

URBI Talk delivered at University of Graz, 4 June 2024

Building on Borrowed Time

Why the “staying afloat” approach will not work for small islands?

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1

Building on borrowed time: Why the “staying afloat” approach does not work for small islands?

Abstract:

Small Island Developing States (SIDS) are on the frontlines of climate change. At 1.5 °C of global warming, severe impacts on populations, livelihoods, and infrastructure, and critical resources such as food, energy, and water, are projected, that will limit adaptation opportunities as well. This talk will argue that small island nations are “building on borrowed time”. Current climate adaptation measures are not only inadequate to deal with this crisis, but they further exacerbate “socio-metabolic risk”, or systemic risk related to the availability and circulation of critical resources such as food, water, materials, and energy. Mitigating these risks is crucial for small islands to withstand climate impacts and avoid cascading dysfunction of environmental, economic and social systems.

2

**The world has warmed 1.5 °C,
according to 300-year-old sponges**

By the time that official temperature records began, global temperatures had already risen by half a degree.

By [Bianca Nogrady](#)



Nature News,
11 February 2024

3

Islands face an existential crisis

- SIDS are least responsible (less than 1% GHGs), but most impacted by CC (SLR, extreme events, droughts, flooding, coastal erosion);
- tenuous resource security and supply, reduced waste absorption capacity
- limited means to develop economies of scale: high dependency on imports to meet basic needs;
- Maladaptive practices (e.g. undiversified exports, centralized energy system, coastal squeeze, poor waste management)
- damages to infrastructure result in loss of critical services and the accumulation of a large volume of debris;
- restoring the services comes with large fiscal and material requirements > high debt cycle.

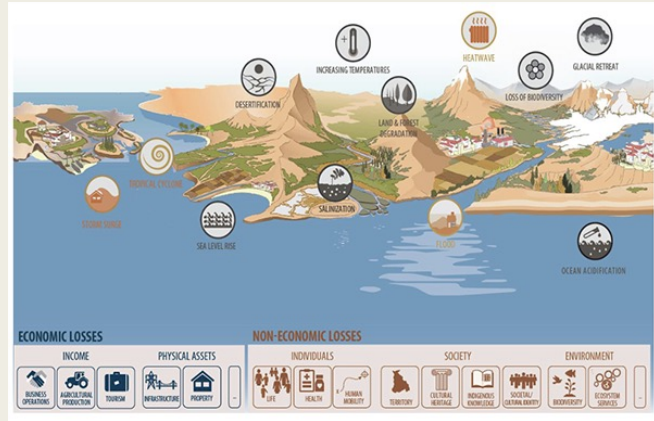
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Islands are sites of multi-hazard risks and cascades

In tightly coupled socio-ecological systems, like islands, even small or single events can set in motion a series of cascading impacts.

Multiple risks are interconnected and amplified through unpleasant feedback loops.

Hence, tipping points are reached very rapidly on islands.



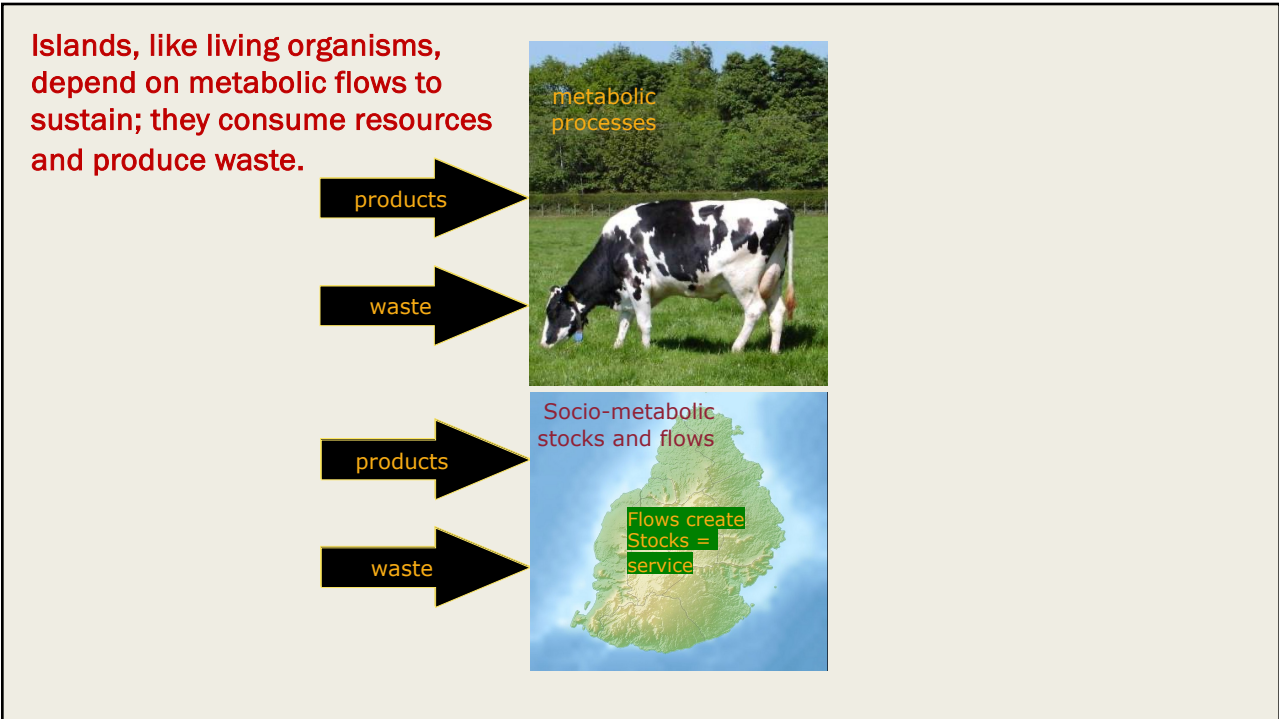
Source: UNFCCC
<https://sdg.iisd.org/commentary/guest-articles/human-mobility-in-the-context-of-sids-and-climate-change-pre-empting-planning-and-contingency-arrangements-for-adverse-climate-change-impacts/>

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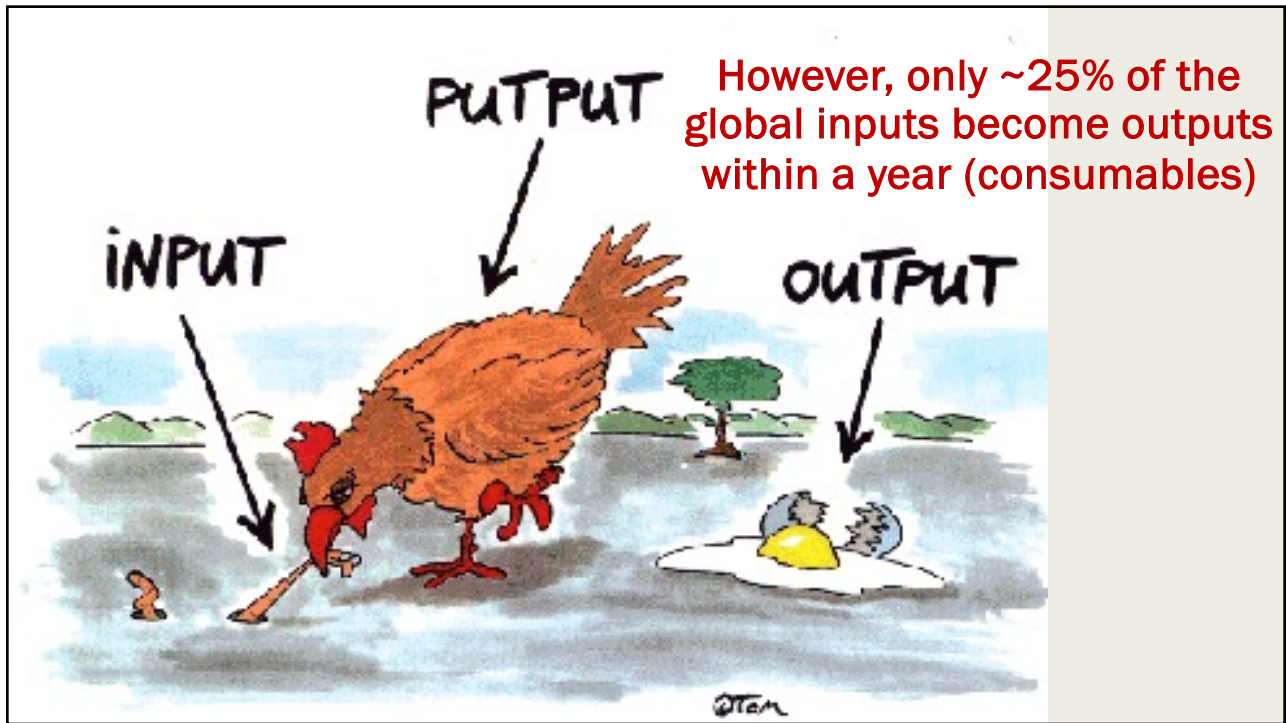
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“Islands-as-an-organism” analogy

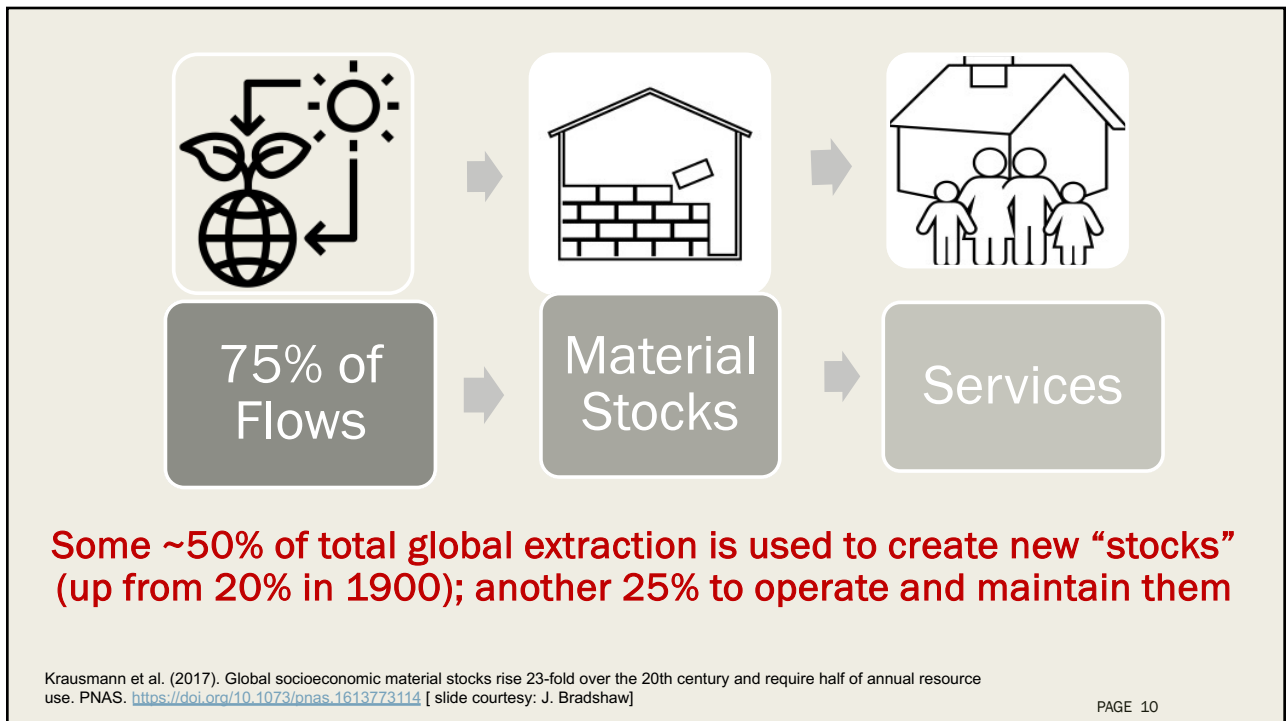
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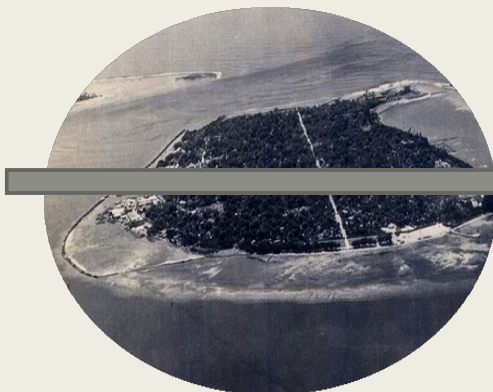
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How did that happen?

11

As economies develop, they stimulate the demand for essential services (more putput) that are provided by the stocks, that require flows.

Malé, 1950



Malé, 2005



<https://www.hassanhameed.com/engineering/the-making-of-male-urban-mess-part-2/>

12

Dynamic feedback between stocks-flows-service (or the SFS nexus) – systems thinking



13

**Unsustainable patterns of resource-use /
metabolism can jeopardize system
resilience = Socio-metabolic risk (SMR)**

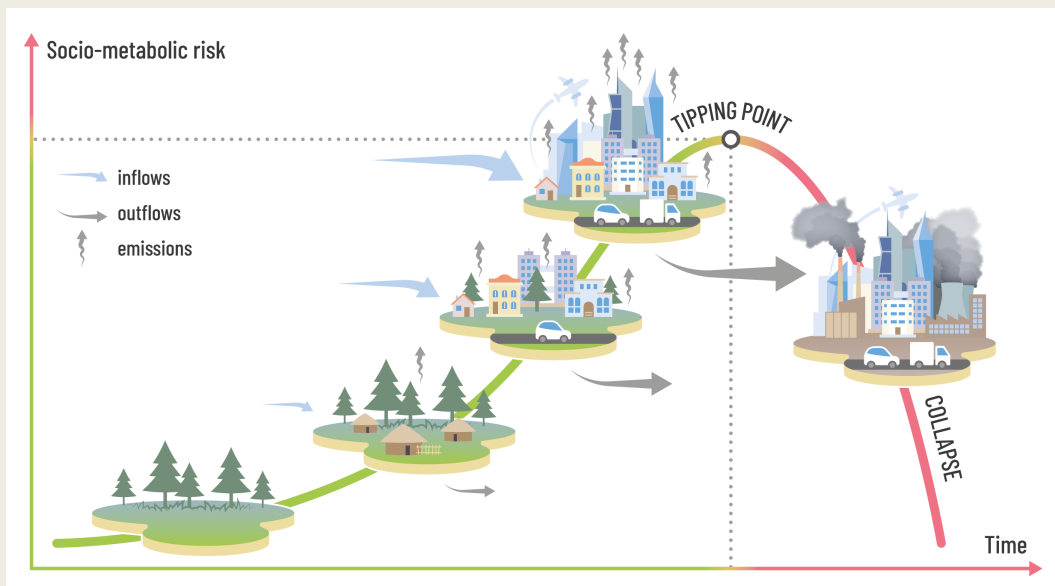
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Socio-metabolic risk (SMR) on islands

- *Socio-metabolic risks are to islands as circulatory health problems are to humans – both constrain the entity’s ability to withstand significant shocks and changes.*
- Maladaptive and climate insensitive development practices – such as coastal squeeze, high import dependency, and centralized energy systems – magnify islands climate vulnerability.
- Analysis suggests that climate-related extreme events, alongside crises like disasters, wars, or pandemics, can expose the inherent vulnerabilities within unsustainable resource-use patterns.

15

Accumulating socio-metabolic risk >> metabolic collapse



16

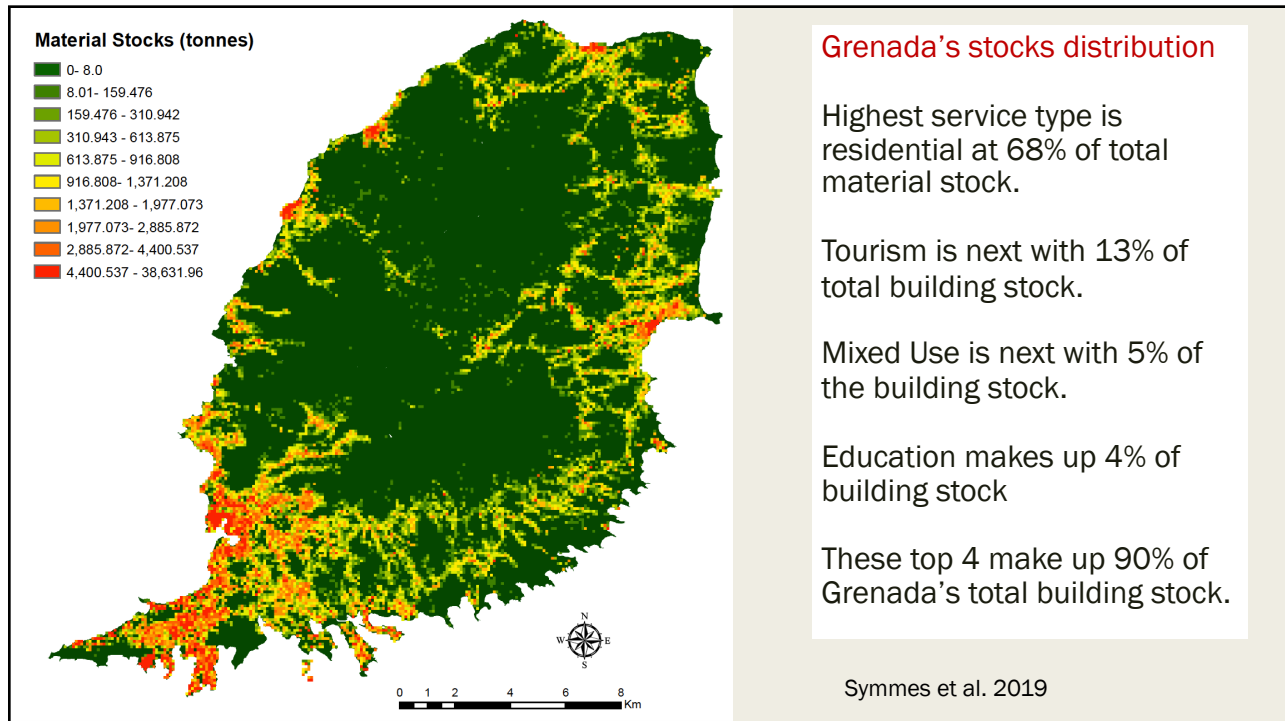
Metabolism of Islands

- monitor **economy-wide resource-use and demand** from entry to exit;
- identify stock-flow combinations (quantity, quality, and spatial distribution) that contribute to the system's proliferation of **socio-metabolic risk**;
- Analyze the cost and benefits of social metabolism (resource-use) across social groups (**environmental justice**);
- identify the potential for **socio-metabolic collapse** from maladaptive practices (tipping points);
- develop strategies (e.g. **from linear to circular metabolism**) to become more resource efficient, adaptive and resilient;
- improve quality of island life using the **stock-flow-service (SFS) nexus approach** (Haberl et al. 2019)

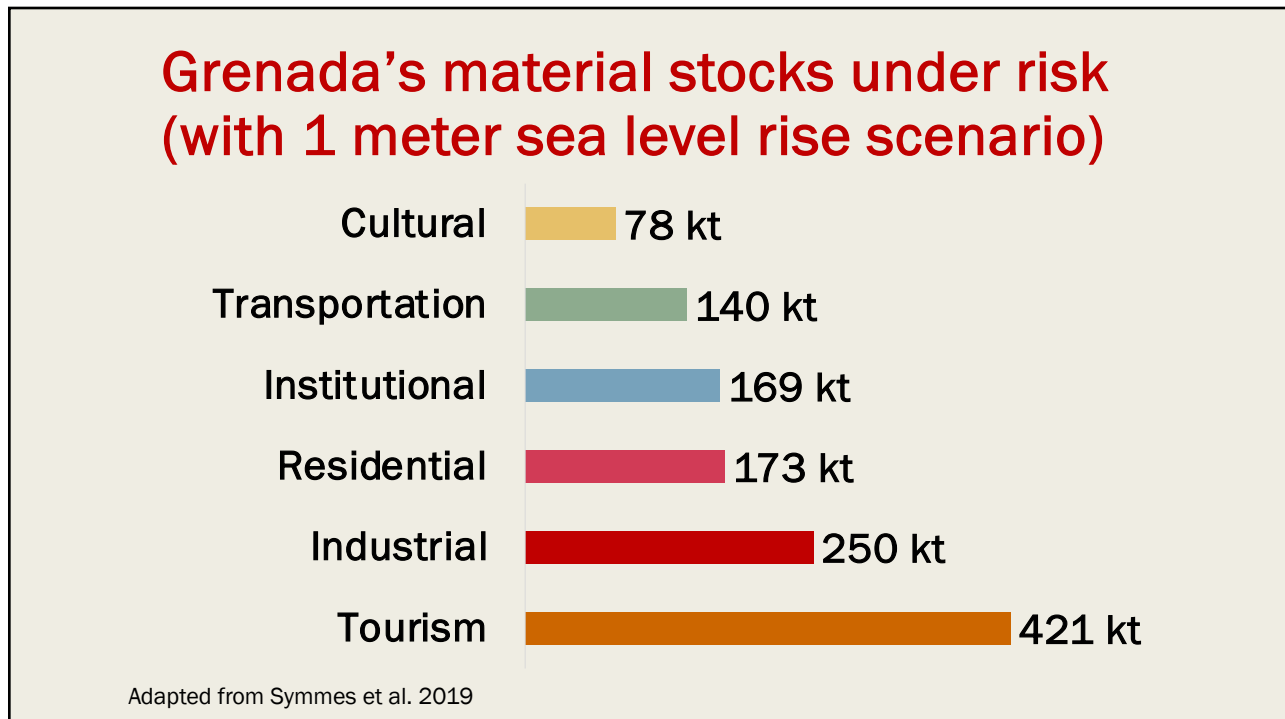
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Grenada – Material stocks at risk

18



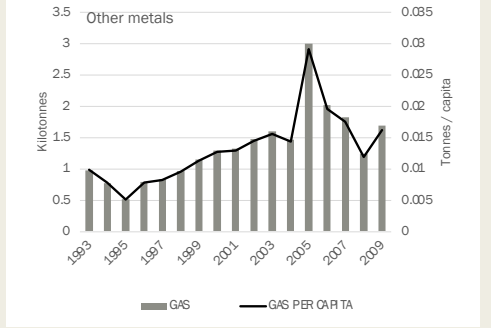
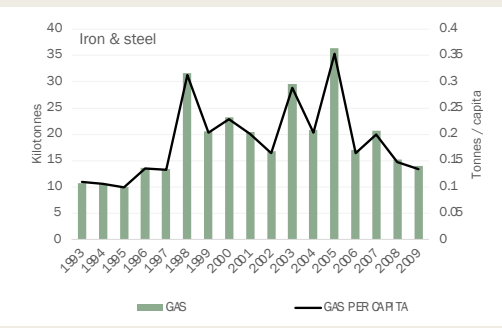
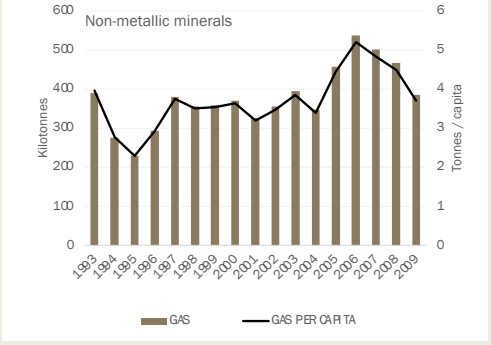
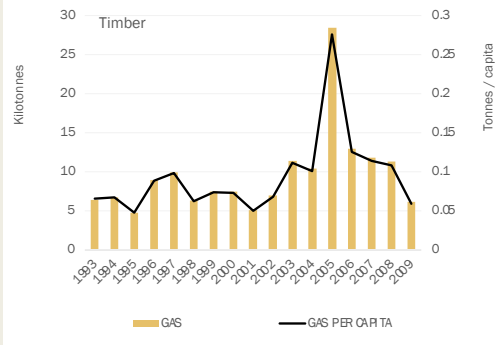
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20

Material requirements in Grenada after 2004 Ivan hurricane

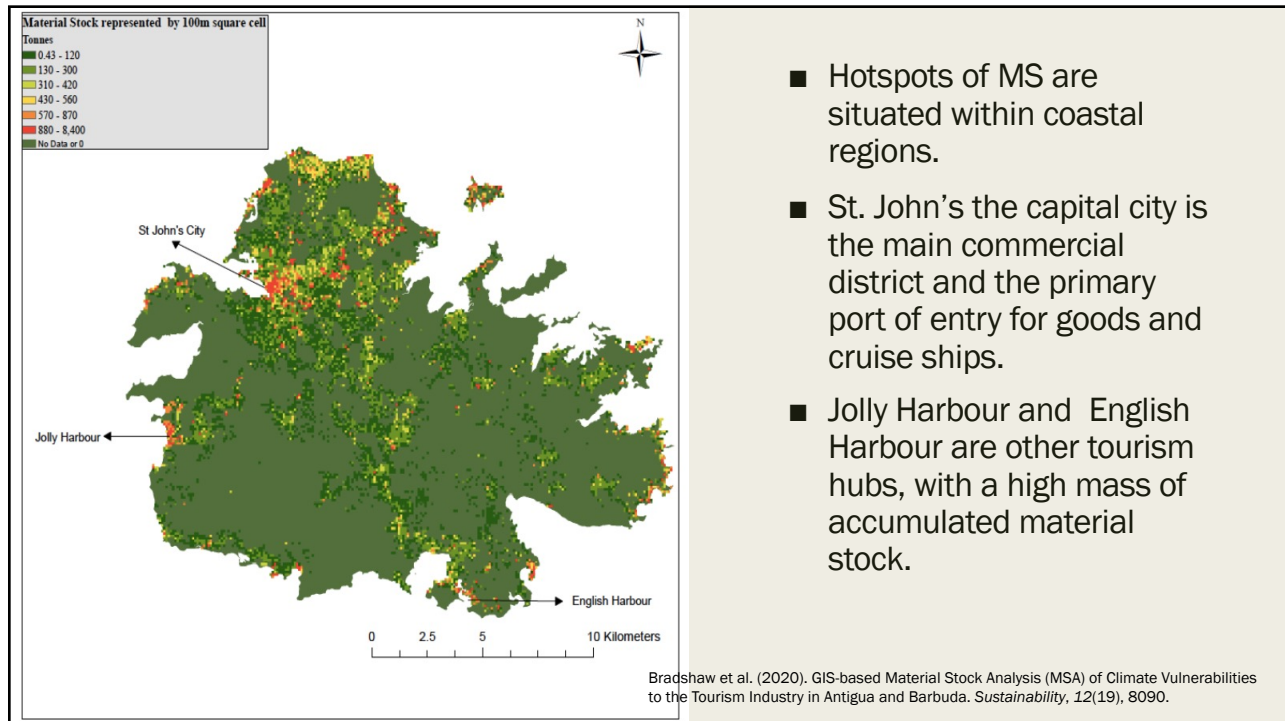
Symmes et. al. (2019). The weight of islands: Leveraging Grenada's material stocks to adapt to climate change. *Journal of Industrial Ecology*, 24(2), 369-382.



21

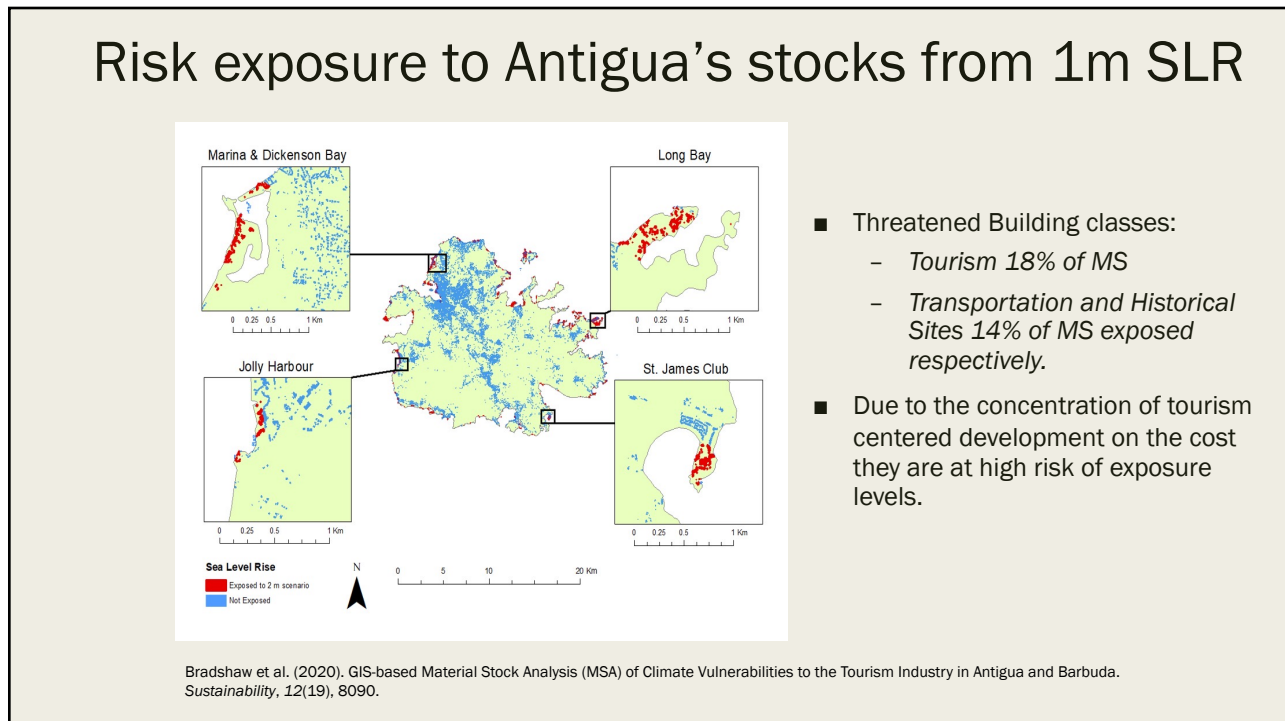
Antigua and Barbuda

22



- Hotspots of MS are situated within coastal regions.
- St. John's the capital city is the main commercial district and the primary port of entry for goods and cruise ships.
- Jolly Harbour and English Harbour are other tourism hubs, with a high mass of accumulated material stock.

23

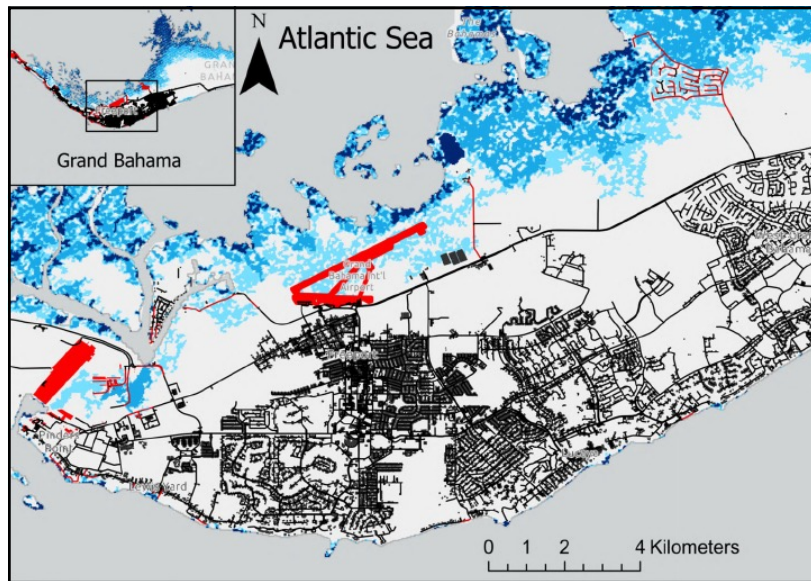


- Threatened Building classes:
 - *Tourism 18% of MS*
 - *Transportation and Historical Sites 14% of MS exposed respectively.*
- Due to the concentration of tourism centered development on the coast they are at high risk of exposure levels.

24

The Bahamas

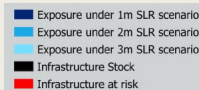
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The BAHAMAS

- Northern part of the country most impacted due to concentration of stocks and low-lying terrain (Grand Bahamas and Abaco).
- Services most impacted is transport, even at 1m SLR - airports ~12% and seaports ~39%.
- Residential and commercial material stocks and services are impacted significantly as next category

Martin del Campo, F., Singh, S. J., Fishman, T., Thomas, A., & Drescher, M. (2023). The Bahamas at risk: Material stocks, sea-level rise, and the implications for development. *Journal of Industrial Ecology*. <https://doi.org/10.1111/jiec.13402>

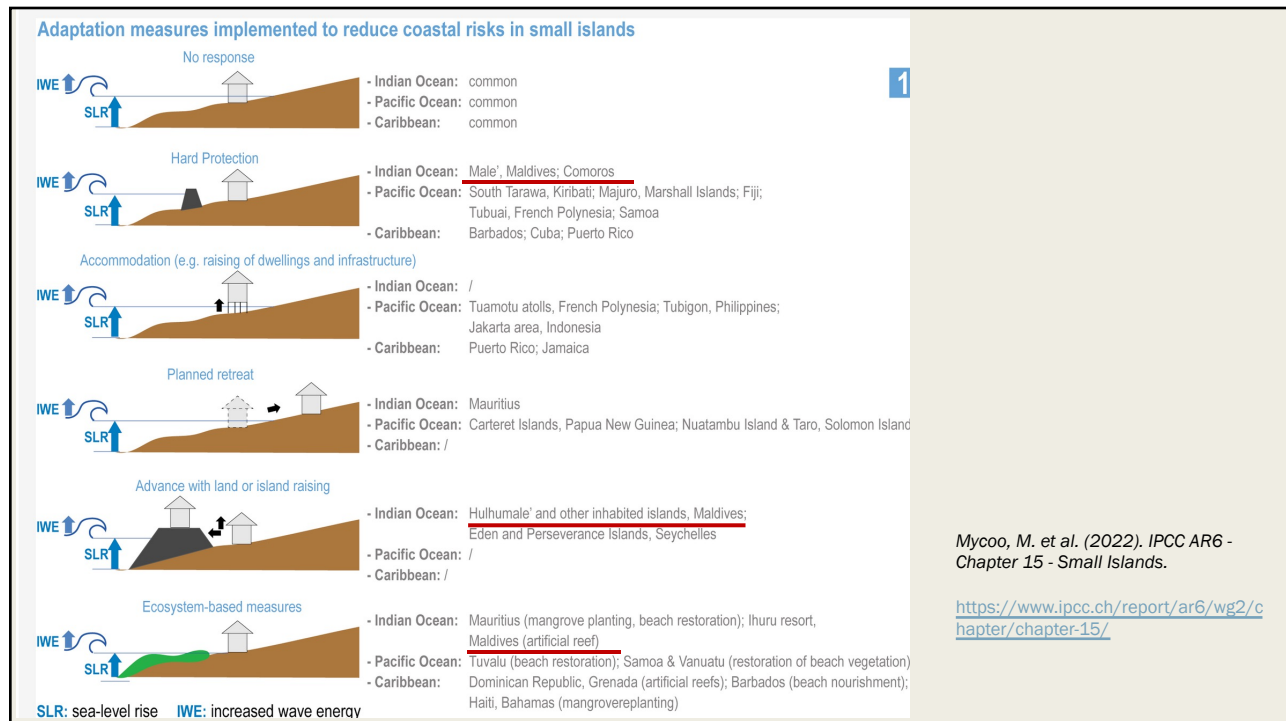


26

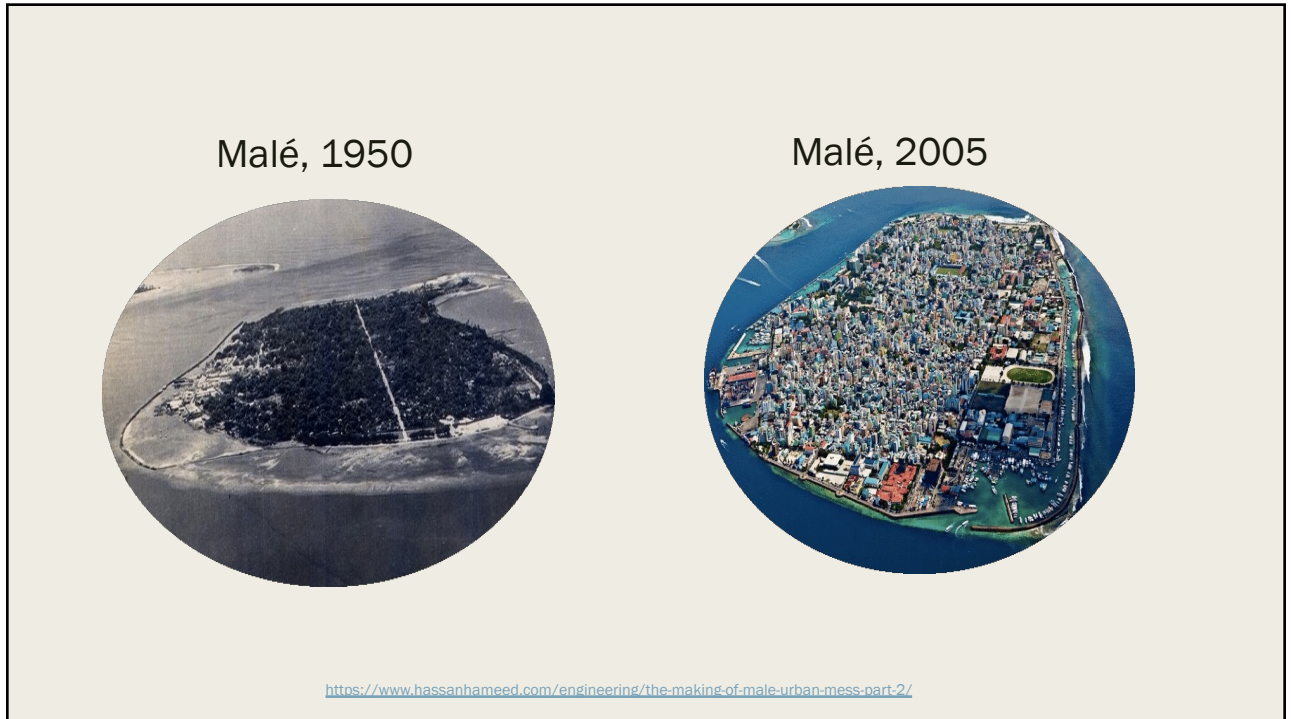
26

Several Small Island Developing States (SIDS) are on a path of resource-intensive measures to adapt to climate change

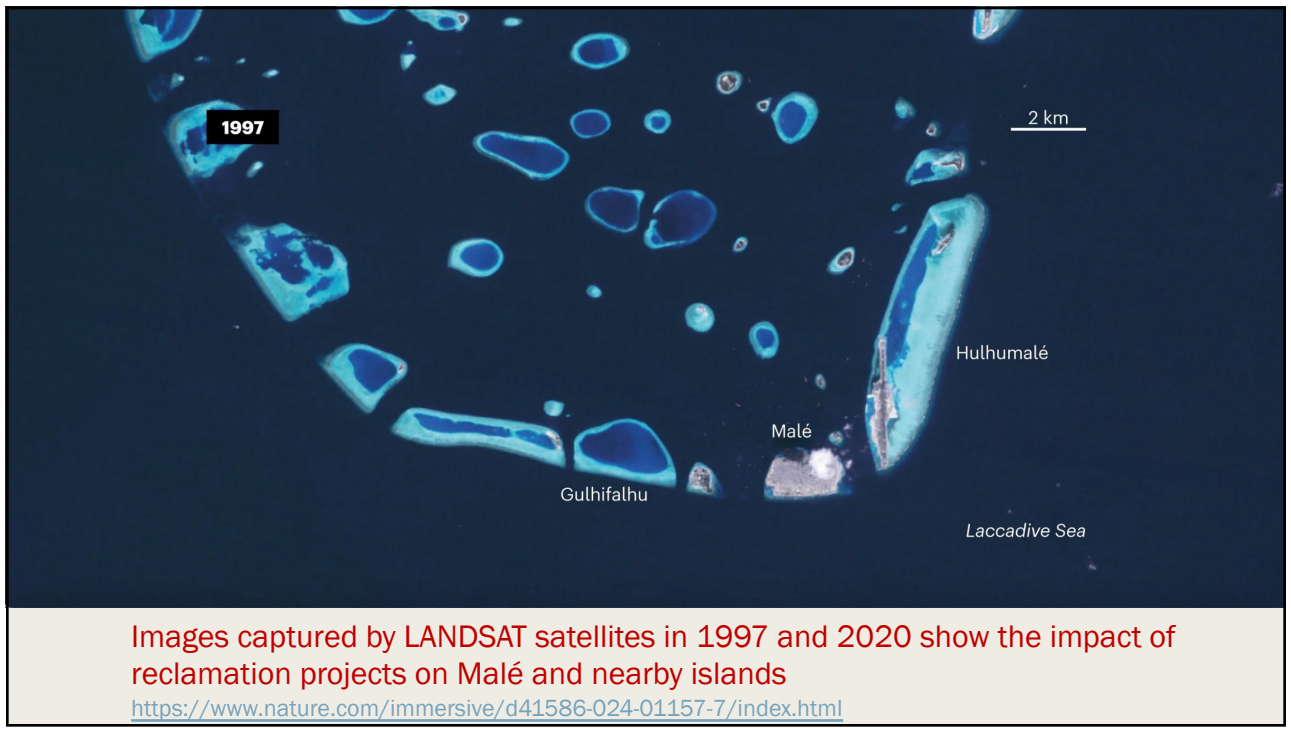
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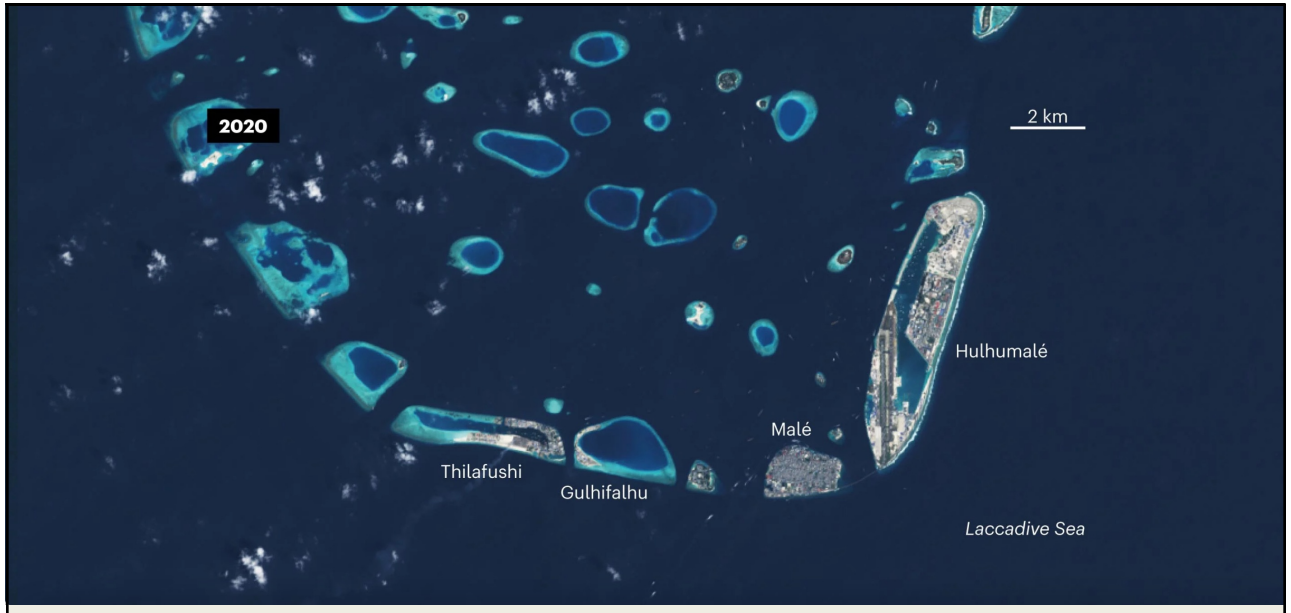
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29



30



Images captured by LANDSAT satellites in 1997 and 2020 show the impact of reclamation projects on Malé and nearby islands

<https://www.nature.com/immersive/d41586-024-01157-7/index.html>

31

This block contains two satellite images on the left, a circular diagram on the right, and a caption below. The two satellite images show the same area as the main image on slide 31, but they are side-by-side, likely representing the 1997 and 2020 images. Each has a 2 km scale bar. The circular diagram on the right is divided into four quadrants: top-left (Services, with icons of a hospital and a factory), top-right (Flows, with an arrow and a water tap), bottom-right (Material Stocks, with a storage tank), and bottom-left (Construction, with icons of cranes and a building). The diagram is surrounded by a circular arrow.

Images captured by LANDSAT satellites in 1997 and 2020 show the impact of reclamation projects on Malé and nearby islands

32



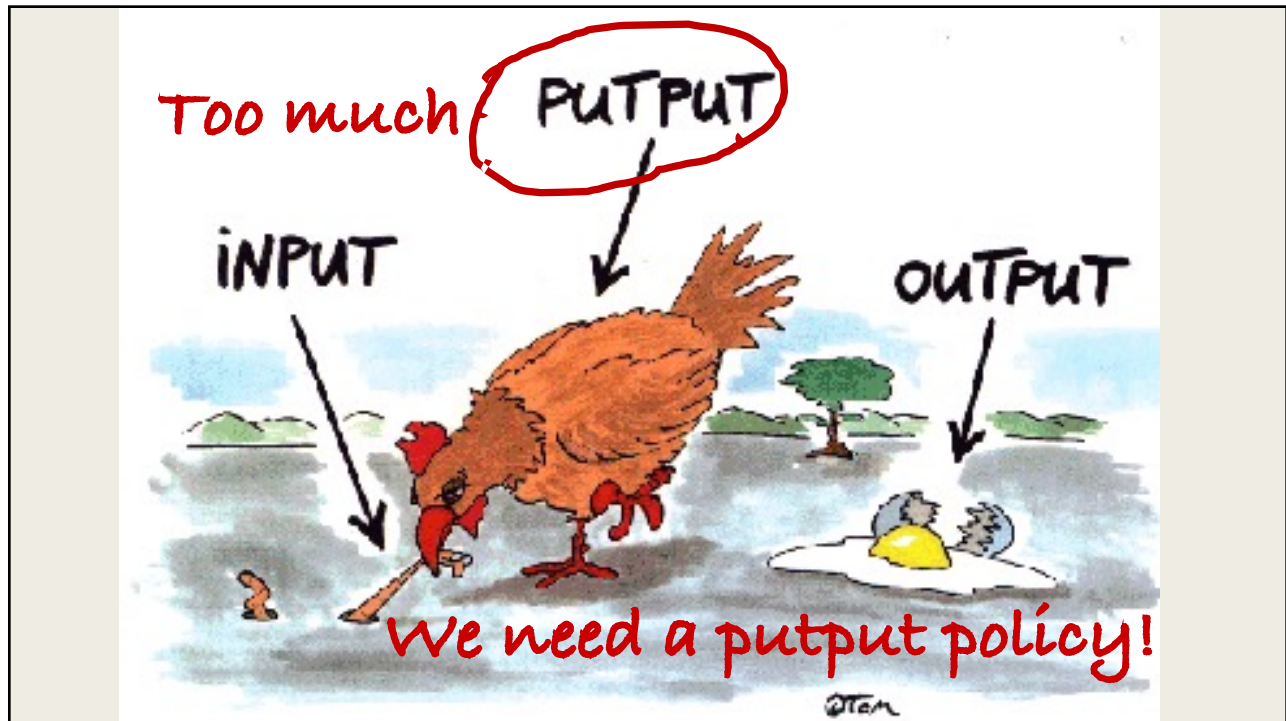
33

What are the current resource requirements for adapting to climate change on SIDS?

Are resource-intensive strategies of simply “staying afloat” a viable one for SIDS?

What alternate metabolic pathways exist to strengthen CCA capacity? (systems-focused, not short-term symptomatic solutions)

34



35

Slim the “putput” (to mitigate socio-metabolic risk and increase adaptative capacity)

Towards a 5E strategy

- **evolve** towards a *circular and regenerative economy* through a transformation in local and regional business and increase the localization of food, energy, and construction materials.
- **expand** *circularity* principles to the level of the island economy, to include flows between sectors;
- **enhance** wellbeing contributions with lower material and energy demand from the perspective of material *stocks-flow-service* (SFS) nexus;
- **ease** resource requirements through *green(-blue) infrastructure* and nature-based solutions to provide crucial societal services;
- **exercise** a *social and environmental justice* perspective to ensure that the costs and benefits of resource-use are equitably shared across gender and social groups.

36

But, do islands matter?

- Islands are home to approximately 600 million people, or nearly 10% of world's population;
- One in four countries are islands or archipelagos;
- Islands comprise nearly 7% of the earth's terrestrial area, and including their exclusive economic zones, this amounts to 1/6th of the earth's total area;
- Islands are biodiversity hotspots, harboring 20% of all plant, bird and reptile species found globally;
- Islands as bounded systems and resource constrained environments are excellent sites for understanding system dynamics and risks;
- The urgency faced by SIDS is an opportunity to innovate and learn about how to adapt/build resilience in a climate challenged world.

37

Must take publications for your next beach holiday!

- **Singh, S. J.**, Elgie, A., Noll, D., & Eckelman, M. J. (2023). The challenge of solid waste on Small Islands: Proposing a Socio-metabolic Research (SMR) framework. *Current Opinion in Environmental Sustainability*, 62, 101274.
- Martin del Campo, F., **Singh, S. J.**, Fishman, T., Thomas, A., Noll, D., & Drescher, M. (2023). Can a small island nation build resilience? The significance of resource-use patterns and socio-metabolic risks in The Bahamas. *Journal of Industrial Ecology*.
- **Singh, S. J.**, Huang, T., Nagabhatla, N., Schweizer, P.-J., Eckelman, M., Verschuur, J., & Soman, R. (2022). Socio-metabolic risk and tipping points on islands. *Environmental Research Letters*, 17(6), 065009.
- Rahman, S., **Singh, S.J.**, McCordic, C. (2022). Can the Caribbean localize its food system? Evidence from biomass flow accounting. *Journal of Industrial Ecology*.
- Mohammadi, E., **Singh, S.J.**, Habib, K. (2021). Electronic waste in the Caribbean: An impending environmental disaster or an opportunity for a circular economy? *Resources, Conservation and Recycling* 164. 105106. Elsevier.
- Elgie, A., **Singh S.J.**, Telesford, J. (2021). You can't manage what you can't measure: The potential for circularity in Grenada's waste management system. *Resources, Conservation and Recycling*, 164. 105170. Elsevier.
- Noll, D., Lauk, C., Haas, W., **Singh, S. J.**, Petridis, P., & Wiedenhofer, D. (2021). The sociometabolic transition of a small Greek island: Assessing stock dynamics, resource flows, and material circularity from 1929 to 2019. *Journal of Industrial Ecology*.
- Bradshaw, J., **Singh, S.J.**, Tan, S-Y., Fishman, T., Pott, K. (2020). GIS-based Material Stock Analysis of Climate Vulnerabilities to the Tourism Industry in Antigua and Barbuda. *Sustainability* 12 (19), 8090. MDPI.
- Symmes, R., Fishman, T., Telesford, J., Tan, S-Y, de Kroon, K., **Singh, S.J.** (2020). The weight of islands: A GIS-based material stock analysis of Grenada in the context of extreme weather and climate change. *Journal of Industrial Ecology*. Wiley.

38