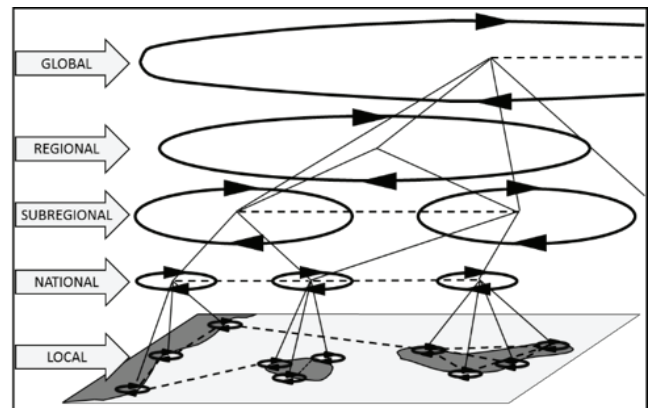


Figure 1. The multilevel, interlinked policy cycle based model underlying the CLME initiative.

What is the challenge?

Making this multilevel regional approach to coastal and ocean ecosystem sustainability a reality needs:

1. A mental model of how this can all come together to provide an integrated approach to ecosystem based management of these ecosystems, something we can all understand and buy into.



2. A programmatic approach to making that mental model a reality. The complexity of the problem is such that if stakeholders at all levels are to obtain the best possible outcomes from their efforts, they will need to tune in on this complex bigger picture, see where they fit into it and work towards making all of the components network and operate optimally.

Not only are the ecosystems and their threats multilevel and complex, so is the institutional mix that has emerged over the years to address the problems of overexploitation, pollution, habitat degradation and climate change. There are many local level NGOs and CBOs, numerous state agencies in every nation of the region, and more than 25 sub-regional state and non-state organisations in this mix.^{[3-6]*} To leave this all to sort itself out by chance would be irresponsible. Similarly, to be in this mix at any level and to think that you do not have to connect with other stakeholders at the same level and those above or below, is very short sighted^[7]. This need for enhanced coordination and connectivity has been recognized for some time, but the enormity of the task, and the challenges of coming to grips with it have caused many potential change agents to throw up their arms in defeat and go back to doing their own thing in their own corner, persisting with business as usual.

Are we meeting the challenge?

Is there a bigger picture for coastal and marine ecosystem management? Is someone trying to put it together? Can it be understood? Is it possible to come to grips with the complexity?

We think all the answers are yes. Since 2002, there has been an ongoing and intensifying Caribbean Large Marine Ecosystem initiative funded by the Global Environment Facility (GEF) to develop a multilevel institutional approach to tackling the problem of

coastal and ocean ecosystem sustainability in the Wider Caribbean. It started with the development of a multilevel conceptual model for the region^[8] followed by an assessment of the transboundary problems that we face^[2] and a strategic action programme to address them over the next 10-year period (2015-2025)^[9]. This was intended to be the beginning of a long-term iterative process that engaged all countries and all regional and sub-regional organisations. It covers the entire Wider Caribbean Region from the mouth of the Amazon River through Central America, the Greater and Lesser Antilles to the Bahamas (*Figure 2*).



Figure 2. The Wider Caribbean Region

So far, two phases of this initiative have been completed and the third is underway (2015—2020)^[10]. The major regional and sub-regional organisations with responsibility for the marine environment have signed on^[11] as have more than 25 countries at the ministerial level. As much as this may seem, it is just a beginning. There is a very long way to go if all stakeholders are to become functionally engaged, contributing to progress and reaping the benefits of being part of an initiative, the whole of which has the potential to be much, much more than the sum of its parts.

* Not hyperlinked, see reference section



What needs to happen now?

The CLME+ initiative (also referred to as a partnership and alliance) must make itself much more widely known by (a) providing easy access to information on past, present and future activities that shows the benefits of an integrated approach and (b) building a suite of ambassadors that spread the word wherever they are out and about.

- All stakeholders – find out what the CLME initiative is about and what it is doing at a practical level that you can engage with in ways that will further your own goals.
- Government technocrats - ensure that your activities are aligned with and take advantage of synergies provided by the CLME+ initiative; brief your managers and ministers so that they are aware too; and connect your local and national NGOs so they can provide, as well as get, added value.
- Local NGOs – Connect with the CLME+ Strategic Action Programme (SAP) through your relevant government department or regional IGO (Intergovernmental Organization). Regional IGOs – align your strategic plans with the SAP in ways that enhance both your goals and objectives and those of the SAP.
- Global IGOs – recognise the potential of this regional initiative and support it by aligning your programmes with it.
- Donors and Global NGOs – encourage your recipients and collaborators in the region to connect their activities with the CLME+ initiative.

There is an opportunity before us that we can choose to engage with and build, or we can each continue doing our own ‘thing’ and let it go by to the detriment

of the long-term well-being of coastal and ocean ecosystems and the millions of people in the region who depend on them.

REFERENCES



To access any closed-source references used in this article, please contact the author for an original manuscript.

1. Agard, J. B. R., A. Cropper, P. Aquino, M. Attz, F. Arias, J. Beltrán, E. Bennett, R. Carnegie, S. Clauzel, J. Corredor, M. Creary, G. Cumming, B. Davy, D. Deane, N. Elias-Samlalsingh, G. Fletcher, K. Fletcher, K. Garcia, J. Garraway, J. Gobin, A. Goodridge, A. Gray, S. Hart, M. Haughton, S. Heileman, R. Insanally, L. A. Jordan, P. Kumar, S. Laurent, A. Lumkong, R. Mahon, F. McDonald, J. Mendoza, A. Mohammed, E. Mohammed, H. McShine, A. Mitchell, D. Oderson, H. Oxenford, D. Pantin, K. Parsram, T. Phillips, R. Pichs, B. Potter, M. Rios, E. Rivera-Arriaga, A. Singh, J. Singh, S. Singh-Renton, L. Robertson, S. Schill, C. Toro, A. Trotman, A. Villasol, N. Vina-Davila, L. Walling, G. Warner, K. Zahedi, M. Zurek. Caribbean Sea Ecosystem Assessment (CARSEA). Caribbean Marine Studies, Special Edition 2007: 85 pp.
2. CLME Project. 2011. Caribbean large marine ecosystem regional transboundary diagnostic analysis. The UNDP/GEF Caribbean Large Marine Ecosystem and Adjacent Areas (CLME) Project, Cartagena, Colombia, 138 pp.
3. Jackson, J., Cramer, K., Donovan, M., Lam, V. (eds.) 2014. Status and trends of Caribbean coral reefs: 1970 - 2012. Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland. 304 pp.
4. Mahon, R., L. Fanning and P. McConney. 2014. Assessing and facilitating emerging regional ocean governance arrangements in the Wider Caribbean Region. *Ocean Yearbook* 28: 631-671
5. Monnereau, I. and H.A. Oxenford. 2017. Impacts of climate change on fisheries in the coastal and marine environments of Caribbean small island developing states (SIDS). *Caribbean Marine Climate Change Report Card: Science Review* 2017: 124-154.
6. Oxenford, H.A. and I. Monnereau. 2017. Impacts of climate change on fish and shellfish in the coastal and marine environments of Caribbean small island developing states (SIDS). *Caribbean Marine Climate Change Report Card: Science Review* 2017, pp 83-114.



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The Way Ahead for Coastal and Ocean Ecosystems in the Wider Caribbean

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References continued

7. McConney, P., T. Phillips, M. Lay and N. Nembhard. 2016. Organizing for good fisheries governance in the Caribbean Community (CARICOM). *Social and Economic Studies*. 65: 57-224.
8. Fanning, L., R. Mahon, P. McConney, J. Angulo, F. Burrows, B. Chakalall, D. Gil, M. Haughton, S. Heileman, S. Martinez, L. Ostine, A. Oviedo, S. Parsons, T. Phillips, C. Santizo Arroya, B. Simmons, C. Toro. 2007. A large marine ecosystem governance framework. *Marine Policy* 31: 434–443.
9. CLME Project. 2013. The Strategic Action Programme for the sustainable management of the shared living marine resources of the Caribbean and North Brazil shelf large marine ecosystems (CLME+SAP). The UNDP/GEF Caribbean Large Marine Ecosystem and Adjacent Areas (CLME) Project, Cartagena, Colombia, 123 pp.
10. DeBELS P., L. Fanning, R. Mahon, P. McConney, L. Walker, T. Bahri, M. Haughton, K. McDonald, M. Perez, S. Singh-Renton, C. Toro, R. Van Anrooy, A. Vanzella Khouri and P. Whalley. 2017. The CLME+ Strategic Action Programme: An ecosystems approach for assessing and managing the Caribbean Sea and North Brazil Shelf Large Marine Ecosystems. *Environmental Development*, 22: 191–205.



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POLICY





Advancing Sustainable Natural Resource Policy in the Caribbean.

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The Journal of Caribbean Environmental Sciences and Renewable Energy
Vol. 1, Issue 1, (2018) doi.org/10.33277/cesare/001.001/03

INTRODUCTION

Natural resources in the Caribbean are critical for human well-being. The ecosystem services that they deliver are the source of a variety of social and economic benefits to people, including those associated with the provision of food and materials, the regulation of nutrients, waste and water, opportunities for recreation, culture and aesthetic beauty, and protection from natural hazards. Nature-based tourism and natural resource extraction are critical but volatile sources of economic activity in the Caribbean^{[1][2]}, providing employment, income and foreign exchange.

Natural resource policy in the Caribbean must strike a delicate balance. On one hand, there is a need to exploit the land, forests, air, water and oceans for economic growth and development. The short-term needs for income, employment and food security in the Caribbean have been heightened by the region's slow recovery from the global financial crisis, mounting debt burdens and impacts from natural disasters.^[3] On the other hand, is the need to maintain the quality and integrity of the natural environment so that it will continue to deliver valuable goods and services to current and future generations.

The development of coastal lands to support tourism provides an example. Coastal tourism is a vital source of employment and foreign exchange for many countries in the region. Yet the loss of environmental quality that accompanies coastal development creates social and economic costs in terms of heightened risk from natural disasters, dilution of culture, loss of access, and potential deleterious impacts on the

tourism product itself. Fisheries provide another salient illustration of the challenging tradeoffs facing policy makers. The extraction of marine resources provides an essential source of food security, culture and livelihoods. Yet, this exploitation can lead to loss of ecosystem resiliency and lower potential future harvests, jeopardizing these socioeconomic benefits.^[4]

Only when the costs of resource damage are weighed against the benefits of extraction and use, can the proper balance be achieved with policy. Put another way, the benefits of environmental protection and maintenance of ecosystem services must be measured and compared to the costs of reduced extraction and use. As simple as these concepts are at the surface, a close look at environmental conditions in the region suggests that we have a long way to go. The natural resource assets of the Caribbean are under constant threat from a variety of sources including pollution, land conversion, over-fishing, coastal development, runoff and sedimentation of reefs, and climate-related impacts such as warmer sea surface temperatures, increased storm intensity, and sea level rise.^[4]

Market Failure

The cause of our collective shortcomings in properly managing these critical resources is no mystery: without policy intervention, market-based economies will fail to provide the quantity and quality of natural resources that are best for society. Unlike other goods and services, a majority of the benefits provided by the natural environment are "hidden" from view because they are not revealed in clearly observable market



outcomes. The relative absence of market signals regarding the value of environmental benefits and the costs of degradation results in readily observed market values carrying more weight in the policy process. Further, the benefits derived from ecosystem services are often shared across society, and cannot be packaged and made available to buyers. Because people are generally unwilling to pay for things when the benefits are shared and because businesses cannot survive without profit, these characteristics eliminate the incentives that drive markets to mutually beneficial outcomes.

This outcome is both understandable and unfortunate. Because we lack formal measures of the contribution of natural resources to human wellbeing, it is understandable that policy makers give them limited attention and treatment. Given the long-term nature of environmental change, the results-based incentives provided by short-term political cycles, and the tendency (especially in difficult economic times) to heavily discount the future, it makes sense that policy makers and the general public respond to immediate wants and needs. The unfortunate result of this imbalance is the long-term decline in the natural resource assets that sustain our health, wellbeing and economic prosperity.

While the idea of market failure is not unique to the Caribbean, it is clear that policy makers in the region have a unique set of challenges in correcting it. These include poor governance, lack of resources and capacity, overlapping and competing institutional arrangements and a regional heterogeneity that includes numerous Small Island Developing States (SIDS) and large continental countries that often have different goals, needs and capacities.^[5] The Caribbean region's inherent dependence on natural resources and ecosystem services also creates a unique vulnerability which directly threatens economic growth and development^[2] making effective conservation policy all the more critical.

How Can Our Research Advance Policy in the Caribbean region?

First, we can do a better job at connecting our research to policy outcomes and directives. Academic researchers often produce only vague visions of a sustainable future without connections to clearly defined policy actions that will move us forward.^[5] Because people, businesses and governments are more likely to adopt sustainable practices if it is in their best interest to do so, we should present our findings in a way that is easily understood outside of the scientific community in terms of how and why the use of natural resources is linked to the wellbeing of Caribbean people. Monetary values are an obvious metric that can serve to illustrate the hidden benefits of protection and the costs of degradation in a way that informs policy and raises general awareness. We also should strive to connect our research to non-monetary outcome measures such as food security, employment, risk reduction, human health, happiness and cultural identity. Connections to human values and outcomes should be bolstered by actionable recommendations that illustrate how the imbalance between market and non-market outcomes can be remedied, particularly as it relates to the acquisition and channeling of resources toward sustainability efforts.

Another important step is to involve local stakeholders in our research at all levels from the inception stage (i.e. formulation of the research question) to the communication of results.^[6] Involving local policy-makers, resource managers and other stakeholders in the research process, will make results more understandable, defensible and actionable, and will enhance on-the-ground capacity for continued study and dialogue regarding the tradeoffs required to advance ecological and economic sustainability.^[7]

These efforts will likely require that we move out of our discipline-specific comfort zones and into



interdisciplinary teams. While it is well understood that no single discipline can solve natural resource management issues, most researchers are trained and conversant only in the language, methods and assumptions of their particular discipline. Branching out into other disciplines will help us understand where synergies lie that can be effective at persuading policy makers.

For example, as a natural resource economist who focuses on the value of environmental quality, I can present a compelling argument that many Caribbean economies depend on tourism and that tourism depends, in large part, on environmental quality.^[8] Coastal ecologists understand that natural shoreline features such as reefs, seagrasses and mangroves provide resilience and protection from storms and rising sea level.^[9] Fisheries scientists understand that the loss of nearshore habitats are key threats to fisheries productivity and sustainability.^[4] Combining these strands of research reveals the potential for environmental policy to advance human wellbeing in numerous ways. The environmental characteristics that attract tourists and their foreign exchange also serve to mitigate risks associated with climate change and improve the viability of nearshore fisheries.

Similar synergies certainly exist with regard to water, waste management, renewable energy and sustainable agriculture. Finding and illustrating these crosscutting areas where social, environmental and economic sustainability are inexorably linked will help to mainstream environmental policy such that it will be addressed not only by NGOs and ministries with direct connections to the environment, but also by more politically powerful entities such as ministries of finance, planning and development^[10], and may help to permanently incorporate environmental protection into national development

Conclusion

Effective resource policy can promote the triple bottom line of sustainable development, facilitating economic growth, advancing social well-being and protecting the environment.^[2] Policy makers in the Caribbean have a unique set of challenges in reaching this end. Yet, without effective policy intervention, market forces will continue to deliver suboptimal environmental outcomes. To improve the policy impact of our research we must present convincing arguments that investments in the conservation of natural resource assets are worth the costs of deviating from the business as usual approach. This will require that we clearly illustrate the linkages between the economic and social wellbeing of Caribbean people and the quality of our natural environment. By involving stakeholders, seeking interdisciplinary connections and providing actionable recommendations our research efforts can advance the triple bottom line.



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1. [WTTC, 2017] World Travel and Tourism Council, 2017. The Economic Impact of Travel and Tourism 2017, Caribbean, March 2017.
2. Ram, J., Frederick, R., Ramrattan, D., Hope, K., and Elliott, W., 2018. A Policy Blueprint for Caribbean Economies, CDB Working Paper No. 1. Caribbean Development Bank.
3. Lewis-Bynoe, D. (ed.) (2016), Achieving a Resilient Future for Small States: Caribbean 2050, Commonwealth Secretariat, London,
4. Linardich, C., Ralph, G., Carpenter, K., Cox, N., Robertson, D. R., Harwell, H., Anderson, W., Jr., Acero, A., Barthelat, F., Bouchereau, J. -L, Brown, J. J., Buchanan, J., Buddo, D., Collette, Bruce B., Comeros-Raynal, M, et al., 2017. The Conservation Status of Marine Bony Shorefishes of the Greater Caribbean. Gland, Switzerland: IUCN. viii +75 pp.
5. Chakalall, B., Mahon, R., McConney, P., Nurse, L. and Oderson, D., 2007. Governance of fisheries and other living marine resources in the Wider Caribbean. Fisheries Research, 87(1), pp.92-99.



References continued

6. Waite, R., Burke, L., Gray, E., van Beukering, P., Brander, L., Mackenzie, E., Pendleton, L., Schuhmann, P. and Tompkins, E.L., 2014. Coastal capital: ecosystem valuation for decision making in the Caribbean. World Resources Institute.
7. Oleson, K.L., Grafeld, S., Van Beukering, P., Brander, L., James, P.A. and Wolfs, E., 2018. Charting progress towards system-scale ecosystem service valuation in islands. *Environmental Conservation*, pp.1-15.
8. Schuhmann, P.W., Bass, B.E., Casey, J.F. & Gill, D.A., 2016. Visitor preferences and willingness to pay for coastal attributes in Barbados. *Ocean & Coastal Management*, 134, 240-250.
9. Guannel, G., Arkema, K., Ruggiero, P. and Verutes, G., 2016. The power of three: Coral reefs, seagrasses and mangroves protect coastal regions and increase their resilience. *PLoS one*, 11(7), p.e0158094.
10. Bizikova, L., Metternicht, G. and Yarde, T., 2015. Advancing environmental mainstreaming in the Caribbean Region: The role of regional institutions for overcoming barriers and capacity gaps. *Sustainability*, 7(10), pp.13836-13855.



Journal of Caribbean Environmental
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The background of the cover is a black and white photograph of a tropical landscape after a storm. A large palm tree on the right is bent over by the wind. The ground is covered in fallen palm fronds and debris. The sky is overcast and grey. The image is partially obscured by teal geometric shapes.

CLIMATE CHANGE & SUSTAINABILITY



Climate Change and Achieving Caribbean Sustainable Development

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INTRODUCTION

The Climate is Vital for High-Quality Caribbean Life, but it's Changing

For people living in the Caribbean, climate change is likely to be one of the most profound challenges to improving human wellbeing. Climate Change is not a distant threat; tropical ecosystems will experience new climates earlier than other countries^[1], and these changes will affect Caribbean people, setting back our efforts to achieve Sustainable Development Goals (SDGs). Our concerns about climate change should not be limited to worries about tropical cyclones. Climate change affects fundamental aspects of life such as water availability and may increase floods and drought. Sea level rise increases the erosion of the beaches that tourism depends on, and increases flood hazards.^[2] Increased ocean acidification reduces the survival of fish larvae, and the viability of shellfish and corals^[3] thus potentially affecting the tourism and fishing industries.^[4] Increased temperatures may reduce economic output for Caribbean and Central American countries by as much as 2.4% for each degree increase^[5], in addition to increasing the viability of mosquitos and requiring more energy for cooling people and storing food.

Our Development is not Sustainable

The Caribbean and Latin America has with few exceptions (Haiti, Honduras, St Lucia, Suriname and Venezuela) eliminated extreme poverty, but progress in health, economic growth, inequality and justice remains challenging.^[6] Despite the dependence of most Caribbean economies on healthy marine ecosystems, the status of life under water, and life on land, is poor. Although progress towards the energy

goal is good in several Caribbean states, this does not translate into meeting the climate SDGs.^[6] The highest-ranking Caribbean island in the **Sustainable Development Solutions Network** (SDSN) Index and Dashboard for 2018 is Cuba at 42, however, many Caribbean SIDS score lower than the regional average. What is worrying is that no Caribbean country rates "Green" in education and the trend for education is downward for two CARICOM members. Since education and training are vital for goals eight (decent work and economic growth and industry) and nine (innovation, industry and infrastructure), those goals currently have low scores for most Caribbean countries.

How can we fix this?

Climate-related events, depending on their scale can cause great destruction, erode or reverse development gains and slow the pace of development. Consequently, Caribbean countries need to build resilience to climate change induced problems at the level of individuals, communities, businesses, nationally, and regionally. Our aim should be to recover, not to where we were before the event occurred, but to the point we would have been had the event never happened.

To build resilience one must build human capital. One way to do this is through education since education is associated with increased long term resilience to disasters.^{[7][8]} The World Bank report on the wealth of nations indicates that human capital is the most



important component of wealth.^[9] Building humancapital is key to improving human wellbeing. For island states with limited natural resources, it's vital to build human capital through education and training. Without a well-educated and trained workforce, improving wellbeing and economic growth is almost impossible.

Addressing climate change is not easy, and while tropical countries may focus on adaptation, there is still uncertainty about how best to adapt, and precisely what to adapt to. We have to adapt while simultaneously addressing other developmental problems such as improving governance and justice. Climate change is a wicked problem.^[10] One way to tame a wicked problem is to generate knowledge about it. The role of scientists is to produce as much new data and information as possible through research and disseminate it effectively. This could include continued update of data on risk and the status of the physical world; accurate forecasting and scenario building.

Research should also be directed to problem solving, particularly for the major problems that beset development in the Caribbean. Of course, scientific data and research alone are not enough. Good information needs to be disseminated, made freely available and applied to problems. Journals, particularly if they allow open access, can play an important role in disseminating quality information and evidence to researchers, particularly those in developing countries. Some publications should bridge the gap between science and policy by brokering knowledge and creating information that can be used by the private sector, governments, communities and civil society.

REFERENCES



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1. Mora, C., Frazier, A. G., Longman, R. J., Dacks, R. S., Walton, M. M., Tong, E. J., ... & Ambrosino, C. M. (2013). The projected timing of climate departure from recent variability. *Nature*, 502(7470), 183.
2. Burgess, C. P., Taylor, M. A., Stephenson, T., Mandal, A., & Powell, L. (2015). A macro-scale flood risk model for Jamaica with impact of climate variability. *Natural Hazards*, 78(1), 231-256.
3. Wisshak, M., Schönberg, C. H., Form, A., & Freiwald, A. (2012). Ocean acidification accelerates reef bioerosion. *PLoS one*, 7(9), e45124.
4. Branch, T. A., DeJoseph, B. M., Ray, L. J., & Wagner, C. A. (2013). Impacts of ocean acidification on marine seafood. *Trends in ecology & evolution*, 28(3), 178-186.
5. Hsiang, S. M. (2010). Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America. *Proceedings of the National Academy of Sciences*, 201009510.
6. Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., & Fuller, G. (2018) *SDG Index and Dashboards Report 2018*. Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN).
7. Lutz, W., Muttrarak, R., & Striessnig, E. (2014). Universal education is key to enhanced climate adaptation. *Science*, 346(6213), 1061-1062.
8. Frankenberg, E., Sikoki, B., Sumantri, C., Suriastini, W., & Thomas, D. (2013). Education, vulnerability, and resilience after a natural disaster. *Ecology and society: a journal of integrative science for resilience and sustainability*, 18(2), 16.
9. Glenn-Marie Lange, Quentin Wodon, and Kevin. Carey. *The Changing Wealth of Nations 2018: Building a Sustainable Future*. World Bank, Washington, DC, 2018.
10. Levin, K., Cashore, B., Bernstein, S., and Auld, G. Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sciences*, 45(2):123-152, Jun 2012.



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