Program and abstracts for the

2020 Sustainable Island Futures Symposium

hosted by
The Metabolism of Islands & The Sustainable Island Solutions through STEM
December 3, 2020
9AM - 1:15 PM AST
Location: Zoom (link will be distributed at the latest 24 hours before start)
Registration link:
https://forms.gle/MUiUEqNfCS7Qr8ev7

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Small island states are characterized by a strong dependency on external resources to meet their basic needs which highly contributes to vulnerability of these territories. The approaches to increase resource security and self-reliance in small island states need to be carefully redesigned considering context-specific challenges and opportunities. At the same time, in order to achieve sustainability and build system resilience, wholistic approaches need to be favoured over narrow agendas. Several research collaborations are ongoing to address these challenges, such as the Sustainable Island Solutions through Science, Technology, Engineering and Mathematics (SISSTEM) program at the University of Aruba and the Metabolism of Islands (MoI) research program. These bring together researchers from a dozen universities that are concerned about sustainable futures for small islands throughout the world. This multidisciplinary symposium aims to bring together researchers to exchange ideas and approaches for a sustainabilitytransformation in small island states and to foster interdisciplinary and interinstitutional collaboration.

Call for papers is closed

Name	Position and affiliation	topic	time (AST)
		Welcome and introduction	9.00 - 9.05
Colleen Weekes	PhD candidate, University of Aruba - KU Leuven	Solid Waste Aruba	9.05 - 9.20
Allison Elgie	PhD Candidate, University of Waterloo, Ontario, Canada	Solid waste Grenada	9.20 - 9.35
Alba de Agustin	PhD candidate, University of Aruba - KU Leuven	Citizen Science and waste	9.35 - 9.50
discussion/feedback			9.50 - 10.20
break			10.20 - 10.25
Elham Mohammadi	PhD Candidate, University of Waterloo, Ontario, Canada	E-waste	10.25 - 10.40
Akeem Mohammed	PhD Candidate, UWI, St. Augustine Campus	Sargassum	10.40 - 10.55
Sharona Jurgens	PhD candidate, University of Aruba - KU Leuven	Urban metabolism – WEF nexus	10.55 - 11.10
discussion/feedback			11.10 - 11.40
break			11.40 - 11.45
Francisco Xavier Felix Martin del Campo	PhD Candidate, University of Waterloo, Ontario, Canada	WEF nexus	11.45 - 12.00
Shobha Dhanpat	PhD graduand; University of the West Indies, Trinidad & Tobago	Water	12.00 - 12.15
Dr Yogang Singh	Post Doctoral Research Associate KU Leuven	Desalination, IMP	12.15 - 12.30
Lara Speijer	Graduate student of the Master in Sustainable Development (KU Leuven, Belgium)	Water, Malta	12.30 - 12.45
discussion/feedback/closing			12.45 - 13.15

Colleen Weekes
PhD candidate, University of Aruba - KU Leuven

Title: Municipal solid waste management in Aruba

Enabling technologies for increased energy and material recovery Municipal solid waste (MSW) represents an excellent but under-utilised resource for material and energy recovery. Given that extreme import dependency and resource scarcity often characterise many small island states, there is a need for greater self-sufficiency and more sustainable patterns of consumption, production and industrial development. Integrated sustainable waste management (ISWM) systems can provide impactful solutions in this regard by optimising source separation of recyclable fractions, improving collection efficiencies, diverting secondary materials from landfill, maximising local reuse, and deploying environmentally sound MSW treatment technologies through which embedded energy can be valorised. Preliminary research outcomes on the development of an ISWM system for Aruba will be communicated within this presentation, with focus placed on waste composition, flows and treatment strategies currently being employed on the island. Opportunities for increased resource recovery within Aruba's MSW sector will then be explored based on the principles of Material Flow Analysis (MFA) as well as the island's specific socio-economic context. Finally, enabling technologies to foster industrial symbiosis and facilitate Aruba's transition towards a circular economy will be proposed.

Allison Elgie
PhD Candidate, University of Waterloo, Ontario, Canada

Can a small island state be sustainable? Small islands often suffer from a myriad of sustainability challenges owing to their remoteness, size, dependency on imports, and limited waste absorption capacity. Most imports end up as waste accumulation in dumpsites at the end of their life-cycle, representing a one-way material flow. The concept of the "circular economy" (CE) is a promising resource management strategy for island nations to improve solid waste management. In a CE, waste is a resource to be continually circulated within the economy. This study uses material flow accounting (MFA) to quantify waste deposits in Grenada, a tri-island, Caribbean state (population: 110,874). Like many Caribbean islands, Grenada has waste challenges as a result of accumulation of materials in open dumpsites and the persistence of illegal dumping. We estimated that Grenada generated 46,097 tonnes or 1.14 kilograms per capita per day of waste in 2017. Leveraging disaggregated trade and waste data, we quantified three problematic waste streams: plastics, tyres, and motor oil and demonstrate an approach for conducting MFA in data-poor environments. Based on the results, Grenada has opportunities to decrease waste production by implementing circularity measures. We recommend improving data collection, implementation of the polluter pays principle, banning substitutable, problematic materials, and developing waste management plans for problematic materials. It is critically important that Grenada transition to a more sustainable waste management system in order to realize the vision of sustainable development. The results of this study make an important contribution to island industrial ecology and sustainable development.

Alba de Agustin
PhD candidate, University of Aruba - KU Leuven

"Citizen Science for pollution data collection in Small Island States". Small Island States have traditionally received Western focused experts to implement projects within limited time frames, both for sustainability aid and for island research. This approach creates external knowledge dependency and jeopardizes the proposed solutions applicability in the local context. For Small Island States to be self-reliant there is an urgent need to recognize the local knowledge and contextualize the recommendations. Citizen science (CS) is a concept that invites valued civil participation in scientific research and decision-making processes, therefore the contextualization of challenges and the co-creation of solutions is embedded in it. Recently, the role of CS to report on the United Nations Development Goals (SDGs) has received serious attention, especially for collecting data on those indicators without an established standard methodology yet. However, despite the rapidly increasing number of projects and its recognized key value, there is not yet a common understanding on the implementation procedure. Our research proposes a standard CS framework in which citizens can contribute with defining research questions; co-creating methods; data collection processing; data evaluation; visualization of results; and output dissemination. The final aim of the framework is to guide future CS projects according to local contexts supporting the monitoring of SDGs in Small Island States. As a first step, a meta-analysis of CS case studies will be conducted to provide the basis for developing the framework. Our proposed framework will then be tested for the waste management case of Aruba contributing in this way to the national achievement of SDG 12.

Elham Mohammadi
PhD Candidate, University of Waterloo, Ontario, Canada

Electronic waste in the Caribbean: An impending environmental disaster or an opportunity for a circular economy? Islands are bounded systems, often plagued with several sustainability challenges of limited land and resource availability, as well as pressing waste management issues. Despite these known problems, research aiming to help develop proper e-waste management systems for small island nations is scarce. Focusing on five Caribbean island states, this study provides the first comprehensive view of e-waste generation trends in an island context and explores the factors driving those trends. The study estimates Electrical and Electronic Equipment (EEE) flows for the five island cases over a period of 60 years (1965-2025), including e-waste that these flows have and will generate. A dynamic material flow analysis (MFA) approach has been used to estimate these flows and stocks for 206 product types. The results show that the five Caribbean islands produced double the e-waste per capita per year, i.e., 13 kg/cap/year compared to global average of 6.1 kg/cap/year in 2016. The aggregated amount of e-waste generated per year on these five islands seems to significantly rise in future: from 27,500 tonnes in 2010 to an estimated amount of 59,000 tonnes in 2025. This considerable estimated e-waste generation rate, when not properly managed, is not only harmful for the local environment, but also translates into considerable health impacts and loss of valuable resources. From a sustainability perspective, small islands should consider moving away from a linear to a circular economy that will limit waste generation as well as reliance on the supply of virgin materials from outside.

Akeem Mohammed
PhD Candidate, UWI, St. Augustine Campus

Sargassum valorization has become increasingly important as the Caribbean region continues to struggle with the massive growth of the seaweed and its damaging effects. Sodium alginate extraction is one method where the seaweed biomass can be utilized to produce a useful biopolymer. However, current processing generally giving low yields of inferior quality, making it unattractive for commercialization. This article seeks to optimize the extraction process using a Box-Behnken Response Surface Design combined with multistage extraction to obtain higher product yield and purity, as well as giving insights, for the first time, into the physiochemical properties of the extracted alginate from Sargassum biomass. Optimum conditions were found and confirmed through validation, with a crude yield as high as 28% after 2 stages and a purity of 92% for purified alginate samples. Characterization of the bleached alginate through NMR studies validated with FTIR, gave an M/G ratio of 0.45 with a molecular weight of 3.14 x 105 gmol-1 and viscosity of 14.10 cP aligned to high gelling capabilities.

Sharona Jurgens
PhD candidate, University of Aruba - KU Leuven

Spatial Analysis of Urban Metabolism in Small Island States
Water, energy, and food are three of the most important resources necessary to sustain life. For most islands, one or all these resources are often naturally scarce. Therefore, islands often require resources from other regions to sustain their livelihood. As global population and standards of living increases and drive demand for water, energy, and food resources it becomes crucial for islands to reduce their vulnerability and increase their resilience to global change. In this research we will investigate the dynamics of the water – energy – food nexus through the urban metabolic framework with regards to urbanization patterns and land use change in Small Island States. We will use both quantitative and qualitative methods to determine the resource flows and driving factors of society's demand for these resources by combining various existing WEF nexus methods. Alongside factors from society and the environment, the analysis will also include political factors. Furthermore, we seek to develop a sustainable development index to assess the development stages of islands based on a comparative study between 5 Caribbean islands (specifically Aruba, Bonaire, Curacao, Barbados, and Martinique). Hence, it is expected that the proposed index will be able to facilitate future sustainable development goals considering that it will provide a general overview of a country's resource demand and drivers, including an overview of different synergies and trade-offs between sectors.

Francisco Xavier Felix Martin del Campo
PhD Candidate, University of Waterloo, Ontario, Canada

The Caribbean Region heavily relies on imports to satisfy its basic needs in a climate challenged world. Island governments increasingly realise the importance of achieving resource security and self-reliance as a resilience building measure, but the reality is far from realised. This study compares resource-use patterns for 14 Caribbean nations in two points in time, years 2000 and 2017. It establishes the shifting baseline for three critical materials: water, energy, and food (WEF) and their nexus, with a focus on their availability, access, consumption, and self-sufficiency. On a regional level, we find that the availability of locally exploitable resources is decreasing, as is the rapid decline in the self-sufficiency of energy and food, compensated by higher imports. At the same time, there is not only an increase in the universal access of WEF by island citizens, but growing affluence and industrial development has also led to higher levels of resource consumption per capita. Water consumption increased from 230 m3/cap/year in 2000 to 275 m3/cap/year, mainly due to water demand in the agriculture sectors of Cuba and Dominican Republic. Primary energy consumption increased from 89 GJ/cap/year to 110 GJ/cap/year, with only 14% self-sufficiency. Domestic food production declined from 1.6 t/cap/year to 0.93 t/cap/year, while imports increased from 35% to 55% of the regional requirement. Our findings also highlight the huge variations between countries, suggesting that the Caribbean is not a homogenous region. Along with regional cooperation, interventions must consider the wide range of realities within the region.

Shobha Dhanpat
PhD graduand; University of the West Indies, Trinidad & Tobago

Over the past three decades, discrete metal-directed supramolecular ensembles have garnered significant interest in the scientific community. The tunable physicochemical properties and the applications in areas as diverse as chemical sensing, catalysis and sieving applications have fuelled the interests. The synergistic interplay of the coordination-driven self-assembly approach to synthesis and the use of weak non-covalent interactions provide an opportunity to rationally tune the size, shape, colour, internal cavity, and functionality by either changing the metal acceptors or by modification of the organic donor linkers. These self-assembled metallacycles can, therefore, act as efficient hosts for the recognition and binding of toxic guest molecules, thereby separating them from potable water. This work deals with the synthesis, characterization and molecular recognition studies of tricarbonyl rhenium metallacyclic supramolecules of nitrogen and oxygen donor ligands such as pyridyl, alkoxides, and Schiff bases. The supramolecules were characterized using NMR, IR, UV-Vis and Mass Spectroscopies, TGA, DSC and Single Crystal X-ray Diffraction. These supramolecules have unoccupied cavity spaces; therefore, they are ideal for toxic guest inclusion studies. Guest inclusion studies were performed using UV-Vis and fluorescence spectroscopies with ions such as Cd2+, Al3+, Ba2+, Cr3+, Fe3+, Pb2+, and biomolecules such as ATP and glycine. The study revealed the recognition abilities of these supramolecules to be as low as 10-7 to 10-6 mol dm-3 molar concentration. Such profound spectral responses were ascribed to the strong interaction of the guests to the supramolecular hosts by weak intermolecular forces, therefore, they could be potentially exploited for environmental monitoring and protection.

Dr Yogang Singh
Post Doctoral Research Associate KU Leuven

Many islands face shortages of fresh water. Desalination using renewable energy can meet their water needs at reduced costs. The main goal of such development is to integrate the renewable energy sources with autonomous low cost technologies for desalination to fulfill the fresh water need of island nations. The current proposal makes a submission towards a novel concept of an autonomous floating platform for desalination, which can be developed at low cost and can be integrated with wind, wave and solar energy. Intelligent Mobile Platform (IMP) research group has been working towards the development of sustainable logistics platform and has a vision to develop such floating models for island nations. With respect to current state of the art, such desalination models have been developed in countries like Saudi Arabia and Thailand but incur heavy operational costs. No such study and implementation of floating models has been made for island nations and there is a need to develop low cost floating desalination models for island nations taking into account the sustainability of local habitat. Island nations have an abundance of renewable energy in form of solar, wind and wave power available throughout the year and have potential to harness the energy for long term operation of floating desalination models. This will lead to reduction in cost of protecting coastal environment and smaller damage to the local eco system of the island nations.

Lara Speijer
Sustainable Development (KU Leuven, Belgium)

As an island state, Malta faces water stress due to a high population density in combination with limited water resources. Over-abstraction has led to the deterioration of the groundwater which pushed the country into using desalination techniques. However, groundwater is still used for part of the governmental water supply and by private groundwater abstracters. Tourist arrivals increase every year, creating extra water demand. Therefore, this master's thesis research investigated how water use is managed in the tourist accommodation sector on the second largest island of the country, Gozo. This research mainly used qualitative methods accompanied with quantitative data. Results highlight the variety of water sources used in Gozitan accommodations. Alternative water sources such as rain and seawater are used, mostly for non-potable purposes such as toilets, irrigation and pools. However, private boreholes are also used, which increases groundwater depletion. Direct and indirect water use of tourists was investigated. Concerning indirect water use, accommodations often prefer local food products, however this trend is limited by the limited food availability. Drivers in the water use and management were also identified. Gozitan accommodations tend to be smaller than on the main island of Malta, making investment in private desalination systems or the re-use of treated sewage water often not beneficial. Pricing of water sources is important since cost saving is an important driver in the tourism industry. Eco-marketing is another incentive to install water conservation practices. Gozo's aim of becoming an eco-island could give an extra push towards sustainability of the tourism sector.