

Strategic action for waste management in Manado City to prevent marine debris input to Manado Bay: a preliminary study

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Abstract: Marine debris has become a serious threat for the coastal and marine environment. Their presence can degrade the quality of marine environments and also has negative impact on several aspects of people lives especially public health and aesthetics. Several efforts have been made, both short (to mitigate the impacts) and long terms (to manage them properly) efforts. Strategic action in waste management is very important in order to manage marine debris in Manado City; this is the objective of the research. In order to achieve the objective, several aspects on situation and condition of marine debris in Manado Bay has been described, and this include composition and density of debris at the coastal area, the quantity of the debris, waste management on land, the status of public awareness, the impact and degradation of marine debris in nature, institutional regulation, and waste management and planning. These aspects were analyzed to identify strengths and weaknesses before strategic actions for management are developed. The results showed that the composition, density, and quantity of marine debris in Manado Bay increased from 2017 to 2019. Waste management on land has been going well, the government institutions dealing with waste have been adequately arranged. Five strategic actions for waste management in Manado City to prevent the input of the waste to Manado Bay are proposed, they are: a) encouraging people to reduce the use of plastic-based products; b) involving people and community institution in waste management on land; c) increasing the activities of the community and community institution in keeping the environment (river, beach) clean; d) inviting the community and community institutions in working together to develop action programs which will be implemented jointly; and e) improvising the waste management according to existing regulations which include marine debris in specific management target and also incorporating rivers and other areas in waste management according to regulation.

Keywords: plastic waste; marine debris; marine waste; manado bay; manado

INTRODUCTION

South East Asian waters, especially those situated in the world coral triangle areas (CT), where Indonesia is right in the middle of it, is known to be rich in marine biodiversity. Indonesia is therefore often referred to as the world marine mega-biodiversity and Amazon of the Ocean (Anonymous, 2017). This area is, however, experiencing very high pressure from waste pollution which can cause habitat disruption and can lead to the decrease in marine biodiversity and even extinction, as well as environmental damage and the decrease in quantity of marine and coastal resource. The condition of the waters which full of debris, especially of plastic waste, can be found in several area of the CT in

Indonesia waters such as in Bali, Kupang, Ternate and Manado. The same condition is also found in another CT region outside Indonesia (for example, Papua New Guinea) (Lasut et al., 2018; Naatonis, 2010; Wardi, 2011; Smith, 2012; Siregar, 2014; Sahil et al., 2016).

A study in 2019 (Lasut et al., 2019) which was conducted in northern part of Sulawesi showed that nine types of material of marine debris (based on classification from UNEP/IOC [Cheshire et al., 2009]) were found in Manado Bay (MB), which was dominated by plastic waste (> 30%). The amount of debris has increased significantly since 2017. This may relate to the situation and condition on mainland city of Manado (Lasut et al., 2020; Kumurur et al., 2023), especially aspects of waste management on

land (Liu et al., 2013). The condition of marine debris could have a negative impact on marine ecosystem of MB.

Several impact of marine debris in MB has been reported. In 2011, Green Eye Project Aquamarine Fukushima Japan found large pieces of plastic material in the waters around MB; and then there was a discovery of pieces of plastic materials inside the living fossil, *Latimeria menadoensis* (Lasut et al., 2018). This can be a big loss for the local community because fishery resources from MB can be disrupted. Because of the impact mentioned above, efforts in preventing waste to enter MB is very urgent. This can become an important part of marine debris management activities, especially in order to support Indonesian government commitment in reducing plastic debris by 70% by 2025 (Anonymous, 2017; GRI, 2017).

In solving the problem of plastic debris in MB, which is carried out to protect the marine ecosystem of Bunaken National Park, strategic action for management is needed. This strategic action should be prepared based on a comprehensive and holistic study, and it has to be effective and efficient as well as suitable for Manado City condition. That strategic action in waste management in question does not yet exist. This is the main problem to be answered in this study. In order to develop that strategic actions, Lasut (Lasut, 2007; 2020) suggested that basic information such as status, impact, community environmental awareness, institutional governance on management system, including the implementation of the latest management, should be analyzed in detail to produce a suitable strategic plan which can be implemented.

MATERIALS AND METHODS

Seven aspects regarding current situation and condition of marine debris management in MB were described. These aspects include the composition and density of coastal waste, the amount of coastal waste, waste management on land, status of public awareness, the impact and degradation of marine debris in nature, institutional governance, and planning and management activities on marine debris. In addition, the strengths and weaknesses of of waste management were also analyzed.

Data on the composition, density and the amount of coastal waste were obtained from a study conducted in 2019 (Lasut et al., 2019). Data on waste management, the status of public awareness, the impact and degradation of marine debris in nature, institutional governance, and and planning and

management activities on marine debris were obtained from the research in 2020 (Lasut et al., 2020).

RESULTS AND DISCUSSIONS

Description of situation and condition of marine debris in Manado Bay

It was found that the composition of marine debris in MB consist of nine types of materials, namely plastic, foamed plastic, cloth, glass & ceramics, metal, paper & cardboard, rubber, wood, and other materials. The order of the most to the least dense type of materials were as the following: plastic, glass & ceramics, metals, other materials, cloths, rubber, foamed plastic, paper & cardboard, and wood (Lasut et al., 2019).

The weight of marine debris on Malalayang Beach is 2,603.59 g, while at Bailang/Molas Beach it is 14,500.08 g. The total weight of marine debris in MB is 17,103.67 g. The amount of marine debris on Malalayang Beach is 315.60 pieces, while on Bailang/Molas Beach there are 827.25 pieces. The total amount of marine debris in MB is 1,142.84 pieces (Lasut et al., 2019). Thus, the weight of marine debris found in MB increases every year; in 2017, it was 1,658.74 g, while in 2019, it was 17,103.67 g, an increase of more than 10 times (Lasut et al., 2019).

The status of marine debris management on land in Manado City is still poor, in other words, it has not been carried out properly. This was concluded from the previous research, which found that there was a high number of wastes in the rivers that cross Manado City. Those waste ended at MB. However, the environmental awareness of the community toward marine debris was on the level 'good' (Lasut et al., 2020).

Marine debris from the type of 'plastic' and 'foamed plastic' takes the longest to decompose in the sea. Other types of marine debris found in the waters of MB can be classified into nine types, namely: a) plastic, b) foamed plastic, c) cloth, d) glass & ceramics, e) metal, f) rubber, g) wood, h) paper & cardboard, and i) other materials (Lasut et al., 2019; Lasut et al., 2021).

In terms of managing plastic waste, it was adequately arranged by the institution of Manado City. Likewise, there are several non-governmental organizations in Manado that have shown a strong commitment in protecting the environment. The planning and management of marine debris in Manado have been carried out though regional regulation and actions programs (Lasut et al., 2020).

Current strengths and weaknesses of waste management in Manado City

Based on the description on the previous parts, an analysis was then carried out on the strengths and weaknesses regarding waste management in Manado in general, and on the existence of marine debris in particular. The strengths comprise:

- There is a good understanding (knowledge, concern, preference) regarding matters related to marine debris.
- The institution of Manado City government that responsible for managing plastic waste have been adequately laid out.
- There are some non-governmental organizations with strong commitments toward environmental protection in Manado City.
- Activities on waste planning and management, including marine debris, have been prepared, both through regulations and action programs.
- Policy concerning Manado City District-Based Waste Reduction and Management, in general, has been implemented.

The weaknesses comprise:

- Various types of marine debris have been found in MB.
- The composition and density of marine debris in MB were high.
- The amount (weight) of marine debris increases every year.
- Waste management on land has not been carried out properly.
- Rivers that flowing through Manado City to MB were filled with waste.

Plastic and foamed plastic which was dumped into MB were the type of debris that take the longest time to decompose in nature.

Strategic actions for waste management to address marine debris problem

In simple terms, the strategic actions for management was formulated based on the strengths and weaknesses analyzed. There are five strategic actions proposed to achieve good waste management to overcome the problem of marine debris in MB. They are as following:

- Encouraging the public to reduce the use of products made from plastic and foamed plastic.
- Involving the community and community organizations in waste management on land.
- Encouraging the community and community organizations in intensifying the activities such as cleaning the rivers and beaches, and other public areas.

- Inviting the community and community organization to develop action programs which can be implemented together.
- Improvising waste management according to regulation which include marine debris as a specific management target and in particular by including rivers and other water area in waste management.

CONCLUSION

To deal with marine debris problem in Manado City, five strategic actions for waste management are proposed here, namely a) encouraging people to reduce the use of products made from plastic and foamed plastic; b) involve the community and community institutions in waste management on land; c) Increasing community activities and community institutions to clean the environment, rivers and beaches; d) invite the community and community institutions to develop an action program, which will be implemented jointly as well; and e) improve in waste management according to the regulations which include marine debris in a special management target and include rivers and waters in waste management according to the regulations.

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