Approaches to reduce marine litter –
a baseline study in the pilot region of North Sulawesi, Indonesia

Julia Giebel, University of Applied Science Magdeburg-Stendal, juliagiebel@ymail.com
Supervisor: Prof. Dr. Gilian Gerke, University of Applied Science Magdeburg-Stendal
Dr. Miriam Weber, Christian Lott, Aqueis e.V. / HYDRA Marine Sciences
Prof. Markus T. Lasut, Sam Ratulangi University (UNSRAT) Manado

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Introduction

Marine litter is one of the foremost challenges facing the world today. Particularly, Indonesia is a major polluter of plastic waste leakage into the ocean.
As part of the No-Trash Triangle Initiative's approach, this study aimed to address this issue and generate baseline data on solid waste and its management and to provide approaches for local marine litter prevention. Model areas of this studies are the city of Manado and Bangka Island in North Sulawesi, Indonesia. To explore how to prevent plastic leakage into the aquatic environment, the following <u>major research question</u> is asked:

How to reduce marine litter considering baseline data obtained from differently structured model areas in the province of North Sulawesi, Indonesia?

Since inadequate practices of municipal solid waste management in low-income countries are considered to be major contributors for marine litter (Velis C., 2017), knowledge gaps on waste sources and its management needs to be closed. Thereof, this research generates baseline data of the composition and sources of present waste as well as the characterization of the current waste management system.
Additionally, a case study about the market value analysis of beached waste was implemented on the island of Bangka to gain an understanding of the situation of small remote islands in North Sulawesi. Within this case study, a quantitative waste analysis was implemented, and the valuable and potentially recyclable fraction was estimated.

Material and methods
Solid waste data were generated through waste sampling analyses on various environments, such as households, street sections and beaches. The waste samples were weighted and counted. The waste management systems of the two model areas Bangka Island and Manado City were characterized and evaluated using a waste-related indicator analysis. Subsequently, a case study was conducted on the island of Bangka to determine the potential market value of beached waste. For this study, a huge waste sample of x weeks collected beach waste was analysed in detail and the market value of the valuable waste fraction was estimated. Based on these data, approaches and recommendations for Manado, Bangka and the province North Sulawesi were written.

Results and discussion

Allover, the waste sampling analysis included 34752 items, weighting 734 kg in twelve different samples. The most commonly occurring waste items were sealed beverage cups, beverage bottles, sachets and plastic bags. The analysis revealed that most sampled waste originated from the mainland, mainly for packaging, in particular for beverages. Overall, the majority of the waste samples was produced as single-use items.

The indicator analysis of the waste management systems showed large differences between Manado City and Bangka Island. In Manado, waste collection was practiced, whereas on the structurally weak Bangka basic waste collection was lacking.

The case study of Bangka Island showed that 53 percent of the analyzed beached waste was considered to be recyclable. Nevertheless, the waste has an estimated local market value not exceeding 518,000 Indonesian Rupiah (32€), which does not cover formal management, sorting and transport costs under current conditions.

Taking the baseline results into account, approaches to reduce marine litter were suggested. Manado requires enhanced waste management, including waste segregation at source and better management of recyclables, as well as comprehensive management of waste bins. For the island of Bangka, infrastructure to manage inorganic waste collection, either directly or through collection points was recommended. This thesis showed that single actions were limited in their reach. Therefore, in the province of North Sulawesi, stakeholders should collaborate more intensely, apply mechanisms of sustainable financing to give plastic a measurable value, enforcing the ban on plastics and spread integral awareness.

Overall, this thesis contributed data on solid waste and sets an essential basis to address the local problem of marine litter in this province.

Literature

Velis C., L. D. (2017). *How to Prevent Marine Litter - Now!* Leeds: ISWA Marine Task Force. Retrieved from http://marinelitter.iswa.org/marine-task-forcereport-
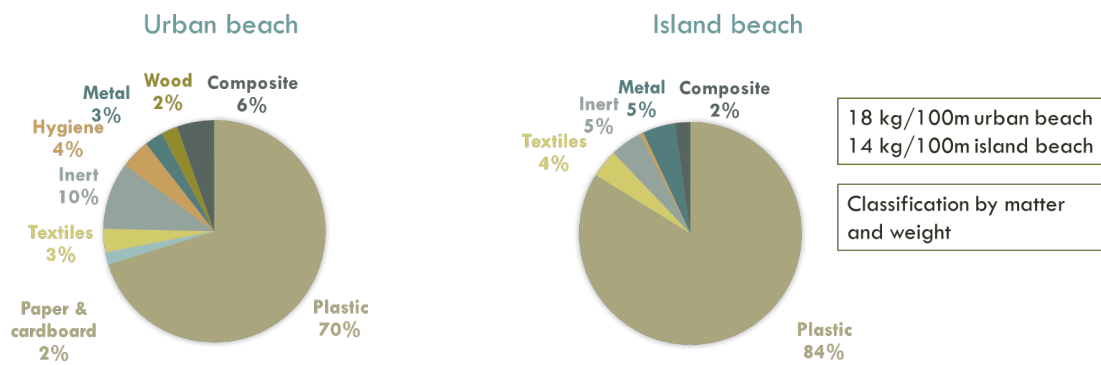
Supporting information

Urban beach

Metal 3%
Wood 2%
Composite 6%
Hygiene 4%
Inert 10%
Textiles 3%
Paper & cardboard 2%
Plastic 70%

Island beach

Metal 5%
Inert 5%
Composite 2%
Textiles 4%
Plastic 84%

18 kg/100m urban beach
14 kg/100m island beach

Classification by matter and weight

Figure 1: Waste sampling analysis results of beach samples

Economics and health care
5 4 3 2 1 0

Waste management and collection
Governance
Perception of cleanliness
Environmental behavior
Waste generation
Environmental position

■ Urban general ■ Urban waste-related

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Waste management and collection
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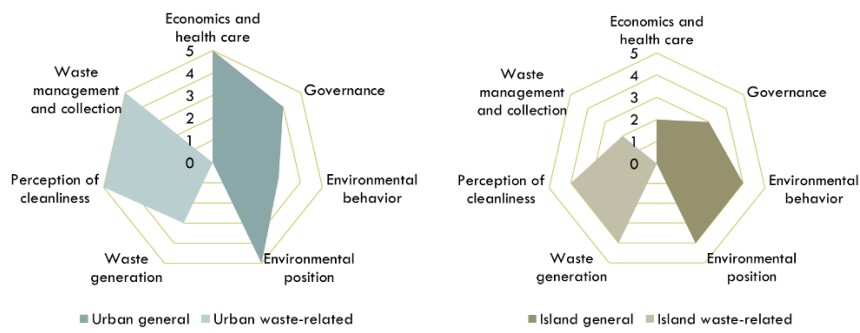Waste generation
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■ Island general ■ Island waste-related

Figure 2: Waste-related indicator analysis