

Crosscutting implications of SDGs in coastal flood defence infrastructures

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ABSTRACT

This research studies the level of sustainability of natural and nature-based flood defences on different geographical scales based on the Green Coastal Policy (GCP) assessment framework. The framework considers an integral sustainability approach (People, Planet, Prosperity) with the use of coastal-relevant targets derived from the Sustainable Development Goals (SDGs). The assessment quantitatively measures the level of sustainability of coastal infrastructure developments and allows comparison between locations and over a period of time. This means that the GCP framework connects the SDG targets with selected parameters and publicly available data to stimulate coastal sustainability to minimise negative ecological and socioeconomic impact, support coastal functions and maximise adaptation of the ecosystem to climate change.

To highlight the framework, this study compares two sets of cases at different scales; five global coasts and deltas (Colombia, Vietnam, The Netherlands, the State of Louisiana, USA; and the State of Queensland, Australia) and five beach nourishment projects in the Netherlands. Results show variation in the sustainability values and applicability to evaluating policies with back or fore casting coastal related strategies.

KEYWORDS: *Coastal Flood Management, Assessment Method, Sustainable Development Goals, Climate Resilient Infrastructures*

1. INTRODUCTION

The uncertainty regarding climate change is the main driving force for sustainable action for coastal protection, coastal management and maintenance planning. The challenge is to optimise the management and maintenance in such a way that it will guarantee the people's flood risk safety. Moreover, this optimisation should prove beneficial for the coastal ecology and economy. Results of the ongoing actions can be used to assess the sustainable economic growth concerning needs in sustainability policy and on flood and coastal erosion risk management to reduce the probability of flooding (Van Koningsveld and Mulder, 2004; Sayers et al., 2017). Sustainable development, in view of social, environmental and economic ('Triple-P') considerations is needed in a balanced manner (Schipper et al., 2017).

Nature Based Solutions in Coastal Management

Because of the growing emphasis on sustainable coasts and the concept of nature-based solutions, increased knowledge is needed to reduce the impact of climate change effects on the natural coastal system (Nicholls et al., 2014). This means that new multi-functional approaches for the protection of the coastline design and infrastructure are required (Van Wesenbeeck et al., 2014). This can be achieved by using nature-based solutions that considers specific knowledge and expertise in the field of flood defence. In the future coast policies will be based on an integrated approach to coastal flood defence or hard structure protection and nature protection on the mainland coast of ports (Dawson et al., 2009). In the last two decades there has been a shift towards applying Building with Nature (BwN) (Stronkhorst et al., 2018; Sutton-Grier et al., 2018). Both concepts combine ecosystem-based monitoring and sustainable land use solutions to create a productive and stable coastline. BwN uses natural forces to implement a flood protection measure whilst also providing ecosystem services, e.g. mangroves or sand nourishments. In the Netherlands, the current coastal adaptation policy is one where the 'base-coastline' is maintained by sand-nourishments in the form of dynamic maintenance.

Sustainable Development Goals

The United Nations (UN, 2015a) made up 17 Sustainable Development Goals (SDGs) including targets and indicators, to end poverty, protect the planet and ensure the well-being of people and prosperity. It is possible to use the SDGs to make the relationship to sustainable infrastructure approaches with the circular economy (Schroeder et al., 2018), smart cities (Ahvenneimi et al., 2017) and green ports or logistics (Schipper et al., 2020). Schipper et al.

(2017) applied a methodology (Green Port Policy) on world-wide port-city cases resulting in recommendations for port development that can be realised in an inclusive way.

GCP Assessment Framework

Therefore, the philosophy behind the methodology will be modified for the assessment of a coastal policy. In this study the Green Coastal Policy (GCP) framework proves to assess the level of sustainability, bearing in mind the resilience of coastal flood protection and adaptation to climate change, to minimize social impacts, protect the coastal functions, and increase the resilience of the ecosystem. In the GCP framework, the coastal flood defence and protection measures will be analysed in line with the 'Triple-P' theory. In the GCP assessment framework, the preparation includes the selection of some global and regional coastal infrastructure. The Green Coastal Policy (GCP) assessment framework is based on coastal targets derived from the SDGs connected with relevant Key Performance Indicators (KPI's).

The objective of this conference paper is to pre-announce a study in preparation¹ with the aim to evaluate the level of sustainability of regional and global natural and nature-based coastal flood defences. The comparison study has been based on the coastal assessment of the level of sustainability and the resilience and adaptation to climate change of different global geomorphological coasts and deltas in countries Colombia, Vietnam, The Netherlands, the State of Louisiana USA and the State of Queensland Australia.

2. METHOD OF GREEN COASTAL POLICY ASSESSMENT FRAMEWORK

The SDG-GCP framework aims to quantitatively assess the level of sustainability to stimulate climate resilience and adaptation of a certain field of policy. The method behind the SDG-GCP is in principle based on the assessment framework developed by Schipper et al. (2017) where it is used to consider green policy in port-city planning of ambitions and sustainability achievements. However, in this study the assessment is modified and extended in such that it is directly connected to SDGs and tailored with specific key performance indicators.

The SDG-GCP framework is divided into four steps: (I) **Characterisation** of the coastal infrastructure and functionalities; (II) **Consideration** of SDG targets based on functionalities;

¹ Schipper, C.A., and Dekker, G.J. (2020). *Characterization of SDGs towards climate resilient coastal infrastructure: sustainability performance and cross-linking cumulative consequences*. [Manuscript in Preparation].

(III) **Selection** of the KPI's connected to selected SDG targets; (IV) **Valuation** of numeric data.

This study focuses on the sustainability of coastal management on global level and variations of sand nourishments on regional level (as an expression of the nature-based solutions concept). The functionalities have been chosen based on literature study and form in combination the characterization of the chosen field of policy². The five global coastal stretches are located in: (1) *Louisiana, United States of America*, (2) *Colombia*, (3) *Queensland, Australia*, (4) *Vietnam*, and (5) *the Netherlands*. The five regional sand nourishment projects located in the Netherlands: (6) *beach nourishments Domburg* and (7) *Texel* (8) *shoreface-beach nourishment Callantsoog*, (9) *sand motor nourishments Delfland* and (10) *system nourishment Ameland*. All cases (two times five) have been selected based on defined selection criteria².

The valuation of the SDG-KPI's is executed based on a 'no-impact' situation representing the 100% condition; full sustainability impact score. The reference for the 'no-impact' situation has been completed by the highest scoring case in the set of cases.

3. RESULTS

Before the implementation of the actual data analyses (step IV) steps I-III are essential. The previous section described in outline the selection process of cases and the characterisation of the policy theme by defining the functionalities (Step I).

The consideration of SDG targets based on the functionalities (Step II) resulted a selection of 37 out of the 169 SDG targets. The SDG targets cover thematic coastal issues with cross-cutting implications, such as climate change, biodiversity and economic growth. The SDG targets are interlinked and multifaceted and require adequate data to monitor progress.

The selection of the coastal data indicator (Step III) resulted in 12 out of the 37 relevant identified coastal SDG targets which prove to be connectable to a relevant, accurate metadata available and measurable KPI. The consideration involves explicitly linking relevant SDG

² *The chosen coastal functionalities as well as the case study selection criteria are not presented in this conference paper due to the publication process of the manuscript (Schipper et al., 2020)*

targets to relevant coastal indicators. The KPI's are partly suggested by the UN expert group IAEG-SDGs (UN, 2017; SDG-Tracker, 2018) and are partly derived from other meta-data. Table 1 shows the 12 identified SDG targets and their description³.

In Step IV, the found data has been analysed taking into account the 'no-impact' situation followed by a statistical analysis to prove the applicability of the used data³. The full data presentation and the cumulative outcomes of the global and regional cases will be presented in Schipper & Dekker (2020). In this conference paper – which can be seen as a pre-announcement of Schipper & Dekker (2020) – two single SDG target examples are presented, one for each set of the cases (global and regional). Figure 1 shows two spider-charts presenting individual sustainability impact scores.

³ *The SDG-KPI's and the meta-data sources as well as the statistical analysis are not shown in this conference paper due to the publication process of the manuscript (Schipper et al., 2020)*

Table 1: Overview of the 12 identified SDG targets and their UN description

SDG target	Description	UN Definition (UN, 2017; SDG-Tracker, 2018)
Social Service		
11.5	Health protection/Sustainable communities	<i>By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations</i>
11.6	Sustainable cities/Air quality	<i>By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management</i>
12.8	Flood preparedness	<i>By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature</i>
16.7	Institutionally capacity	<i>Ensure responsive, inclusive, participatory and representative decision-making at all levels</i>
Environmental Service		
6.6	Water quality	<i>By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes</i>
9.4	Greenhouse gas concentrations	<i>By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities</i>
13.2	Coastal erosion	<i>Integrate climate change measures into national policies, strategies and planning</i>
14.2	Biodiversity abundance/Ecology	<i>By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans</i>
Economical Service		
7.2	Renewable energy	<i>By 2030, increase substantially the share of renewable energy in the global energy mix</i>
8.2	Coastal revenue/Economy	<i>Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors</i>
8.9	Tourism	<i>By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products</i>
9.5	Knowledge and Innovation	<i>Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending</i>

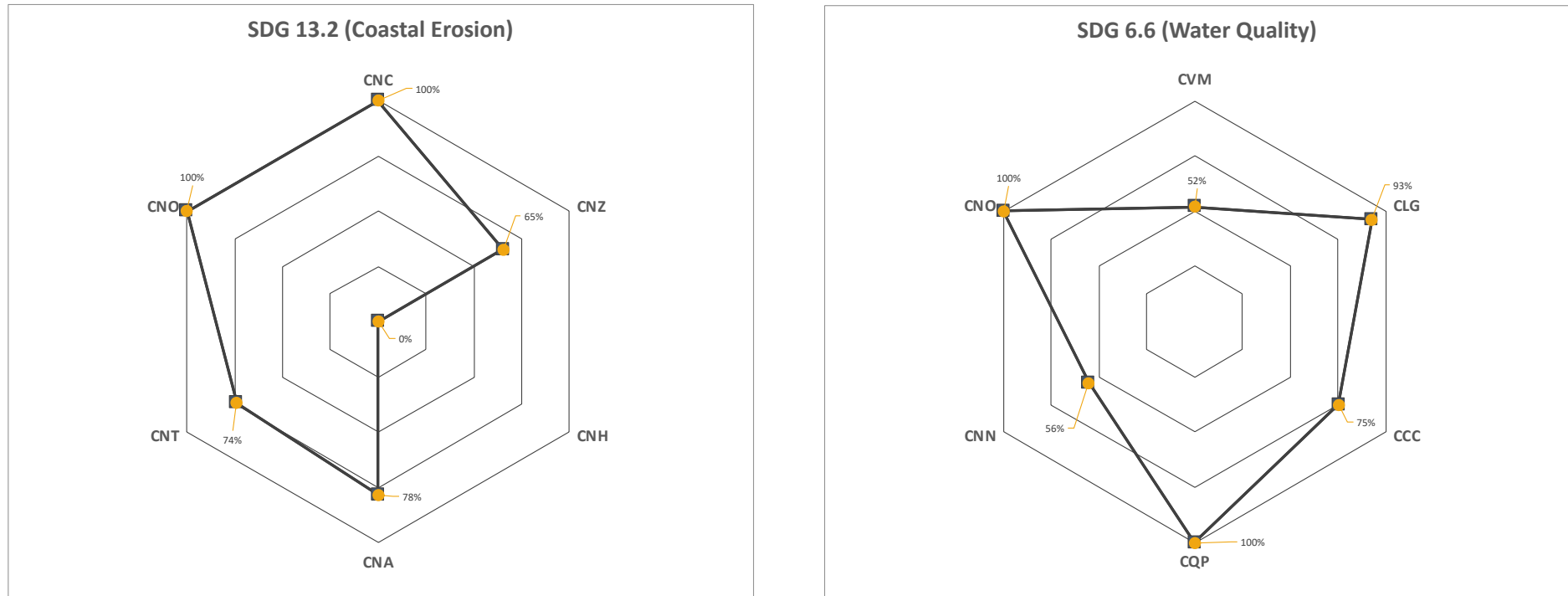


Figure 1: *Left:* SDG target 13.2 for the regional cases. *Right:* SDG target 6.6 for the global cases. Showing an example of an individual SDG target Sustainability Impact Score.

4. DISCUSSIONS

The GCP framework briefly presented in this conference paper shows the possibility of sustainability assessment based on the SDGs. It shows the prospect of factualizing the level of sustainability of certain policy implications in an interdisciplinary and multi-perspective. For this conference paper, five points of discussion has been formulated:

- The GCP framework integrally facilitates a systematic assessment of human induced pressures and the impact on the social, environmental and economic aspects of a certain system. It creates the possibility to monitor certain policy implications, like Nature-Based Solutions, from the point of sustainable development.
- The study proves the distinct possibility of characterizing sustainability using SDG targets in combination with tailored KPI's. This makes it possible to use conceptual UN policy in a concrete, regional manner without missing the 'Triple-P' philosophy.
- This connection with KPI's makes it possible to quantitatively and specifically measure the SDGs. This indicates the dependence on adequate and specific data as a boundary condition for identifying priorities on early action in order to achieve the SDGs.
- GCP demonstrates to be flexible applicable, depending on the objectives of the assessment. For example, the framework facilitates global country comparison over time or best practices of certain regional based project sites. It also offers the flexibility to benchmark the progress against the threshold for achievement of the SDGs.
- Besides the different modes of application, GCP demonstrates to be flexible appropriate towards different fields of expertise and policy. This conference paper focusses on coastal flood protection, however all kind of infrastructure constructions or networks (e.g. ports, river management, dams, flood protection barriers) could be assessed using the framework. This could be a direction for further and additional research.

5. CONCLUSIONS

The SDG-GCP framework as developed in this study, provides an assessment method to evaluate the level of sustainability from a multidisciplinary perspective (social, environmental and economic). The framework evaluates – in a *bottom-up* manner – *the top-down* UN policy

framework. In other words, the GCP shows the option to assess, track and stimulate implementation of the UN global policy on regional level.

The international ‘language’ in the form of the SDG targets and their definitions in combination with tailored KPI’s is a valuable combination to monitor and encourage progress towards achieving the SDGs of coastal infrastructures. The study proves, the framework may be flexible applicable depending on the objective of the analysis and flexible appropriate for different fields of policy.

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This symposium manuscript can be considered as a pre-announcement of a yet ready to publish paper (expected 2021). It is therefore that this manuscript does not describe and discuss all the details of the study.

REFERENCES

- Ahvenniemi H., Huovila A., IPinto-Seppä, M., Airaksinen (2017). What are the differences between sustainable and smart cities? *Cities* 60 (2017) 234–245
- Dawson R.J., Dickson M.E., Nicholls R.J. *et al.* (2009) Integrated analysis of risks of coastal flooding and cliff erosion under scenarios of long-term change. *Climatic Change* 95(1–2): 249–288.
- Sayers, P., Walsh, C. and Dawson, R. (2015). Climate impacts on flood and coastal erosion infrastructure Infrastructure Asset Management. Paper 1400040. <http://dx.doi.org/10.1680/iasma.14.00040>
- Schipper, C.A., Vreugdenhil, H., & De Jong, M.P.C. (2017). A sustainability assessment of ports and port-city plans: comparing ambitions with achievements. *Transportation Research*, 57, 84-111.
- Schipper, C.A., Bolman, B., & Slingenberg, A. (2020). Assessing the sustainability of the Chinese Maritime Silk Road. [In press].
- Schipper, C.A., and Dekker, G.J. (2020). *Characterization of SDGs towards climate resilient coastal infrastructure: sustainability performance and cross-linking cumulative consequences*. [Manuscript in Preparation].
- Schroeder P, Anggraeni K., and Weber U. (2018). The relevance of circular economy practices to the sustainable development goals. *Journal of Industrial Ecology* 2, volume 0 number 0
- Stronkhorst, J., Huisman, B., Giardino, A., Santinelli, G., & Santos, F.D. (2018). Sand nourishment strategies to mitigate coastal erosion and sea level rise at the coasts of Holland (The Netherlands) and Aveiro (Portugal) in the 21st century. *Ocean & Coastal Management*, 156, 266-276.
- Sutton-Grier, A.E., Gittman, R.K., Arkema, K.K., Bennett, R.O., Benoit, J., Blich, S., *et al.* (2018). Investing in Natural and Nature-Based Infrastructure: Building Better Along Our Coasts. *Sustainability*, 10, 523;
- UN (2015). Transforming our world: the 2030 Agenda for Sustainable Development; Resolution adopted by the General Assembly on 25 September 2014 (A/Res/70/1). New York: United Nations.
- Van Wesenbeeck, B.K., Mulder, J.P., Marchand, M., Reed, D.J., de Vries, M.B., de Vriend, H.J., & Herman, P.M. (2014). Damming Deltas: a practice of the past? Towards nature-based flood defences. *Estuarine, coastal and shelf science*, 140, 1-6.