

Capacity Building for Sustainable Development in Small Island States through Science and Technology Research and Education

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1. Introduction and motivation

Sustainable development is needed for all countries, but especially small island states are vulnerable due to their small size and the many (largely external) challenges they face. Higher education needs to play a pivotal role towards the implementation of sustainable development policies and the corresponding SDGs (Cortese 2003) (Stephens, et al. 2008) (Karatzoglou 2013) (Hanefeld and Kickbush 2017; 358) (El-Jardali, Ataya and Fadlallah 2018) (Eppinga, de Scisciolo and Mijts 2019). For small island states, besides local governance strategies, local universities play a very crucial role in the implementation of the SDGs due to their contextual settings and their knowledge of the contextual variables of that specific island state. Compared to continental countries, small island states are subject to numerous extra threats due to their specific environmental, geographical, social and economic characteristics (Briguglio 2003) that lead to greater vulnerability. Multiple initiatives have been undertaken to build resilience to these threats, but the focus of these attempts is mostly externally oriented, rooted in international technical and logistical support and consultancy (Baldacchino 2018). Such solutions often do not consider the specifics of the local situation, and lead to a lack of institutional and social adoption in the island states concerned.

As today's research capacity in small island states is typically limited, both in relative numbers of researchers and students as well as in education programs offered and research activities supported, local and regional academic capacity building for higher resilience of these small island states is of crucial importance for decreasing the vulnerability of these states. Scientifically rooted technological solutions properly addressing the local situation but embedded in a global context are key. The creation of a critical mass of local higher educated experts, who can create, design, assess and implement such contextually relevant and locally accepted sustainable development solutions, will highly contribute to the resilience of these states. Institutes for higher education in small island states therefore need to take the responsibility to develop – through education and research – academic programs and networks to foster the development of a resilient and critical network of scientifically and technologically schooled experts in multidisciplinary collaboration for inclusive and affordable sustainable development in small island states. These universities do not only have a crucial role in their state's achieving the SDGs, but will also greatly benefit from engaging with the SDGs through the creation of new funding streams, and the development of new local, regional and global partnerships (SDSN, Australia/Pacific 2017, 7).

In the fall of 2019, the University of Aruba in collaboration with the University of Leuven (KU Leuven) in Belgium will start new academic programs called "Sustainable Island Solutions

through Science, Technology, Engineering and Mathematics” (SISSTEM). The start of these programs is funded by a project grant from the 11th European Development Fund with a focus on SDGs 7, 11 and 17. The SISSTEM project will start with a new Bachelor of Science program and 12 PhD projects, as well as the establishment of a research and services center, followed later on by a Master of Science program (Government of Aruba 2019). The research-based education programs stimulate the development of a critical mass of academic experts in a wide variety of fields that can address the vulnerabilities and developmental needs of small island states from an internal perspective, as well as contextualize solutions and create new industries in small island states. Note that Aruba is an obvious test case, but the education’s focus extends to small island states in general.

In this contribution, the authors will present the rationale behind the SISSTEM project, the local and international network partnership development, the model behind the design of the new education programs, as well as the way in which the programs will contribute to capacity building for sustainable development.

2. Sustainable development challenges in small island states

Addressing the challenges for sustainable development in small island states can be considered as a litmus test for global sustainable development: if we fail to solve small-scale challenges, how are we going to be able to solve global challenges? On the other hand, the challenges in small island states may require different innovative approaches as - due to scale, isolation, geography, tradition and culture, governance and education - the sustainability challenges in these states all turn out to be wicked problems. These wicked problems, in which economic, environmental, social, ethical and governmental challenges intertwine, can not only be addressed by academic solutions, neither by traditional and mostly foreign consultancy for sustainable development. The traditional approaches typically fail to account for the challenges of geographic scale, local and context-specific expertise and value systems, lack of redundancy and bureaucratic and technical (inter)dependency of these states. These specific characteristics differ from island state to island state, making it clear that not only technically adequate solutions for the wicked problems in small island states need to be developed, but also fundamentally different approaches to the implementation of these solutions. As such, not only a critical mass of technologically and environmentally educated engineers is needed for the sustainable development in small island states, but also the development of a critical mass of social engineers and interdisciplinary schooled politicians is fundamental to the successful further development of small island states. It is, however, unthinkable that small island states would be able to independently develop the expertise and knowledge necessary for sustainable development fully on their own. That is why forging strategic partnerships between island state universities and other research institutes as well as between island state universities and continental universities is key to achieve the targeted objectives.

It is important to discuss here the specific position of small island states in some more detail. The majority of small island states are former colonies, which legitimizes the fact that they are indicated as postcolonial states. Although the use of the term postcolonial may be rejected by those that prefer not to linger in the past, postcolonialism is a present-day concept and a concept of the future that plays a pivotal role in the social fabric and the institutional development of these states. The colonial heritage, including state tradition, institutional and governmental mutual interdependency and also in many cases the use of the colonial heritage language are realities of the present. As such, the postcolonial status of both the former colonizer and the formerly colonized are important factors in understanding processes in these small island states.

The terminology that is commonly used to refer to small island states is SIDS, i.e. Small Island Developing States. This terminology, coined by the United Nations (UN), is criticized as it reinforces the assumption that these states would have a stronger need to develop than other states, and are as such in a stage of being underdeveloped. Therefore, when referring to these states, we prefer to use the terminology of small island states instead of small island developing states – while we are aware that also the concepts of smallness as well as insularity are under debate. The small island states as listed by the UN contain 58 members and associated members, geographically spread over the Pacific, Caribbean, Atlantic, Indian Ocean, Mediterranean and South China sea. Their status ranges from independent nations (e.g. Haiti, Cabo Verde) to subnational semi-sovereign jurisdictions that either form part of an overseas centralized national authority (e.g. Puerto Rico, Guadeloupe) or form part of broader associations (e.g. Aruba, Cayman Islands). Their territories may be insular (e.g. Aruba and Malta), archipelagoes (e.g. Vanuatu, Bahamas), shared insular (e.g. Haiti and Dominican Republic) or peninsular or coastal continental (e.g. Singapore, Belize and Surinam). UN membership or association as a SIDS determines whether a state can be considered to be a small island state or not.

Small island states are studied as a separate category of states as their geographic and demographic characteristics constitute extra challenges for sustainable development (Briguglio, 2003) including challenges for socio-economic development, education and justice. Due to their scale and isolation, the autonomous development and maintenance of contextually situated institutions and policies imposes a relatively high burden on the available resources and personpower of these states. In most postcolonial small island states, this leads to the adoption of institutional structures, policies and practices that have been borrowed from the former colonizer, and to a dependency on external (foreign) consultancy and quality control. This would not be a problem if the conditions of these states would be similar, but that is not the case. Postcolonial power inequality, in combination with differences in scale, isolation, demographic characteristics, norms and values, religious backgrounds, and geological and climatological vulnerabilities are some of the differences which determine that the structures, policies and practices adopted from the former colonizers do not fit the postcolonial societies in which they are being applied. These factors have a fundamental influence on the extent of community involvement in sustainable development processes and the way in which communities take responsibility in any processes of change.

A number of challenges have been recognized as being most urgent for small island states: these include energy efficiency, waste management, water management, biodiversity, food security as well as social cohesion, poverty eradication and labor productivity, as well as sound governmental and economic frameworks (Commonwealth Secretariat 2004) (UNDESA 2012) (Gomes 2014) (Connell, et al. 2019). Following the SIDS Accelerated Modalities of Action (SAMOA) pathway strategy, many small-scale initiatives have been developed locally in Aruba to address these needs, including the UN Center of Excellence for Sustainable Development in SIDS, the Aruban SDG committee and the Aruban government's innovation center FUTURA. These initiatives are now complemented by the new SISSTEM project.

3. The academic “Sustainable Island Solutions through STEM” (SISSTEM) project in Aruba

The SISSTEM project structure focusing on Sustainable Island Solutions through Science, Technology, Engineering and Mathematics (STEM) consists of 4 pillars: a bachelor program, a master program, a PhD program and a research and development center. The project starts in

August 2019, and is implemented at the University of Aruba in collaboration with the University of Leuven (KU Leuven). Each project component is elaborated on in the following bullets.

- The 3-year Bachelor of Science (BSc) program in Sustainable Engineering and Technology starting in 2019-2020 consists of a 180-European credit curriculum that combines a thorough and broad foundation in STEM theory with applied focus and practice on sustainable development in small island states. After a common 1.5-year baseline education in mathematics, statistics, physics, biology, chemistry, informatics, geosciences, environmental sciences, bio-economics and materials engineering, the students then specialize in either 1) Bio-environmental Engineering, 2) Informatics and Data Science, or 3) Technology and Engineering. The first group of SISSTEM bachelors is planned to graduate in mid 2022. The BSc degree obtained will facilitate access to academic master programs in a wide range of STEM and sustainability studies, including of course the multidisciplinary SISSTEM master program.
- The Master of Science (MSc) program in Sustainable Island Solutions will be a multidisciplinary 60-European credit program that prepares students for the development of sustainable solutions for complex challenges in small island states in which perspectives and collaborations between disciplines are embraced and encouraged to achieve maximum effectivity and integration. For students wanting to enter the program but with insufficient academic background in the relevant disciplines, a 30-European credit entry program will be offered.
- The PhD program and a Research & Development Center are established at the University of Aruba. As part of the SISSTEM project, 12 PhD candidates will carry out research projects on selected sustainable development needs in small island states. These projects will be supervised by KU Leuven professors in the field and will therefore leverage the wide expertise available in Leuven, while focusing on the small island context of Aruba and beyond. PhD topics include for example studies on engineering for sustainability, methods for sustainable agriculture in small island states, bio-active characteristics of plant species, solutions for waste management, marine fish populations, urbanization and land use, governance of sustainability as well as the development of methods for the separation of valuable elements from reverse osmosis brines.
- The Research & Development Center will not only facilitate academic research, but will also focus on contract research and consultancy for both the private and public sectors in small island states. A Triple-Helix Platform for continued co-operation between public, private and university partners will complement the R&D Center, together with the development of an ICT platform, including the necessary IT infrastructure as well as human infrastructure to share research and education outputs.

The SISSTEM project serves multiple goals as part of a key development strategy towards achieving the sustainable development goals in Aruba and beyond :

- Offering new education in STEM resulting in increased program options at the University of Aruba (UA). Currently, UA offers 9 bachelor and master programs, the majority of which are in the social sciences. Expanding into the STEM field with this new SISSTEM program allows a new type of students to obtain their degree(s) locally/regionally,

therefore diminishing the likelihood of brain drain in this area that is essential to achieve sustainable development.

- The creation of a STEM knowledge base through academically educated experts: Aruba has identified a need for more skilled people to work in sustainability-related issues, specific to small islands. Both the public and the private sector have expressed the demand for more people trained in STEM-related subjects, with the necessary expertise to develop and implement projects related to innovative biotechnologies, renewable resources and energy, adaptation and mitigation to climate change, etc. Currently, graduates from secondary education in Aruba do not have any education offering in sciences, engineering and technology at the University of Aruba. This gap entails that students who want to pursue a career in these sectors need to seek higher education outside the territory and, most often, they choose educational offerings outside the Caribbean and then do not return to the region. Obviously, this limits the availability of sustainability and green-growth oriented experts on the job market in small island states such as Aruba.
- The development of research capacity and products: through the establishment of a research center, publications, certificate programs and other research outcomes (such as patents) in the field of sustainability will be delivered. Increased contact between the different actors will enable a quicker and more effective uptake of research results into policy or innovation activities in Aruba and in the region.
- The development of STEM services to society and industry: organizing lectures to the general public and/or specific target groups, short courses and workshops aimed at professionals, cooperation in research and development with industry partners, applied research and consultancy among others are but a fraction of the possible services that SISSTEM students and staff can contribute to society and industry in Aruba and in the region.
- Increased UA positioning in the Aruban society: through the research center, the applied research and advisory possibilities, the UA will become a viable option to industry and government for the procurement of such services, enhancing the knowledge and expertise position of the UA in these matters.
- Expanded network: the availability of the SISSTEM educational and research offering will increase the attention on Aruba as a destination for related research. Through consortium agreements with partners, the Erasmus Mundus program or mobility flows between EU and non-EU regions in STEM-related research, as well as collaboration with international partners (such as KU Leuven, Oregon State University, the University of the West Indies, and the development of partnerships with Latin American institutes), the UA will ensure that students and researchers will be enabled to further develop their networks in the Caribbean region, in North and South America, as well as in Europe.
- The Government of Aruba's education and research and innovation policy: in collaboration with UNESCO, the Government of Aruba has prepared a National Education Plan 2018-2030, which reflects the integration of STEM fields especially at the secondary and technical vocational education levels. Additionally, the Government has produced a number of policy documents specifically on sustainable development, e.g. "Green Gateway", "Creation of Sustainable Prosperity in Aruba", and "2020 Vision Green

Deck Aruba” from January 2017. The Government is a strong advocate of Sustainable Development and the UN Agenda 2030. A multisector National Commission for the implementation of the SDGs has been established and is working in close collaboration with the United Nations Development Program, the Economic Commission for Latin America and the Caribbean (ECLAC) and the University of Aruba (UA). The SISSTEM project has been identified as an important element in achieving the SDGs. In this respect, the Government is a strong promoter of the SISSTEM and green-economy practices both at national and international levels to create a center of excellence to support sustainability best practices for small island states.

- The contribution to the achievement of SDGs in SI(D)S: The program will contribute to the achievement of multiple SDGs at the scale of Aruba as a small island state, and the SISSTEM project as such serves as a global example for sustainable development in small island states. Both the research output and the output in expert students will build an expertise and knowledge base that will address developmental challenges and wicked sustainability problems in small island states in fundamentally novel ways.

4. Conclusions

Following this approach of capacity building through an academic education and research program offering for sustainable development, universities in small island states can and have to play a pivotal role in addressing the sustainability issues at hand in small island states. The SISSTEM project at the University of Aruba, being established in collaboration with the University of Leuven, is an example of such capacity building. The academic bachelor and master program offering will focus on multidisciplinary engineering and technology education for sustainable development in small island states, rooted on a solid scientific baseline and on academic sustainability research.

In addition, it is important to forge island-to-island and island-to-continent academic institutional partnerships for sustainable development in small island states. These partnerships are mutually beneficial. While the island-to-island partnerships support the mutual development of institutional expertise in the development of contextually adequate approaches to sustainable development, the small island states institutions can root the development of their research and education in continental, often more traditional approaches, and can at the same time also be a valuable partner for continental universities in contextualizing innovative research and further development perspectives on adequate practices for the advancement of the SDGs. The Aruban SISSTEM program aims to do exactly that: forge south-south and south-north mutually beneficial academic networks for the sustainability development in small island states.

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