



SISSTEM Symposium



Location: University of Aruba

Duration: 3 Days, May 10th - May 12th

Sustainable Islands Solutions

KU LEUVEN



University of Aruba



Start	End	Topic
Opening ceremony - aula		
16:00	16:20	Welcome by Dr. Eric Mijts and speeches from government representatives
16:20	16:35	Opening speech by Rector Prof. Dr. Viola Heutger
16:35	17:00	The SISSTEM Bachelor and Master Program at a glance – Dr. Nigel John and Dr. Salys Sultan
17:00	17:10	SISSTEM: building a STEM program from scratch through equal partnership – Dr. Anouk Mertens
17:10	19:00	Reception

 **Wednesday**
10th of May 2023





SISSTEM



Thursday
11th of May 2023

Start	End	Topic
Information and Data Sciences		
09:00	9:45	Keynote speaker: Dr. Trina Halfhide – Data management and increasing risk management in vulnerable coastal communities.
09:45	10:25	Introduction by Prof. Bart Vanrumste Lacé, Francis, Vanrumste, Bart, Sultan, Salys: “For who and when should we intervene in others’ health: An exploratory study of Aruba as a possible case for other small island states”.
10:25	11:05	Introduction by Prof. Anton Van Rompaey Jurgens, Sharona S., Mijts, E., Van Rompaey, Anton: “Spatial analysis of urbanization in Aruba”.
11:05	11:20	Coffee break
Technology and Engineering		
11:20	12:05	Keynote speaker: Prof. Georges Gielen – Engineering and the winding road to a sustainable society
12:05	12:45	Introduction by Prof. Bart Van der Bruggen Acevedo, Diego, Van der Bruggen, Bart: “Valorization of reverse osmosis brines in small islands”
12:45	13:45	Lunch break
13:45	14:25	Introduction by Prof. Jo Van Caneghem Weekes, Colleen, Van Caneghem, Jo: “Life cycle impact assessment of alternative scenarios for municipal solid waste management in Aruba”
14:25	14:45	Mohammed, Akeem, Gaduan, Andre, Chaitram, Pooran, Pooran, Anaadi, Koon-Yang, Lee, Keeran, Ward: “Sargassum inspired, optimized calcium alginate bioplastic composites for food packaging”.
14:45	15:25	Introduction by Prof. Maarten Vanierschot Malwade, Kailas, Vanierschot, Maarten: “Heat transfer mechanisms in a novel solar-powered food dehydrator for Aruban mango drying”
15:25	16:00	Coffee break
Education for Sustainable Development		
16:00	16:45	Keynote speaker: Dr. Therese Ferguson: “Sustainability Education in the Caribbean: Importance, Impediments and Imperatives”
16:45	17:45	Round table discussion with: Dr. Therese Ferguson; de Scisciolo, Tobia, Eppinga Maarten, Chapman, Molly, Mijts, Eric: “Pre-university education for local ownership and initiatives for sustainable development in small island states: monitoring engagement at the Academic Foundation Year”; Mertens, Anouk, Buys, Nadine, Arens, Patrick, Gielen, Georges, Mijts, Eric: “SISSTEM and Education for Sustainable Development, theory in practice!”



SISSTEM



Friday
12th of May 2023

Start	End	Topic
Bio-environmental sciences		
09:00	9:45	Keynote speaker: Dr. Stefano Moncada: "Measuring what counts: Multidimensional vulnerability and resilience in small islands"
09:45	10:25	Introduction by Prof. Constanza Parra Laclé, Francielle, Krimizea, Eirini, Parra, Constanza: "Social innovation and just resilience in the governance of small island social-ecological systems: the role of place-based sustainability initiatives on Aruba"
10:25	10:45	Coffee break
10:45	11:25	Introduction by prof. Filip Volckaert López-Márquez Violeta, Hellemans, Bart, Mijts, Eric, Volckaert, Filip A.M.: "Corals in the ABC islands: differences in connectivity between brooding and broadcasting colonies"
11:25	12:05	Introduction by Prof. Bram Van de Poel Facun, Kryss, Mertens, Anouk, Van de Poel, Bram: "Enhancing food resilience: Economic analysis of an indoor vertical farm growing strawberries in a small island state – the Aruba case"
12:05	13:00	Lunch break
13:00	13:40	Introduction by prof. Annemie Geeraerd Ameryckx van Veghel, Amber, Sultan, Salys, Geeraerd Ameryckx, Annemie: "Vegetables should be qualitative, tasty and affordable, but what about their carbon footprint?"
13:40	14:20	Introduction by prof. Wim Dehaen Semerel, Jeltzin, John, Nigel, Dehaen, Wim, Fardim, Pedro: "Valorization of <i>Aloe vera</i> processing waste"
14:20	14:40	Coffee break
14:40	15:20	Introduction by prof. Wim Van Petegem de Agustin Camacho, Alba, Van Petegem, Wim: "Bridging society and technology to manage plastic waste in small island states"
15:20	15:25	Eicher, Helena: "Turning the tide - Maintaining economic resilience on Aruba through hands-on restoration and conservation of its marina biodiversity"
Closing remarks		
15:25	16:00	Closing remarks by Dr. Eric Mijts and Prof. Nadine Buys



Thursday 11th - Time: 09:00-9:45



SISSTEM

Information and Data Sciences

Data Management and Increasing Risk Management in Vulnerable Coastal Communities



Dr. Trina Halfhide

Departement of Life Sciences, The University of The West Indies

Many coastal communities and small island developing states (SIDS) face water security challenges. These challenges are the compounded effects of climate change, increased water demand, and limited management of natural water resources. Climate change risks include increased hurricane intensity, flash flooding and saltwater intrusion. Population growth within SIDs increases demand for finite freshwater supplies. These issues coupled with point and non-point pollution sources from an increasingly urbanized environment may result in reduced water quality and quantity. This in turn affects residents and fragile ecosystems. Comprehensive risk and opportunity assessments are crucial in the development of an integrated and strategic management plan. Data collection and partnerships with all stakeholders are crucial for risk management and increasing community resilience. Data management tools, such as Supervisory Control and Data Acquisition (SCADA) and Operational Analysis Simulations of Integrated Systems (OASIS) can be leveraged to increase understanding of underlying hydrologic and management processes and vulnerabilities. SCADA systems improve efficiency, functionality and are responsible for network data communication and graphical user interfaces. OASIS is a mass balance water analytical and simulation software that captures the operating hydrologic rules and has applications in river basin management, hydropower, water supply and conflict resolution. OASIS utilizes historical data to validate hydrologic models and facilitates prompt and informed decisions in the face of the future problematic events. This talk will explore the use of these tools in increasing communication and efficacy of management plans.





SISSTEM

Thursday 11th - Time: 09:45-10:25

FOR WHO AND WHEN SHOULD WE INTERVENE IN OTHERS' HEALTH: AN EXPLORATORY STUDY OF ARUBA AS A POSSIBLE CASE FOR OTHER SMALL ISLAND STATES

Francis Laclé (University of Aruba; KU Leuven)

Prof. Bart Vanrumste (KU Leuven)

Dr. Salys Sultan (University of Aruba)

This presentation is aimed at researchers in small island states that are studying disease burden in environments where data is limited and incomplete. We share the available data sources, tools, and analysis techniques to address some of these challenges. The research questions are what diseases or disease categories give the most burden, and when should healthcare interventions be considered. Our results are as follows. The Aruban population experienced an overall increase in life expectancy [1], as well as an increase in national healthcare insurance costs that proportionally coincides with population ageing [2,3]. However, the burden of disease (years of life lost due to disability or disease), as defined by the World Health Organization, is not known due to lack of data [4,5]. To help answer the two research questions, we studied statistical and scientific publications, and conducted outreach to the neighboring island of Curaçao. The latter led to limited mortality data between 1999 and 2015 [6]. Based on cumulative analysis we have identified a group of top four causes of death, all cardiovascular that exhibit the strongest upward trend. Non-standardized mortality ratios for all ages show that between 1999 and 2015, mortality ratios have seen a decline in this group. However, when considering yearly differences per age category we see non-linear increases from age 40 upwards. Our findings for this given period show that for this probable largest group of amenable disease, preventive human suffering can be optimally reduced by intervening at the younger age of 40. To conclude, this exploratory study shares challenges encountered and methods for practice and research that were used to overcome these challenges. This study acts as a case that could help small

island researchers during the development of targeted healthcare interventions in environments that contain limited information on the burden of disease. Data collection and partnerships with all stakeholders are crucial for risk management and increasing community resilience. Data management tools, such as Supervisory Control and Data Acquisition (SCADA) and Operational Analysis Simulations of Integrated Systems (OASIS) can be leveraged to increase understanding of underlying hydrologic and management processes and vulnerabilities. SCADA systems improve efficiency, functionality and are responsible for network data communication and graphical user interfaces. OASIS is a mass balance water analytical and simulation software that captures the operating hydrologic rules and has applications in river basin management, hydropower, water supply and conflict resolution. OASIS utilizes historical data to validate hydrologic models and facilitates prompt and informed decisions in the face of the future problematic events. This talk will explore the use of these tools in increasing communication and efficacy of management plans.





SPATIAL ANALYSIS OF URBANIZATION IN ARUBA

Thursday 11th - Time: 10:25-11:05

Sharona Jurgens (University of Aruba; KU Leuven)

Dr. Eric Mijts (University of Aruba)

Prof. Anton Van Rompaey (KU Leuven)

One of the major urban changes in land cover for specific areas driven by either demographic changes or economic development is urbanization. According to various recent studies, Aruba has one of the largest population densities in the Caribbean and high-speed urbanization takes place in this formerly rural island state. This study aims to identify the historical and present drivers of urban development in Aruba. To achieve this goal, land use and land cover change are analyzed over the period 1980 until 2020 by means of a supervised classification of Landsat images in increments of 10 years. Secondly, we determine whether urbanization expansion occurs as sprawl or infilling. And lastly, we assess whether the observed changes are a result of demographic changes or economic development. Our findings indicate that Aruba's urban environment increased to approximately 60 km² by 2020, which corresponds to one third of the entire island. Furthermore, expansion was dominated by sprawl in the earlier years and changed to infilling in the latter. Through the years expansion was mostly driven by immigration which is mainly correlated to economic development in the tourism sector.

Thursday 11th - Time: 11:20-12:05



Technology and Engineering

Engineering and the winding road to a sustainable society



Prof. dr. ir. Georges Gielen

Department of Electrical Engineering (ESAT), KU Leuven

Our society is at a turning point, squeezed between the industrial achievements and their aftermaths from the past centuries and the highly digital and green future ahead. Enormous challenges need to be addressed, such as feeding the growing world population, keeping healthcare effective and affordable, resolving the energy problem and curtailing climate change, to name a few. This presentation will review some emerging technological solutions and also analyze their impact in the context of small island states such as Aruba. Engineering and engineering education will be key to establish the desired sustainable world.





SISSTEM

Thursday 11th - Time: 12:05-12:45

VALORIZATION OF REVERSE OSMOSIS BRINES IN SMALL ISLANDS

Diego Acevedo (University of Aruba; KU Leuven)

Prof. Bart Van der Bruggen (KU Leuven)

Increased reliance on desalination has been identified by some as a threat to the marine environment where failure to design optimal brine outfalls can lead to hypersalinity areas that interfere with natural ecosystems in coastal areas. Some effects from the increase in desalination use that have been identified may come from the construction of the plants, the use of fossil fuels for operations or the constant brine discharge in near shore ecosystems. Islands in particular, while becoming more and more dependent on desalination to meet their water needs could benefit from a circular economy perspective in the water sector by encouraging the recovery of multiple resources from the ocean.

Aruba, an island in the Southern Caribbean, is completely reliant on desalination and is considered a pioneer in desalination technology with ongoing experience for over 100 years. This research focuses on the extra economic value that can be recovered from desalination plants in coastal areas like Aruba beyond the production of fresh water alone. The recovery of valuable raw materials from these desalination brines has the potential to reduce the salinity and amount of effluent back to the ocean and at the same time can increase in overall economic value of processing seawater. The added economic value can serve as a financial support for more responsible effluent

management techniques. Recovery of magnesium, chlorine, sodium hydroxide and hydrogen have been recognized as a promising first resources, an integrated approach to their exploitation is suggested. When looking at desalination systems, an alternative viewpoint is suggested in which fresh water is seen as only one of the by-products of sustainable seawater processing plants.



SISSTEM

Thursday 11th - Time: 13:45-14:25

LIFE CYCLE IMPACT ASSESSMENT OF ALTERNATIVE SCENARIOS FOR MUNICIPAL SOLID WASTE MANAGEMENT IN ARUBA

Colleen Weekes (University of Aruba; KU Leuven)

Prof. Jo Van Caneghem (KU Leuven)

Strategic decisions regarding municipal solid waste (MSW) management are often dominated by technical and economic concerns in small island states. However, the environmental impacts of proposed end-of-life treatment processes must also be thoroughly examined before long-term planning decisions are made. Given that the island of Aruba currently faces such a choice, the present study compares the environmental performance of several alternative MSW management scenarios using a life cycle approach, with the aim of determining the most environmentally-sound strategy for Aruba's future waste management system.

Through the application of life cycle assessment (LCA) methodologies, the proposed alternatives are objectively evaluated by quantifying the environmental benefits and/or burdens of each life cycle phase, i.e., MSW collection, MSW treatment, export, and recycling of secondary materials. Each alternative scenario comprises different energy and material recovery processes which are modelled and compared, including mechanical treatment, composting, incineration with energy recovery, co-processing and sustainable landfilling. Subsequently, life cycle impact assessment results for eleven impact categories are used to assess the performance of each scenario. Finally, sensitivity analyses are conducted to determine the implications of changing MSW composition and varying waste collection rates.

As LCA methodologies have been seldom used for measuring the impacts of MSW management in small island contexts, this environmental impact assessment is a novel contribution to the state of the art, highlighting the most optimal route for material and energy recovery for the island of Aruba. Further, it underscores the areas of the current system that should be improved in the short term to immediately remedy the most damaging effects of the status quo and accelerate Aruba's transition towards more sustainable MSW management.



Thursday 11th - Time: 14:25-14:45

SARGASSUM INSPIRED, OPTIMIZED CALCIUM ALGINATE BIOPLASTIC COMPOSITES FOR FOOD PACKAGING

Akeem Mohammed (University of the West Indies)

Andre Gaduan (Imperial College London)

Pooran Chaitram (University of the West Indies)

Anaadi Pooran (University of the West Indies)

Koon-Yang Lee (College London)

Keeran Ward (University of Leeds)

Plastic pollution, more specifically from food packaging and containers which account for the largest share of 36% of current plastic production, is one of the greatest threats to the natural environment and human health. Thus, the development of alternative renewable plastics are needed to complement a circular economy and reduce resource depletion. Seaweeds have been known to possess good film forming properties ideal for bioplastic production, and Sargassum natans- an invasive brown seaweed which has been inundating the shores of the Caribbean, has been shown to be an excellent candidate. This study presents, for the first time, the development of a novel optimized biodegradable alginate composite bioplastic as an alternative to traditional plastic packaging. The optimization process was carried out using Response Surface Methodology (RSM) resulting in a formulation of 6 wt.% alginate, 0.263 wt.% starch, 0.35 wt.% CMC, 0.065 g/g sorbitol and 0.025 g/g PEG 200- with ultra-high oxygen barrier (OP - 0.2 cm³ μm m⁻² d⁻¹ kPa⁻¹), good water vapor barrier (WVP - 2.18 x 10⁻¹² g m/m² s Pa) and high tensile modulus (E - 3.93 GPa)- with no migration of additives into a simulated aqueous food system in 10 days. Furthermore, composite films were found to fully degrade in 14 days and possessed better OP, higher WVP

and comparable material properties to HDPE, PET and PLA. Ultimately, our results support alginate composite films as a viable alternative to conventional plastic for food packaging in low moisture environments- encouraging the use of renewable materials for packaging innovation and supporting UNSDGs.



Thursday 11th - Time: 14:45-15:25

HEAT TRANSFER MECHANISMS IN A NOVEL SOLAR-POWERED FOOD DEHYDRATOR FOR ARUBAN MANGO DRYING

Dr. Kailas Malwade (University of Aruba; KU Leuven)

Prof. Maarten Vanierschot (KU Leuven)

The global energy transition from fossil fuel-based systems to renewable energy, in sustainability point of view, has become an essential need. The use of renewable energy sources, for instance solar energy, in energy intensive unit operations, like food drying, has a main challenge in achieving this transition. However, sustainable alternatives to energy intensive processes have prompted the need of numerical modeling and experimental measurements. Therefore, in this work, the heat transfer mechanism in a novel solar-powered food dehydrator was investigated. A transient heat transfer analysis was done to investigate the temperature distribution within the food cabinet of the solar food dryer. Initial experimental measurements demonstrated a temperature of approximately 36° C. The temperature obtained within the food cabinet through laboratory measurements was compared with numerical modeling outcomes for validation.

Thursday 11th - Time: 16:00-16:45



Education for Sustainable Development

Sustainability Education in the Caribbean: Importance, Impediments and Imperatives



Dr. Therese Ferguson

School of Education (SOE), The University of the West Indies

For the Caribbean region, comprised of primarily island nations in the Caribbean Sea alongside a few mainland territories, the sustainable development pathway is not an easy, straightforward one. The complex linkages between environment and development in the region, and other sustainable development issues can challenge and undermine sustainable development efforts. Environmental issues such as marine pollution and biodiversity loss, societal issues such as crime and violence, and economic issues such as poverty, necessitate the development of knowledge, values and behaviours that support a sustainability ethic for regional populations now and in the future. This is a critical means of fostering an ethic of care for self, others and the natural world. Thus, sustainability education must be a priority. This presentation will, firstly, outline and underscore the importance of sustainability education in the region. Secondly, it will explore some of the major factors that can serve as impediments to sustainability education in formal and non-formal realms. Finally, imperatives with respect to sustainability education will be proposed to chart a pathway for moving sustainability education forward in the region.



Thursday 11th - Time: 16:45-17:15

PRE-UNIVERSITY EDUCATION FOR LOCAL OWNERSHIP AND INITIATIVES FOR SUSTAINABLE DEVELOPMENT IN SMALL ISLAND STATES: MONITORING ENGAGEMENT AT THE ACADEMIC FOUNDATION YEAR

Dr. Mollie Chapman (University of Zurich)

Dr. Maarten Eppinga (University of Zurich)

Tobia de Scisciolo (University of Aruba)

Dr. Eric Mijts (University of Aruba)

Small island states face several threats to sustainable development, including low participation grades in university education, high dropout rates, and brain drain. These issues contribute to a lack of locally developed expertise and ownership of sustainable development processes, as such creating a dependency on external consultants and expertise that may not fit the specific context of the region. To address this challenge, the University of Aruba has implemented the Academic Foundation Year (AFY) program, which has been available since 2016. This program is a full-time, one-year pre-university program designed to equip students with the necessary skills for higher education, whether in Aruba or abroad. Along with academic development, the program also aims to foster students' understanding of their context, culture, and history, as well as the opportunities and challenges for sustainable development in small island states.

To gain a better understanding of the potential and challenges for developing local ownership and initiatives for sustainable development in small island states through education, this contribution presents a study of alumni evaluations and quantitative research, along with interviews and focus group meetings with lecturers, students, and alumni of the AFY program.



Thursday 11th - Time: 17:15-17:45

SISSTEM AND EDUCATION FOR SUSTAINABLE DEVELOPMENT, THEORY IN PRACTICE!

Dr. Anouk Mertens (KU Leuven)

Prof. Nadine Buys (KU Leuven)

Patrick Arens (University of Aruba)

Prof. Georges Gielen (KU Leuven)

Dr. Eric Mijts (University of Aruba)

Aruba, like other small island states, is characterized by a complex myriad of intertwined sustainability challenges that require very specific expertise to be addressed. In the past, dependency on external consultancy's solutions to address the sustainability challenges of Aruba has not always been effective. Instead, given the wicked nature of the sustainability challenges, the island requires locally tailored and embedded, holistic solutions that go beyond independent technological or economic quick-fix interventions.

Within this context, local education and more specifically local education according to the principles of Education for Sustainable Development (ESD) is crucial. Indeed, education in accordance with the principles of ESD enables students to successfully address sustainability challenges of small island states, including Aruba, whether as policy makers, via sustainable entrepreneurship or as scientists.

Despite a growing body of literature on ESD in general, as well as in the Caribbean context, there have been few initiatives in the Caribbean region for ESD. We address this theory-practice gap as we demonstrate how ESD at higher educational level can be put in practice in a small island state context. More specifically, we describe

SISSTEM (Sustainable Island Solutions through Science, Technology, Engineering and Mathematics (STEM)), a very innovative and quite unique higher education program developed at the University of Aruba in collaboration with KU Leuven (Belgium). SISSTEM is an interesting case study and example for other universities in the Caribbean and beyond as to how the principles of ESD could be implemented in their engineering curricula. We describe specific examples of how the ESD principles, main competences and learning methods are put into practice in the different courses, based on analysis of the SISSTEM study guide and interviews with lecturers.

We strongly believe this contribution can therefore be considered as an important contribution to closing the theory-practice gap when it comes to applying the ESD principles in a small island context in general and in the Caribbean in particular.



Friday 12th - Time: 09:00-9:45

Bio-environmental sciences

Measuring what counts: Multidimensional vulnerability and resilience in small islands



Dr. Stefano Moncada

Islands and Small States Institute (ISSI), University of Malta

The defining characteristics of small island states and jurisdictions typically refer to the size of the domestic market and the lack of critical mass, which pose restrictions on the capacity of islands to exploit economies of scale, scope and diversification, and generally implies higher costs for running the country. The small size of the market also gives rise to a high dependence on international trade which makes islands susceptible to exogenous economic conditions. The remoteness from key commercial centers and the low accessibility to international markets translates into higher transport costs which further erode the external competitiveness of islands. In this context, climate change is an additional factor challenging small islands, affecting their sustainable development trajectories. All these factors make small islands inherently and disproportionately more vulnerable than larger countries to external shocks. In spite of these territorial constraints, many small islands have been performing remarkably well, reaching high standards of living. Success stories in small islands tend to resonate with policies that strengthen governance, regional integration as well as islands resourcefulness, thus acting on their overall resilience. However, there are still uncertainties on what specific factors can lead to better resilience in small islands, and to what extent the degree of vulnerability is due to the size of a country, and what are the additional costs associated with running an inherent vulnerable small island. This presentation presents a multidimensional framework to identify and measure vulnerability and resilience to external shocks, which can be possibly used to accompany the more traditional measures, such as income per capita, to support the attainment of sustainable development in small islands.



Friday 12th - Time: 09:45-10:25

SOCIAL INNOVATION AND JUST RESILIENCE IN THE GOVERNANCE OF SMALL ISLAND SOCIAL-ECOLOGICAL SYSTEMS: THE ROLE OF PLACE-BASED SUSTAINABILITY INITIATIVES ON ARUBA

Francielle Laclé (University of Aruba; KU Leuven)

Eirini Skrimizea (KU Leuven)

Prof. Constanza Parra (KU Leuven)

This paper presents the island of Aruba as a case study, having social-ecological systems (SES) resilience, social innovation, place-based sustainability and island studies theories as analytical lenses. With these an exploration of the role of place-based sustainability initiatives for transforming governance processes towards a just resilient trajectory is conducted. The analysis emphasizes the social sustainability dimension within such a trajectory, especially as power, agency and decision-making processes influence path-dependencies. Aruba is an interesting case for the investigation of social-ecological relations and vulnerability to natural resource degradation due to its strong dependency on mass tourism. Aruba forms part of the Dutch Caribbean islands within the Kingdom of the Netherlands, a trans-Atlantic institution uniting a middle-size European country with six small Caribbean countries colonized in the 1630s. Since 1986, Aruba has been an autonomous country within the Kingdom. In the post-colonial period, as many Caribbean islands gained more autonomy from their respective metropolises, tourism became the primary avenue for development and employment. However, the strong dependence on tourism also brings externalities, such as ecological degradation coupled with socio-economic polarization, economic leakages through high imports and expatriate labor and profit repatriation. The goal of this paper is to examine the actual transformative capacity of socially innovative place-based sustainability initiatives in Aruba's SES, as well as to reflect on the difficulties that are influencing the islands' current trajectory. The place-based sustainability initiatives considered involve individuals, organizations, associations, or cooperatives, initiated by citizens at a local island level that promote

sustainable development through approaches to manage, conserve and restore marine and terrestrial natural resources. The citizen initiatives range from terrestrial regeneration, coral reef replanting, zero/circular waste management, invasive species management and more. These essentially represent socio-political dynamics countering the vulnerabilities of tourism monoculture on the island with their socially innovative potential leading to negotiation and possible construction of just resilience. This paper seeks to answer first the question of identifying if significant institutional dynamics are taking place to call these social innovative initiatives with the features of need satisfaction (material and nonmaterial), reconfiguration of social relations including more-than-human ones, and socio-political empowerment. Secondly, the question on their potential for transformative change at higher spatial scales, by taking into account the structures and exogenous forces in which they are anchored (dominant economic and mainstream political ideas) and identify what resistances are encountered by such initiatives in their struggles to expand and institutionalize this change in governance processes. This research makes use of a multi-method qualitative design. In-depth semi-structured interviews with placebased sustainability initiatives, key policymakers, and community actors within the arena of study which is the island social-ecological system of Aruba. The primary data collection is complemented by secondary scientific and grey literature (policy documents, local press and other reports).



Friday 12th - Time: 10:45-11:25

CORALS IN THE ABC ISLANDS: DIFFERENCES IN CONNECTIVITY BETWEEN BROODING AND BROADCASTING COLONIES

Dr. Violeta López-Márquez (University of Aruba; KU Leuven)

Bart Hellemans (KU Leuven)

Dr. Eric Mijts (University of Aruba)

Prof. Filip Volckaert (KU Leuven)

Population connectivity studies are an effective tool for species management and conservation planning, particular of highly threatened or endangered species such as corals. Here, we show how to determine the genetic structure and connectivity pattern of four coral species in the ABC islands (Southern Caribbean Sea), with different dynamics of larval brooding. Two of the species, *Diploria labyrinthiformis* and *Diploria strigosa*, are broadcaster spawner corals. These species have a large range of larval dispersal and consequently we expect a high population connectivity. On the contrary, the two other corals species *Favia fragum* and *Porites astreoides* are brooders, which means low range of dispersion, therefore, low connectivity between populations. The main aim of this study is quantifying the scales of connectivity in corals with short range and long range dispersal, but also, characterize source-sinks dynamics of these two dispersal strategies within and between the three islands (Aruba, Curaçao and Bonaire).

In addition, different environmental factors such as sea surface temperature, sea currents and salinity will be evaluated to identify their influence in the genetic structure and differentiation of the populations. More than 1400 individuals from 12 locations distributed in the three islands will be sampled and analyzed with species-specific polymorphic microsatellite markers. Genotypes will be used to perform genetic structure analyses following previous studies (López-Márquez

et al., 2022, *Mol. Ecol.*). Taking into account the biological traits of the species we expect high genetic differentiation for the brooding corals and lower levels for the broadcast spawners. Despite the low dispersal ability of the brooders we expect also casual dispersive events between regions that will maintain the considerable genetic diversity. Understanding the population connectivity and structure of these scleractinian corals allows for more informed conservation decision making



Friday 12th - Time: 11:25-12:05

ENHANCING FOOD RESILIENCE: ECONOMIC ANALYSIS OF AN INDOOR VERTICAL FARM GROWING STRAWBERRIES IN A SMALL ISLAND STATE - THE ARUBA CASE

Hanna Kryss Facun Sarmiento (University of Aruba; KU Leuven)

Dr. Anouk Mertens (KU Leuven)

Prof. Bram Van de Poel (KU Leuven)

Aruba, although having a high GDP, shares similar economic, social and environmental vulnerabilities as other small island states (SIS). In an effort to foster economic resilience, the island, amongst other strategies, focusses on agricultural innovation. In this context, especially given the limited land availability, indoor vertical farming (IVF) has the potential to further enhance food resilience while diversifying the economy.

For larger continental countries there are some comprehensive economic studies available for IVF. However, these models are not adapted to SIS in the Caribbean region. This is mainly because there is a significant deficiency in data for this region. To address this gap, our work evaluates the economic feasibility of building and running a vertical farm for local strawberry production in Aruba. We investigate the potential profitability of the IVF investment and operations, and determine thresholds such as minimum fruit selling price upon which different scenarios will be evaluated against the current "pilot indoor vertical farm" scenario.

Our results show that a minimum price of \$15 per kg fruit and a scale of 20 racks are required to have a positive NPV. The largest costs are energy (electricity) and labor costs. Energy costs can be reduced by installing 20 solar panels, each with surface of 2 m².

This Aruba case study offers some first interesting insights into the economic potential of indoor vertical farming for SIS in the Caribbean region. Our results could be interesting for both entrepreneurs as well as policy makers.



Friday 12th - Time: 13:00-13:40

VEGETABLES SHOULD BE QUALITATIVE, TASTY, AND AFFORDABLE, BUT WHAT ABOUT THEIR CARBON FOOTPRINT?

Amber S. van Veghel (University of Aruba; KU Leuven)

Dr. Salys Sultan (University of Aruba)

Prof. Annemie Geeraerd-Ameryckx (KU Leuven)

Food production and consumption are responsible for about one third of anthropogenic greenhouse gas (GHG) emissions. We used Life Cycle Assessment (LCA) as a tool to quantitatively measure the carbon footprint of a selection of vegetables imported to Aruba. Our focus was on the most (46 weight% of vegetable imports in 2017 – 2019) imported vegetables: potatoes (18%), lettuce (10%), onions (10%), and tomatoes (8%). We also selected green beans as an interesting case study because they can be either flown-in from Kenya through the Netherlands or shipped from the United States. Through trade data from Trademap and supermarket visits we identified 12 countries of origin and 22 product-country combinations.

First, we did an exploratory carbon footprint analysis, from the farm in the country of origin until arrival at the supermarket in Aruba. Included aspects of the food chain were: agriculture, processing, packaging, losses, and chilled road/sea/air transport. We used the LCA database “LCA of food & drink products” from Poore (2018) as the basis of our analysis and complemented with data from Agri-footprint and Ecoinvent. As islands are not situated on main maritime transport routes, we calculated sea transport with a high level of detail. Additionally, we made one in-depth analysis of a package of Mexican tomatoes to assess how additional details on production method, production region, transport routes, and storage altered the carbon footprint. Upon adding more detail, the carbon footprint of Mexican tomatoes increased with 19%.

With this exploratory analysis we aimed to give insight into low-carbon vegetable import strategies for Aruba. We observed that vegetables imported by air had a significantly higher carbon footprint than those imported by sea. Usually, the carbon footprint was dominated by the transportation phase. This was expected for flown-in vegetables but not for those transported by sea. Typically, not transportation but crop production and food losses contribute mostly to the carbon footprint of vegetables. Therefore, it is important to make island-specific case studies to lower carbon emissions of vegetable imports.



Friday 12th - Time: 13:40 14:20

VALORIZATION OF ALOE VERA PROCESSING WASTE

Jeltzlin Semerel (University of Aruba; KU Leuven)

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Aloe vera is a medicinal plant that is of high-value in the cosmetic and pharmaceutical industry. On the small islands of Aruba, Bonaire and Curacao, the Aloe vera plantation harvests the gel for application in the shampoo, soap and sunscreen. Aloe vera processing waste has accumulated on these small islands due to the high demand for the gel. An Aloe vera plantation could accumulate up to 4000 kg processing waste per month. The processing waste include the leaf (rind, sides & base), roots, flowers, dead plants, suckers and latex (bitter yellow sap). There are multiple methods that can be applied to valorize Aloe vera processing waste¹. The current project will focus on methods that can be applied on small islands to valorize Aloe vera processing waste. These methods will deviate from the current ways of processing waste disposal, which include transfer to landfill or used as fertilizer. The first method for valorization includes extraction of phenolic compounds from leaf waste to identify the chemical profile of the rind, base and sides. The chemical profile will give us insight into the value of the different parts of the Aloe vera leaf waste. The second method includes recover of lignin using hydrotropic extraction for structural characterization to determine potential application of lignin derived from

Aloe vera processing waste. Lignin has potential applications in fuel, polymer, food and chemical industry. The third method includes valorization of latex by converting aloin into aloe-emodin. Aloe-emodin is of high-value to the pharmaceutical industry due to its anticancer property. This project could take us one step further away from conventional waste disposal methods and closer to Aloe vera processing waste valorization.



Friday 12th - Time: 14:40-15:20

BRIDGING SOCIETY AND TECHNOLOGY TO MANAGE PLASTIC WASTE IN SMALL ISLAND STATES

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Waste management is a challenge for many small island states where landfilling practices are extensively applied. This impacts health, economy, and environment, hampering the sustainable development from different angles. When designing strategies towards sustainable waste management processes, the current limited data available complicates taking informed decisions. In addition, social norms and environmental awareness play a key role in the transition. Therefore, due to its complexity, it requires multidisciplinary sustainable solutions.

Citizen science, the participation of citizens in one or more phases of scientific projects, creates opportunities to contextualized projects by engaging citizens in addressing local challenges, and facilitates collecting data. While citizen science is increasingly applied worldwide for research on diverse themes, in this contribution the focus is on the implementation of citizen science approaches to tackle plastic waste data collection in Aruba.

Technology can support collecting data and improving plastic waste sorting and management. Some examples are citizen science data collection mobile phone apps used by citizens, and smart bins applied to improve sorting of recyclable materials. Therefore, there is a high potential for applying technological developments to improve plastic waste management. However, to be sustainable this technology needs to be designed according to the island context, ensuring societal adoption.

This research focuses on bridging technology and society to manage the plastic waste in Aruba, which could be potentially replicable in other Small Island States. This contribution presents how citizen science projects are designed and implemented on the Small Island States context, and how technology is developed to collect data on plastic waste while aiming to increase awareness



Friday 12th - Time: 15:20-15:25

TURNING THE TIDE - MAINTAINING ECONOMIC RESILIENCE ON ARUBA THROUGH HANDS-ON RESTORATION AND CONSERVATION OF ITS MARINE BIODIVERSITY

Helena Eicher (University Utrecht)

Coral reefs, having one of the highest biodiversity of ecosystems worldwide, offer opportunities for recreation, employment, tourism, and coastal protection. Local and global stressors as wastewater, pollution, fertilizer, run-off, coastal development, overfishing and global change attribute to a decline in coral health in the Caribbean. Being in risk of losing part of the economic, social, and cultural benefits coral reefs provide us with, management interventions are needed to interfere with the decline of Aruba's reefs. By implanting artificial coral reefs in spots within the Parke Marino Aruba, we aim to contribute to the restoration and conservation of a healthy, resilient coastal marine environment in Aruba. In this environment native marine biodiversity thrives, while its ecosystem services contribute to the welfare of future generations of the island. By quantifying the health and condition of the local reef communities in different locations within the Parke Marino Aruba, spots for the installation of the artificial coral reefs will be determined. As Aruba locally harbors small but extremely healthy reef communities, showing that reef growth is locally possible, and as local interventions primarily determine reef health in the Caribbean presently, a positive outcome regarding Aruba's natural and artificial reefs is more likely than for most Caribbean islands facing similar issues of reef degradation.