

# TOWARDS A FRAMEWORK FOR INTEGRATED, ECOSYSTEM-BASED PORT DEVELOPMENT

by

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## ABSTRACT

This paper describes an integrated, ecosystem-based research project exploring what it means to be a sustainable port in a developing country context. Africa is one of the few areas in the world where greenfield port development is still occurring in addition to brownfield development. This means there are many challenges and opportunities to design for sustainability and to nudge existing ports towards more sustainable activities. A stepwise, case study oriented approach to tackling these issues is explicated in an effort to understand the advantages for port developers and their financiers to move in this direction.

## 1. INTRODUCTION

A paradigm shift is required in our approach to large scale infrastructure development including ports, whereby the emphasis lies on achieving our objectives in an ecosystem and societal context in an uncertain environment. There is a growing recognition of the need for more sustainable approaches to port development aimed at balancing social, environmental and economic aspects. In spite of this, an integrated inter-disciplinary approach to sustainable port development, which embraces the four perspectives of engineering, ecosystem services (ecology and economy) and governance is lacking. The ongoing NWO-WOTRO UDW project "Integrated and Sustainable Port Development in Ghana within an African context" (NWO, 2018) addresses this gap.

The project which started in May 2016 spans 3 years and is carried out by a multidisciplinary consortium, wherein academia, applied research institutes, knowledge institutes, practitioners and potential users collaborate as partners and interact with a broad range of local stakeholders. It adopts an inter-disciplinary approach that integrates different aspects of sustainable port development to create a knowledge base serving a design-framework and accompanying design tools that can be applied in developing more sustainable ports. Using a case study in Ghana as the central application focus, subsequent replication of new knowledge and practices is expected within Ghana and beyond, followed by eventual institutionalization through bottom-up adoption and activated Pan-African networks.

## 2. TOWARDS SUSTAINABLE PORTS IN AFRICA

The selected case study is the Port of Tema, located in the south eastern part of Ghana along the Gulf of Guinea. Tema has evolved from a small fishing village in the mid twentieth century to become Ghana's leading industrial centre and seaport in the last decade. The port is undergoing expansion to serve rising cargo traffic volumes as Ghana's economy maintains its high rate of growth. To integrate knowledge and learning on the case study, four sub-projects focussing on engineering (P1), ecology (P2), economy (P3) and governance (P4) have been defined.

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P1 *Port engineering and design* views the port as a component within the coastal zone and develops alternative layouts for the port expansion of Tema. Hereby, the principle of Building/Working with Nature is gainfully applied in exploring infrastructural options to maintain, restore or offer opportunities to coastal ecosystems. The changes engendered by alternative port layouts and diverse port infrastructural designs are studied in terms of their ecological and societal effects.

P2 *Marine ecosystems and coastal erosion* examines the dynamic interactions between infrastructural elements and the coastal ecosystem. Here the emphasis lies not on the infrastructural elements, but on the ecological components, their functioning and evolution from the start of port development in Tema. Understanding of the changes in the functioning of the ecosystems are sought so that opportunities to create added value for nature from the the port can be identified. For instance, by countering erosion problems and integrating restoration of ecological habitats in new road infrastructure development.

P3 *Economic valuation of ecosystem services* applies state-of-the-art methods to quantify the evaluation of changes in ecosystem service delivery to humans. This allows the inclusion of ecosystem services in the socio-economic analysis of port development alternatives. Social aspects identified as relevant in P4 will also be valued.

P4 *Governance of green port development* formulates an opportunity-oriented implementation model for port development in which port authorities, contractors, nature conservation organizations, ecologists, engineers and local stakeholders cooperate to formulate a better fit between ports and their social-ecological landscape. In this process, the values that stakeholders hold regarding the future alternative states of the port-city and its surroundings are accessed.

The overall project encompasses the following steps:

- gathering relevant data for the pilot project through desk studies, field research and workshops;
- exploratory studies and brainstorm sessions to formulate alternative port layouts and identify potential ecosystem services;
- stakeholder-inclusive workshops to elicit stakeholder values and local knowledge;
- integration of the findings into alternative conceptual port layouts. These alternatives include: status quo as reference layout, the current port expansion plan of Ghana Ports and Harbours Authority (GPHA), an incremental port development plan with a focus on value addition by considering sustainability, and an innovative layout;
- detailed assessment of alternative port layouts with respect to functionality of port operations, morphological effects, environmental impacts on the marine and coastal ecosystems, and economic valuation of ecosystem services;
- a detailed assessment of stakeholder values in relation to port-city development and the effects on surrounding ecosystems;
- the formulation of a framework for sustainable port development, tested in Tema, Ghana.

The pilot case study will result in a port design for Tema that complies with the requirements as to functionality and sustainability. The knowledge and insights gained from the case study are also used to develop a potentially generic framework and tools for stakeholder-inclusive design of sustainable ports. Knowledge dissemination in accordance with a well-formulated research uptake strategy forms an important component of the project, as does the desire to test the developed framework by applying it on other ports in Africa and elsewhere.

### **3. CONCLUDING**

By describing this on-going research project, including the underlying vision, the challenges and the objectives, the activities pertaining to the selected pilot project in Ghana, as well as the envisaged end results, this paper aims to share new knowledge and learning about the practice of port development. Finally, as the approach and underlying principles are applicable to large scale infrastructure development at other locations, we encourage others to apply these principles in the sustainable development of ports.

#### **References**

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