The resource (in)sufficiency of the Caribbean:

Analyzing **S**ocio-**m**etabolic **R**isks (**SMR**) of **W**ater, **E**nergy, and **F**ood

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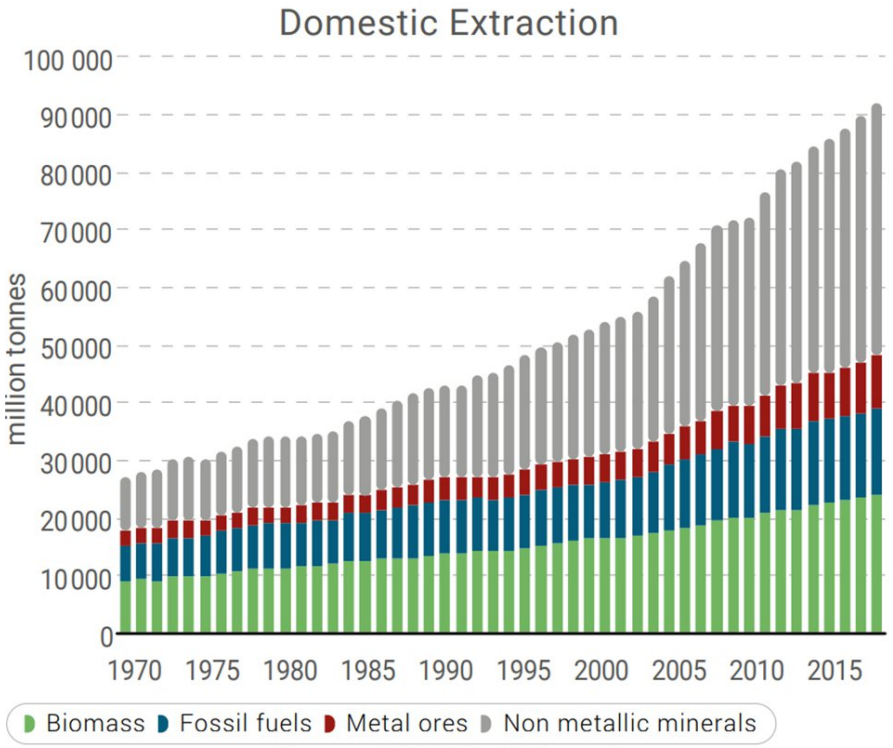
IMPORTANCE OF RESOURCE DYNAMICS

The growth in resource use has caused a sharp increase in global material extraction, particularly of non-renewable materials.



Source: UNEP & IRP, 2018

These trends are being intensified by:

- **Rapid** economic and population **growth**
- **Higher consumption per capita**

SUSTAINABILITY CHALLENGES FACED BY SMALL ISLANDS

- **Limited** resource-bases
- **Reduced** waste absorption capacity
- Geographic **dispersion**
- **Susceptible** to shocks
- **Isolation** from markets
- **Imports** of up to 80-90% of their basic resource needs
- Highest ranking nations on **vulnerability** indexes

Impacts from climate change amplify:

- **Vulnerability** levels due to sea-level rise, extreme events, unpredictable droughts, flooding, and more
- **Exposure** to risks
- Pre-existing sustainability challenges

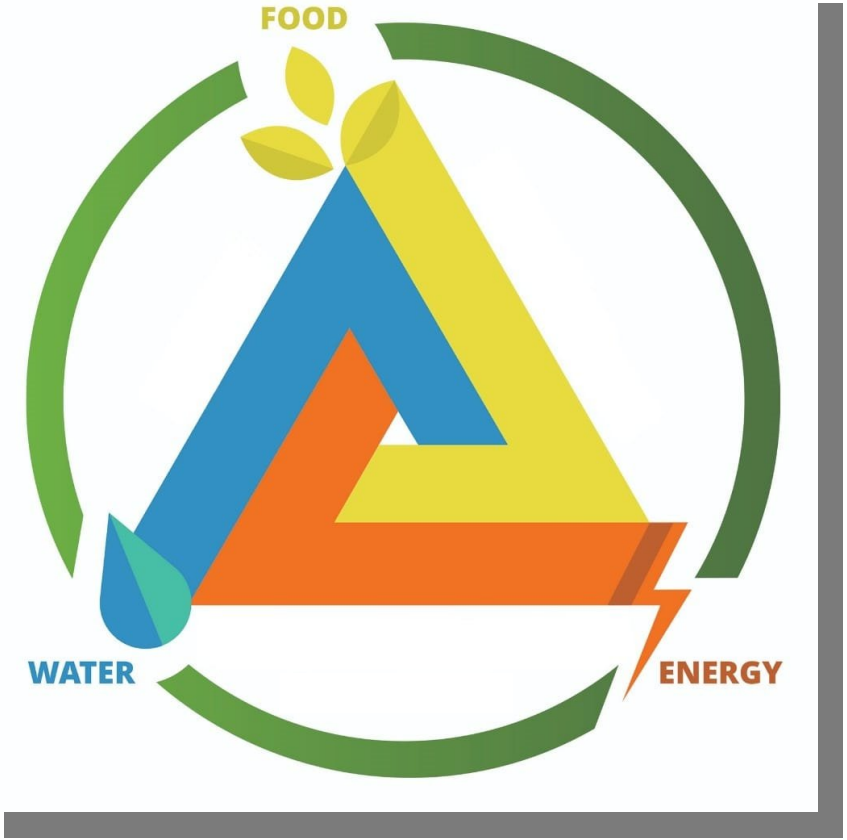
Source: Deschenes & Chertow, 2004; UNCTAD, 2021; Bradshaw et al., 2020; Dorodnykh, 2017; FAO, 2019; IRENA, 2014; Symmes et al., 2019; Aleksandrova et al., 2021; The Commonwealth Secretariat, 2021; Atkins et al., 2000; IMF, 2021; Sachs et al., 2021; Thomas et al., 2020

Need for a deeper understanding of the resource dynamics: Resources **nexus**, **drivers**, and **management**

Socio-metabolic Risks (SMRs): Systemic risks related to critical resource **availability**, material **circulation integrity**, **(in)equities** in cost and Benefit distributions (Singh et al., 2022)

Specific resource-use patterns exhibit potentials for systemic risks and cascade effects, inhibiting progress towards:

Resource security Self-reliance Provisioning of societal services



Analyze the shifting resource-baseline of (Caribbean) Small Islands through the lens of **SMRs**, to enhance resource security and build system's resilience

CASE STUDY: THE CARIBBEAN SMALL ISLANDS

Caribbean small islands: key figures

	Countries	Population 2017	Land area km²	GDP Per Capita 2017	HDI 2018	Ease of Doing Business Index 2019
1.	Antigua and Barbuda	95,400	440	15,820	0.776	113
2.	Aruba	105,400	180	25,630	0.908	N/A
3.	Barbados	286,200	430	16,300	0.814	128
4.	Cuba	11,340,000	103,800	8,540	0.778	N/A
5.	Dominica	71,500	750	6,950	0.724	111
6.	Dominican Republic	10.510,000	48,300	7,200	0.745	115
7.	Grenada	110,900	340	10,200	0.763	146
8.	Haiti	10,980,000	27,600	770	0.510	179
9.	Jamaica	2,921,000	10,800	5,100	0.726	71
10.	St.Kitts and Nevis	52,000	260	19,100	0.777	139
11.	St. Lucia	181,000	610	9,600	0.745	93
12.	St. Vincent and the Grenadines	110,000	390	7,150	0.738	130
13.	The Bahamas	382,000	10,100	31,900	0.805	119
14.	Trinidad & Tobago	1,384,000	5,100	16,000	0.799	105

Source: The World Bank, 2022; Villeret, 2022; Worldometer, 2022. Note: HDI stands for Human Development Index. Ease of doing business was based on a rank among 190 countries.

90% of total population and land area.

Covers a diversity of:

- Landscapes
- Physical sizes
- Governance structures
- Levels of human development
- Economies

METHODOLOGICAL FRAMEWORK

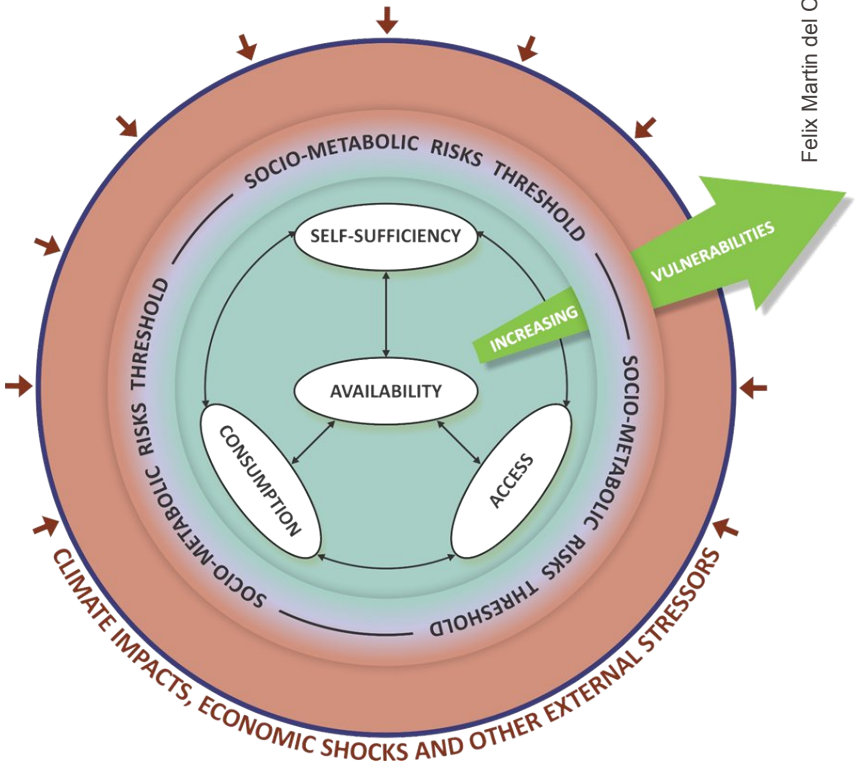
This section analyzes the Water-Energy-Food Nexus from a Socio-metabolic risk perspective.

- **Availability** - "exploitable" resources per capita
- **Access** – Population benefited from a particular resource
- **Consumption** – Resources consumed per capita
- **Self-sufficiency** – Capacity to meet demand through local means

Year of analysis: 2000 and 2017

Main Data Sources:

- FAO AQUASTAT (water)
- U.S. EIA, IRENA, NREL (energy)
- FAO Food balance sheets (food)



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RESULTS

		Availability (m^3/cap/yr)		Access (%)		Consumption (m^3/cap/yr)		Self-sufficiency (%)	
	SIDS	2000	2017	2000	2017	2000	2017	2000	2017
WATER	Antigua and Barbuda	688	545	90	92	111	121	100	100
	Aruba	0	0	96	98	121	120	0	0
	Barbados	295	279	94	98	298	283	100	100
	Cuba	3,430	3,362	63	70	468	614	100	100
	Dominica	2,852	2,799	79	87	238	280	100	100
	Dominican Republic	2,779	2,235	84	90	574	681	100	100
	Grenada	1,946	1,804	92	94	97	127	100	100
	Haiti	1,540	1,185	36	50	152	132	89	93
	Jamaica	4,087	3,704	88	89	306	464	100	100
	St. Kitts and Nevis	543	461	92	95	147	300	100	100
	St. Lucia	1,924	1,658	85	93	274	282	100	100
	St. Vincent and the Grenadines	926	911	82	91	93	77	100	100
	The Bahamas	2,339	1,834	93	97	94	92	100	100
	Trinidad & Tobago	3,023	2,774	91	96	248	277	100	100
	Averages	**1,884**	**1,682**	**83**	**89**	**230**	**275**	**92**	**92**
		-10%		**+6%**		**+20%**		**No change**	

RESULTS

ENERGY

	Availability (GJ/cap/yr)		Access (%)		Consumption (GJ/cap/yr)		Self-sufficiency (%)	
	2000	2017	2000	2017	2000	2017	2000	2017
Antigua and Barbuda	179	142	100	100	101	114	0	1
Aruba	12	11	92	100	175	180	0	8
Barbados	277	79	100	100	92	89	19	12
Cuba	560	315	88	100	36	37	35	41
Dominica	178	174	81	100	27	53	18	7
Dominican Republic	3	2	89	100	37	34	3	8
Grenada	146	135	86	96	30	40	0	1
Haiti	4	3	34	44	3	5	12	2
Jamaica	12	11	85	100	59	46	2	5
St. Kitts and Nevis	959	812	94	100	63	65	0	2
St. Lucia	50	43	88	99	34	38	0	0
St. Vincent and the Grenadines	279	273	74	100	23	27	11	9
The Bahamas	38	30	100	100	199	117	0	0
Trinidad & Tobago	34,188	12,670	80	100	367	690	100	100
Averages	**207***	**156***	**85**	**96**	**89**	**110**	**14**	**14**
	-25%		**+11%**		**+24%**		**No change**	

RESULTS

		Availability (kg/cap/yr)		Access (%)		Consumption (kcal/cap/day)		Self-sufficiency (%)	
FOOD	SIDS	2000	2017	2000	2017	2000	2017	2000	2017
	Antigua and Barbuda	624	610	58	86	2,149	2,429	35	23
	Aruba	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
	Barbados	640	603	95	96	2,803	2,896	85	53
	Cuba	757	848	95	98	3,030	3,409	100	92
	Dominica	1,063	1,013	95	94	3,065	2,945	100	85
	Dominican Republic	502	791	72	91	2,218	2,856	88	89
	Grenada	558	596	69	81	2,221	2,404	56	62
	Haiti	381	422	45	55	1,959	2,163	80	75
	Jamaica	686	675	93	91	2,725	2,754	85	74
	St. Kitts and Nevis	614	542	82	90	2,516	2,517	94	77
	St. Lucia	719	558	88	88	2,706	2,658	81	64
	St. Vincent and the Grenadines	525	679	83	94	2,499	2,962	100	78
	The Bahamas	897	638	91	90	2,781	2,043	37	50
	Trinidad & Tobago	544	526	88	93	2,776	3,039	78	44
	Averages	**655**	**654**	**81**	**88**	**2,573**	**2,698**	**78**	**67**
		No change		**+7%**		**+5%**		**-11%**	

SOCIO-METABOLIC RISKS

Dimension	Availability	Access	Consumption	Self-sufficiency
WATER	Declining levels of water availability: • water shortages • lower recharge capacity through changes in hydrology • water stocks contamination through saline water intrusion and other pollutants	Unequal access between social groups: • water insecurity • social unrest • decline in local food production • increased household and government expenditures	Quantity and quality of the resource is compromised: • exhaustion of water stocks • political and socio-economic instability • ecosystems damage • impacts on human health	Demand larger than supply: • water scarcity and water crisis • impacts on local economy • decline in local food production

Availability below the threshold of 1,000 m^3/cap/yr

- Antigua and Barbuda
- Aruba
- Barbados
- St. Kitts and Nevis
- St. Vincent and the Grenadines

Changes driven by consumption and climate change

- Demand larger than supply
- Rainwater and temperature variability
- Droughts

SOCIO-METABOLIC RISKS

Dimension	Availability	Access	Consumption	Self-sufficiency
ENERGY	Damages during transport and extreme weather events: • oil spills and runoffs • shortages due to disruption on supply • degradation of marine and coastal ecosystems • impact on local development and economy	Frequent energy provisioning disruptions: • quality and stability of the supply (blackouts) • impacts on health, agriculture, drinking water, sanitation, and food • increased energy consumption	Deficiencies of affordable and clean energy supply: • increased consumption • transmission and distribution losses • elevated energy tariffs • pressure on grid and risk of destabilizing it • impacts on health and national energy security	Fossil-fuel dependent economies: • imports dependency is perpetuated • increased exposure to external shocks • delays in recovery responses in case of disasters

Caribbean region: fossil-fuel dependent

- Damage to ecosystems
- Long-term ecosystem collapse
- Impacts on tourism
- Impacts on health, water and food security

Energy system: overview

- High electricity tariffs
- Energy system losses
- Power outages
- Recurrent extreme weather events

SOCIO-METABOLIC RISKS

Dimension	Availability	Access	Consumption	Self-sufficiency
FOOD	Low resource productivity and competing land uses: • decline in arable land (less than 0.06 ha/cap) • decline in locally sourced food (less than 20%) • increased import dependency and food bills	Deficiencies in food security: • prevalence of undernourishment • impairing of human development • intergenerational cycle of malnutrition and poverty	Shift from healthier diets to nutritionally inferior diets: • higher levels of non-communicable diseases such as stunting, wasting or anemia • low work productivity • poor school performance • loss of healthy life	Deficiencies in the agri-food supply chain: • decline in domestic foodstuff production • higher food losses • increased food insecurity • increased foodborne hazards and diseases outbreaks

Low food productivity

- Narrow agricultural resource-base
- Land-use changes
- Deficiencies in the agri-food supply chain
- Climate change (flash floods, droughts)

Food nutrition and security

- 80% foods is imported
- Lower vegetables and higher processed foods intake
- Nutritionally inferior diets
- Increase in non-communicable diseases

TO CONCLUDE

Sustainable resource management and planning is integral to properly manage risks

- Focus on resource-baselines (e.g., scale, distribution, and composition)
- Focus on nature-based solutions (e.g., ocean-based resources)

Mitigating socio-metabolic risks by reconfiguring resource-use patterns can be a crucial adaptation strategy

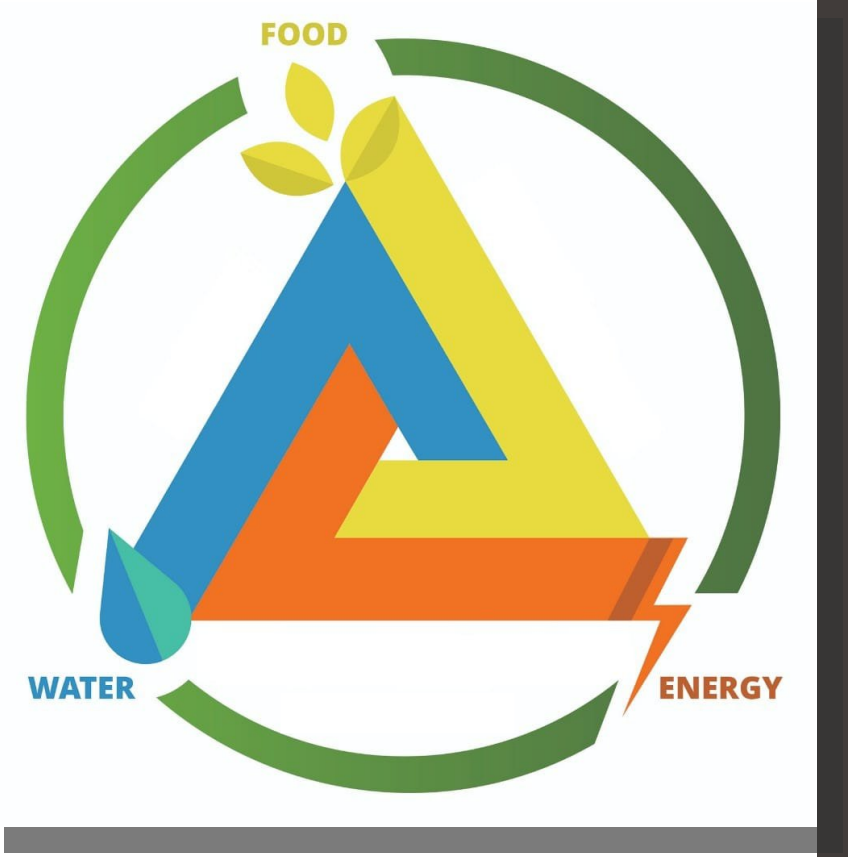
- By taking advantage of the resource-baselines, institutional, and technical capacity

Wide reality from territory to territory

- Different social, economic, and environmental characteristics
- Varying vulnerability levels

Holistic long-term sustainability vision strategy

- Cooperative
- Flexible and adaptive
- Strong regulatory and institutional frameworks
- Context specific



Thank you for your attention!

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