Spatial Analysis of Urban Metabolism in Small Island States

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Research on urban development mainly focuses on the interaction between social, spatial, and environmental dimensions of urban processes and on how to address prevailing challenges on numerous spatial scales in a sustainable manner for all involved (Boger, 2014). Urbanization is a process driven by various factors, ranging from demographic changes and economic development to social transformations (Onyango, 2018; Gu, 2019). When combined with global predictions pertaining to future population growth, the United Nations General Assembly was prompted to convene the Habitat III Conference to reinvigorate the global commitment to sustainable urbanization and to focus on the implementation of a New Urban Agenda, building on the Habitat Agenda of Istanbul in 1996 (UN-Habitat, 2016). This New Urban Agenda encourages member states and other key stakeholders to drive sustainable urban development at the local scale.

According to UN-Habitat (2016) one of the vulnerabilities of Small Island States (SIS) is that approximately 38 million (59%) of the 65 million inhabitants, are living in urban areas often situated in low lying coastal areas. When combined with other vulnerabilities SIS are facing, for instance sea level rise induced by climate change, social challenges, and economic vulnerabilities due to limited resource availabilities, these cumulative pressures may lead SIS to reaching the boundaries of their natural carrying capacity (Boswell, 1990 ; UNEP, 2014; CDB, 2019). However, islands have less time to adapt or plan for the effects of global and local physical, natural, or economical disruptions (Deshenes & Chertow, 2007; Rhiney, 2015).

Understanding and defining the boundary between the social system, nature, and their interaction is vital (Fisher-Kowalski et al., 1998). Therefore, this study we will focus on developing a method to identify historical and present drivers and barriers of society's well-being from the perspective of sustainable urban development. We strive to develop a sustainable development index to assess the level of development of SIS as a foundation for future sustainable urban development in SIS. With this method we aim to assess the carrying capacity of islands depending on the sustainable management of their available land resources (UNEP, 2014). Furthermore, we will identify the trade-offs that lifestyle changes pose on land carrying capacity by promoting sustainable consumption and production patterns. Lastly, we will decouple economic success indicators from Gross Domestic Product (GDP) by including indices on nature as well as the well-being of society in general.

The above-mentioned targets are being studied through the perspectives of the urban metabolism framework and the water – energy – food (WEF) nexus framework. To study the pressure that humans impose on the earth in general, it is best to consider the target region as an isolated system (Deshenes &Chertow, 2007). Therefore, islands provide a unique opportunity to address these challenges if we consider the island to be an environment with a clear physical boundary.

Because islands are connected to local and distant geographies via globalization and are intertwined through the exchange of water, energy, food, materials, capital, and people (Cousins & Newell, 2015; Newell et al., 2019), they provide a solid opportunity to analyze the resources needed to sustain life. To assess this flow, we will consider islands as metabolisms. The metabolism framework represents islands as living organisms which need materials, nutrients, energy, and water to sustain themselves. In addition, looking at the water – energy – food nexus through the lens of island metabolism will allow us to capture the input and output of resources needed to sustain basic human life. Moreover, using this approach will allow us to capture the multiple interdependencies between these 3 major resources for human existence (Leck et al., 2015). Ultimately, the WEF nexus approach will help us enhance resource security by increasing efficiency, reducing trade-offs, building synergies and improving governance on local, national and regional scale (Hoff, 2011).

The methodology of this research consists of first mapping the historical urban extent of Aruba from the 1980s to present by means of Google Earth Engine (GEE; Liu et al., 2020). This is followed by an input-output analysis of national resource flows on sectoral level (Arthur et al., 2019). The outcomes of the previous will be used to develop two questionnaires. The first will be an opinion-based questionnaire to assess the intersectoral issues, synergies, and trade-offs on national level (de Strasser et al., 2016) by means of resource flux, resource efficiency and environmental impact. The second questionnaire will assess society's vulnerability, security, and wellbeing in relation to the WEF resources via creation of a typology of the interviewee's experience regarding the WEF sectors and resource availability. The latter is of great importance as society's demands drive accumulation and materials flows, thus uncovering the relations that underpin the WEF nexus (Foran et al., 2015; Haberl et al., 2017).

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