Island Innovation Policy Brief:
The University of the West Indies
Cave Hill Campus, Barbados Centre for Biosecurity Studies

Waste, Sustainability, Climate Trade & Tourism Nexus in Barbados: Biotrash for Cash & The Circular Economy
Part 1

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Introduction

For small island developing states (SIDS) in the Caribbean, tourism is a major contributor to national gross domestic products (GDP) and economic growth. As climate change impact risks increase and the vulnerabilities of trade and tourism all threaten to impair sustainable economic growth in the Caribbean, new ways of thinking and a shift in trade and tourism economic policies are required. Tourism generates copious amounts of waste globally with some estimates indicating tourists generate twice as much waste as residents. The climate/green energy/sustainable tourism nexus is intriguing, offering new and exciting opportunities.

We advance a potential sustainable solution as a remedy, employing the conversion of multiple biomass waste ('biotrash') streams to primarily biomethane using anaerobic co-digestion on a national scale in Barbados, utilising a sharing economy, circularity, sustainability, and technology approach to leverage by-products such as organic digestate, reclamation and reuse of rectified wastewater, and innovative CO and H S utilisation strategy (multiple formats in multiple sectors) as additional revenue streams.

As tourism and trade sectors expand waste conversion volumes will expand thus driving more revenue generation ensuring circularity. This model significantly changes the current paradigm of the 'polluter pays' to a 'Biotrash to Cash' approach transforming biowaste generation from a iability into an asset and from a punitive approach to a rewarding one. This approach is a better green energy and sustainable tourism model for SIDS with polycrisis challenges (lack of jobs, high debt, pollution, health, waste management, etc.), limited government expenditure, aged and inadequate infrastructure, heavy dependency on tourism, threatened maritime ecosystems, limited land space, and limited food production.

Data systems to monitor waste volumes and relevant conversion efficiencies to economically viable products are needed urgently in SIDS to facilitate adaptation to climate change, achievement of carbon neutrality and maintenance of a clean, healthy, and sustainable environment.

Given this high dependence on tourism and trade there are radiating vulnerabilities that emerge which are amplified within the context of vulnerabilities that emerge which are amplified within the context of SIDS given their inherent characteristics. Tourism and trade are two key vulnerabilities to national and regional biosecurity systems globally as was exemplified by the COVID-19 pandemic. With increasing risks of climate change impacts to SIDS particularly in the Caribbean and the added vulnerabilities posed by tourism and trade, all threaten to impair sustainable economic growth in the region,

thus new ways of thinking and a drastic shift in trade and tourism economic policies are required. Tourism generates copious amounts of solid waste per capita globally, with some estimates indicating tourists can generate as high as twice as much waste per capita as residents even in the Caribbean as is the case of St. Lucia. These estimates exclude sewage and wastewater which would increase the waste generation volumes attributable to tourism. Trade adds to the generation of waste in SIDS, further exacerbating the waste issue. For example, an estimated 145,000 tons of waste per day are disposed in open dumpsites, including 17,000 tons of plastic in Latin America and the Caribbean which often finds its way into waterways, drainage systems, rivers, streams, and oceans.

Barbados, with an area of 166 m2 (430 km2), had a population of approximately 277,821 based on a national census conducted in 2010, with a per-capita GDP of $15 330. In Barbados, the daily generation of waste escalated from 936 tonnes in 2005 to 1,024.24 tonnes in 2015. Like most countries Barbados and other Caribbean states struggle with increasing waste volumes.

In this policy brief we frame the systemic vulnerabilities posed by climate, trade, and tourism but will also present future solutions to reduce these vulnerabilities that threaten lives and livelihoods.

Policy Actions

- **Integrated waste management** with biosecurity and climate change education, fire services, air pollution mitigation, greenhouse gas emissions control, urban planning, emergency management, water management, roadworks and environmental services.

- **Legislative changes to existing environmental & planning laws** on solid waste, energy, agricultural zoning, water and wastewater management and air pollution and emission levels.

- **Economic policies to drive uptake of green bioenergy** at more favourable rates than PV, issuance of green credits or cash rebates for land management, carbon capture, biowaste conversion and water reclamation. This advances the progression of the National Energy Policy goals of being carbon neutral by 2030.

An Overview of Rubbish Fires in Barbados

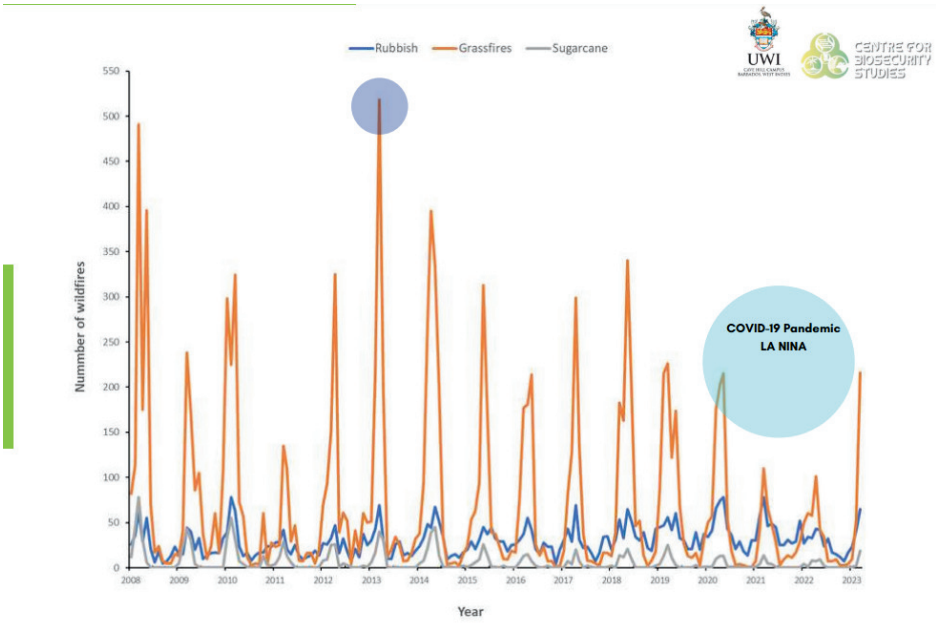

Figure 1. The numbers of wildfires (rubbish, grass & sugarcane fires) by type in Barbados 2008-2020.

(***Source:*** *Centre for Biosecurity Studies, The University of the West Indies)*

Rubbish fires are the second most prevalent type of wildfire in Barbados. During the COVID-19 pandemic there was an increase in rubbish fires during 2020 since there were lockdowns and reduced garbage collection frequency. People therefore resorted to open burning to get rid of solid waste.

Rubbish fire peaks occurred between March and May of every year. These peaks occurred during the driest times of the year and also coincide with the peak winter tourist season.

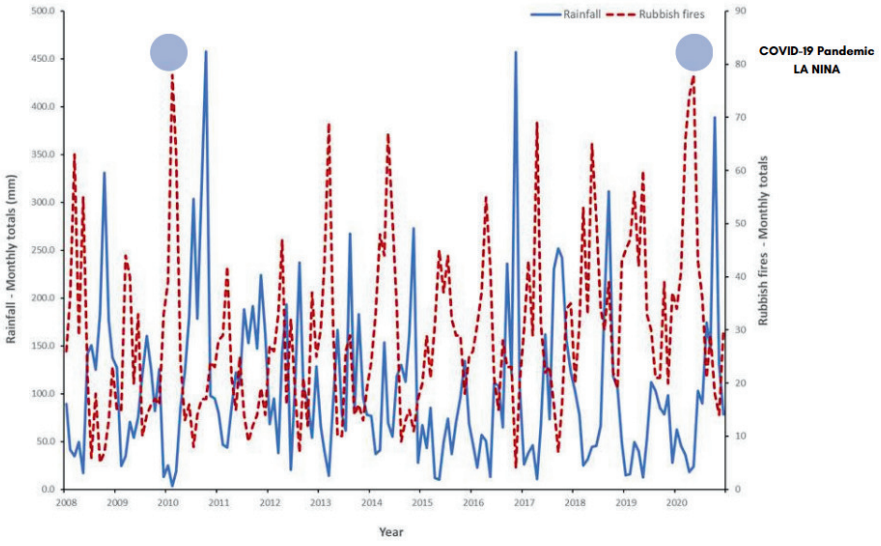

Figure 2. The numbers of rubbish fires and the monthly rainfall totals in Barbados 2008-2020.

(***Source:*** *Centre for Biosecurity Studies, The University of the West Indies)*

Rubbish fires in Barbados peak during the dry season. During the rainy season when monthly rainfall levels increase rubbish fires are reduced and when rainfall levels drop during the dry season then rubbish fires increase.

The highest rubbish fire peaks were observed during 2010 & 2020 in Barbados. During the COVID-19 pandemic there was an increase in rubbish fires during 2020 since there were lockdowns and reduced garbage collection frequency persons resorted to open burning to get rid of solid waste. During 2010 Barbados experienced simultaneous dengue and hantavirus epidemics indicating there may be a potential link with rubbish fires, waste management and vector-borne diseases.

The highest rubbish fires peak in St. Michael was observed during 2016. This highest rubbish fire peak was observed during the period of time when the tipping fee levy was in place. This likely reduced waste disposal volumes into the landfill due to increased economic costs. Open burning then appears to have become a more popular method of waste disposal.

The lowest number of months with fewer than 3 rubbish fires in Christ Church was observed during 2015 - 2018. This lowest of months with fewer than 3 rubbish fires were observed during the period of time when the tipping fee levy was in place. This likely reduced waste disposal volumes into the landfill due to increased economic costs. Open burning then appears to have become a more popular method of waste disposal in this parish.

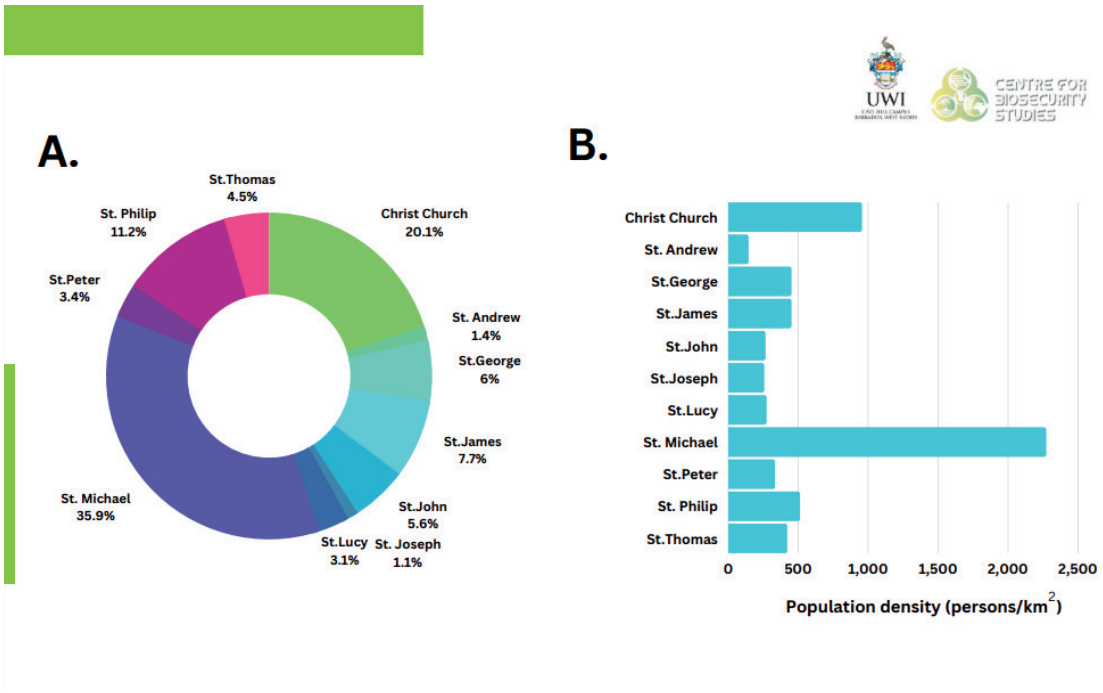

Figure 3. A. The percentages of total rubbish fires by parish in Barbados 2006-2020.
B. The population densities of all parishes in Barbados.

(***Source:*** *Centre for Biosecurity Studies, The University of the West Indies*)

Rubbish fires are most prevalent in St. Michael, Christ Church, St. Philip and St. James in Barbados. These are the most populous parishes in Barbados but are also the parishes with the highest density of hotels, restaurants, resorts and tourist attractions as well. Waste management in these parishes should be examined more closely to see if targeted interventions can be used to reduce rubbish fire incidence in these locations.

Rubbish fires in Barbados occur in the most densely populated parishes. The high density of both residents and tourists (transient population) likely increases the burden of waste management in these parishes, increasing the risk of garbage accumulation and open burning practices. These densities may actually be higher with incoming tourist arrivals depending on the time of year creating waste volume surges and challenges to effective waste management.

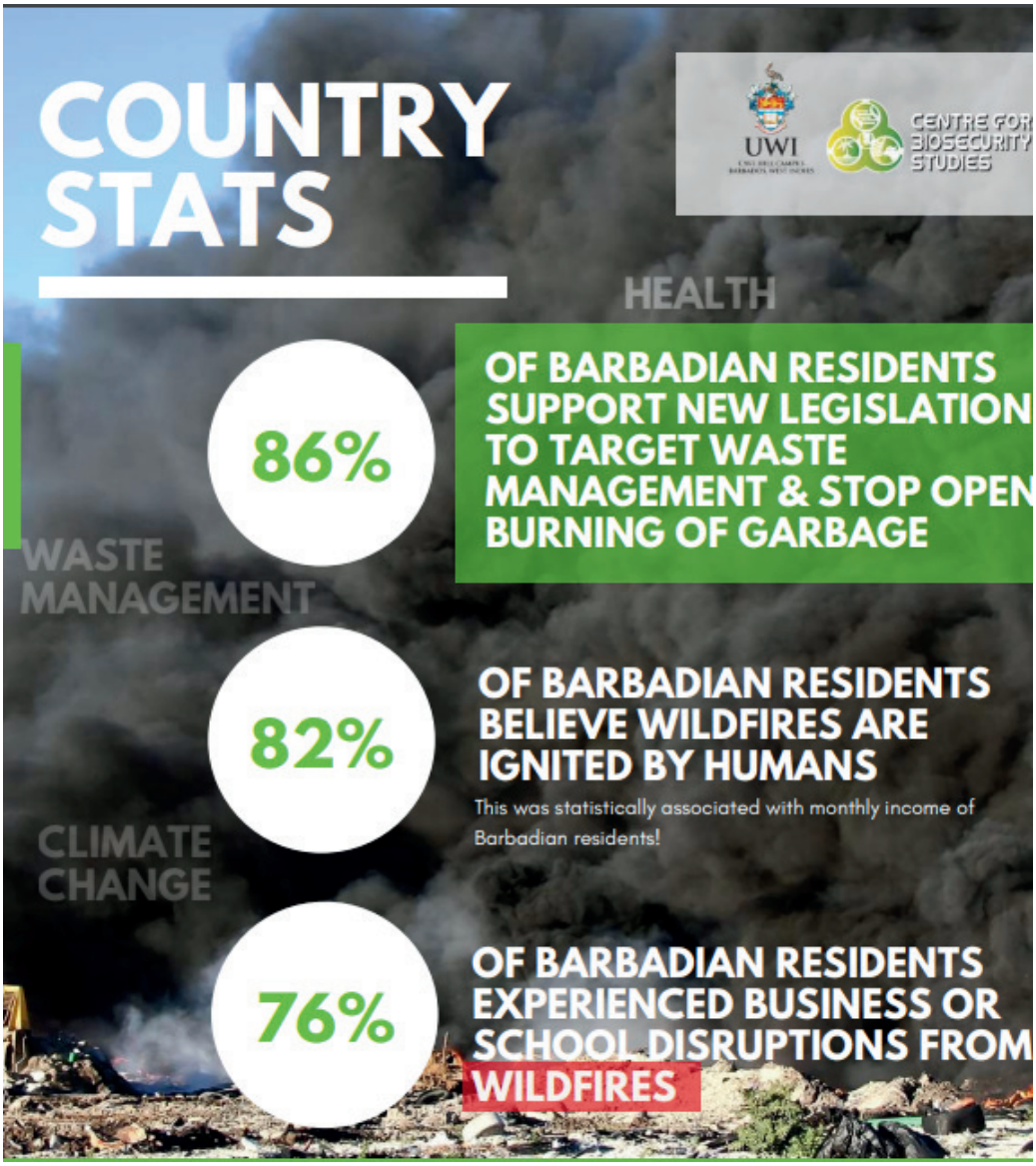

Figure 4. The percentages of population awareness about the rubbish fires by parish in Barbados 2006-2020.

(***Source:*** *Centre for Biosecurity Studies, The University of the West Indies*)

Overview of Research

Wildfires which often include rubbish fires have a negative impact on communities in Barbados. Most Barbadians support new legislation targeting the proper waste management efforts in the island to halt open burning of garbage. Disruptions from wildfires (grass and rubbish fires) include closures of schools and businesses. The most vulnerable within communities such as disabled persons, the elderly, infants/young children, and NCD sufferers are at particular at risk and should be prioritised. This offers a prime opportunity for policy and legislation development to effect impactful and positive change.

References

1. Ivanov, S.H.; Webster, C.; Stoilova, E.; Slobodskoy, D. Biosecurity, crisis management, automation technologies and economic performance of travel, tourism and hospitality companies–A conceptual framework. Tourism Economics 2022, 28, 3-26.

2. Rogerson, C.M.; Rogerson, J.M. COVID-19 and tourism spaces of vulnerability in South Africa. African Journal of Hospitality, Tourism and Leisure 2020, 9, 382-401.

3. Aguirre, A.A.; Gore, M.L.; Kammer-Kerwick, M.; Curtin, K.M.; Heyns, A.; Preiser, W.; Shelley, L.I. Opportunities for transdisciplinary science to mitigate biosecurity risks from the intersectionality of illegal wildlife trade with emerging zoonotic pathogens. Frontiersin Ecology and Evolution 2021, 9, 604929.

4. Albert, C.; Baez, A.; Rutland, J. Human security as biosecurity: Reconceptualizing national security threats in the time of COVID-19. Politics and the Life Sciences 2021, 40, 83-105.

5. Stennett-Brown, R.K.; Stephenson, T.S.; Taylor, M.A. Caribbean climate change vulnerability: Lessons from an aggregate index approach. PloS one 2019, 14, e0219250.

6. Lincoln Lenderking, H.; Robinson, S.-a.; Carlson, G. Climate change and food security in Caribbean small island developing states: challenges and strategies. International Journal of Sustainable Development & World Ecology 2021, 28, 238-245.

7. Lewis, C.T. Climate Change and the Caribbean: Challenges and Vulnerabilities in Building Resilience to Tropical Cyclones. Climate 2022, 10, 178.

8. Martins, A.M.; Cró, S. The Impact of Tourism on Solid Waste Generation and Management Cost in Madeira Island for the Period 1996–2018. Sustainability 2021, 13, 5238.

9. Mateu-Sbert, J.; Ricci-Cabello, I.; Villalonga-Olives, E.; Cabeza-Irigoyen, E. The impact of tourism on municipal solid waste generation: The case of Menorca Island (Spain). Waste management 2013, 33, 2589-2593.

10. Estay-Ossandon, C.; Mena-Nieto, A. Modelling the driving forces of the municipal solid waste generation in touristic islands. A case study of the Balearic Islands(2000–2030). Waste management 2018, 75, 70-81.

11. Shamshiry, E.; Nadi, B.; Bin Mokhtar, M.; Komoo, I.; Saadiah Hashim, H.; Yahaya, N. Integrated models for solid waste management in tourism regions: Langkawi Island, Malaysia. Journal of environmental and public health 2011, 2011.

12. Zorpas, A.A.; Voukkali, I.; Loizia, P. The impact of the tourist sector in the waste management plans. Desalination and Water Treatment 2015, 56, 1141-1149.

13. Mohammed, A. SMEs' Sustainable Development Challenges Post-COVID-19: The Tourism Sector. World Journal of Entrepreneurship, Management and Sustainable Development 2022, 18, 407-424.

14. Dixon, J.; Hamilton, K.; Pagiola, S.; Segnestam, L. Tourism and the environment in the Caribbean: an economic framework. 2001.

15. Mohammadi, E.; Singh, S.J.; Habib, K. Electronic waste in the Caribbean: An impending environmental disaster or an opportunity for a circular economy? Resources, Conservation and Recycling 2021, 164, 105106.

16. Savino, A.; Solorzano, G.; Quispe, C.; Correal, M. Waste management outlook for Latin America and the Caribbean. UNEP, https://wedocs. unep. org/bitstream/handle/20.500 2018, 11822, 26448.

17. Clayton, C.A.; Walker, T.R.; Bezerra, J.C.; Adam, I. Policy responses to reduce single-use plastic marine pollution in the Caribbean. Marine Pollution Bulletin 2021, 162, 111833.

18. T. D. Agbeyegbe, "The Link Between Output Growth and Output Growth Volatility: Barbados," Annals of Data Science, vol. 10, no. 3, pp. 787-804, 2023.

19. Sanitation Service Authority (SSA), "Barbados Solid Waste Characterisation Study," Ministry of Environment and Drainage, Barbados, 2015.

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