Mitigation approach in preventing environmental destruction continuity in Merauke Regency

R L Lekatompessy¹, E E Maturbongs¹, K Betaubun², Y E Teturan¹, W Jeujanan¹, and L Antonio¹

¹Department of Science State Administration, Faculty of Social and Political Sciences, Musamus University, Jalan Kamizaun Mopah Lama, Merauke, 99600. Indonesia.
²Department of Management, Faculty of Economic and Business, Musamus University, Jalan Kamizaun Mopah Lama, Merauke, 99600. Indonesia.

E-mail: ransta@unmus.ac.id

Abstract. Environmental problems are becoming a global problem today, ranging from environmental pollution, greenhouse gas effects, forest fires, landslides, to abrasion. The causes of this environmental problem are due to natural factors and human activities. Environmental damage caused by human activities and natural elements is disasters such as abrasion, landslide or high tide. This study aims to describe the approach of disaster mitigation implemented by the Government of Merauke Regency to prevent continuous environmental damage. This study used a literature study approach; data were obtained from observation and relevant literature sources. The results of the research show that in the effort to prevent continuous environmental damage, then the mitigation approach that has been implemented by the Government of Merauke Regency was building wave breaker, mangrove planting, making policies governing coastal sand mining and dissemination of information. That approach was intended so that the consequences of environmental damage that lead to abrasion and cause loss of shoreline, damage to public facilities and residences can be prevented as much as possible.

1. Introduction

Environmental problems are becoming a global problem today, both caused by climate and human negligence. Humans sometimes do not care about the balance and harmony of the environment in every activity. Human needs and desires that always strive to be fulfilled will surpass the ability of the environment to support the life. Activity such as excessive exploitation is the cause of disruption of balance and harmony of the environment. It is common for humans to engage in overexploitation driven by a motivation to seek material gain [1].

Nowadays, the most significant threat to human life is climate change. Climate change has the potential to increase the frequency of extreme events in different regions of the world [2]. The climate change impacts on various aspects of life such as health, agriculture, forestry, infrastructure and social life. Natural disasters that occur in the world which are almost 80% are the result of climate change [2].

Mitigation as an effort to reduce and prevent the risk of loss of life and property both through structural and non-structural approaches. Structural mitigation is an effort of disaster risk reduction through the physical construction and engineering of a disaster-resistant building, while non-structural
mitigation is a non-physical effort of disaster risk reduction such as policy, community empowerment, institutional strengthening, and awareness [3].

Merauke Regency based on the Indonesia Disaster Risk Index (IRBI) 2013 released by the National Agency for Disaster Management (BNPB), for multi-hazard assessment, Merauke Regency is included in a high-risk category with a value of 170 or ranked 169 in national and 4th in Papua Province after Jayapura City, Nabire Regency and Sarmi Regency. As for the assessment of each type of the threat, the disaster risk index in Merauke Regency is shown in table 1 [4].

| No | Type of Disaster | Score | Class of the Risk |
|----|------------------|-------|-------------------|
| 1  | Flood            | 36    | High              |
| 2  | Earthquake       | 11    | Medium            |
| 3  | Tsunami          | 8     | Medium            |
| 4  | Landslide        | 12    | Medium            |
| 5  | Extreme wave/abrasion | 18  | High              |
| 6  | Land and forest fire | 36  | High              |
| 7  | Extreme weather  | 14    | Medium            |
| 8  | Drought          | 36    | High              |

In 2016, BNPB reviewed the disaster risks throughout Indonesia, with the aim of providing information as a first step in identifying possible disaster risks, as well as a reference for policy planning and formulation. The results of a study of the Indonesia Disaster Risk (RBI) in 2016 that may arise because of a potential disaster in Merauke Regency are shown in table 2.

| No | Type of Disaster | Earthquake | Tsunami | Landslide | Flood | Forest Fire |
|----|------------------|-------------|---------|-----------|-------|-------------|
| 1  | Social (People)  | Low         | 216.394 | 1.624     | 45.205|             |
|    |                   | Medium      |         |           | 142.910|             |
|    |                   | High        |         |           | 24.652 |             |
| 2  | Physical (Rp Million) | Low |         |           |       | 2.795.799 |
|    |                   | Medium      |         |           |       |             |
|    |                   | High        |         |           |       |             |
| 3  | Economy (Rp Million) | Low  | 1.716.725| 2.066     |       |             |
|    |                   | Medium      |         |           | 257.172|             |
|    |                   | High        |         |           | 8.715  |             |
| 4  | Environment (Hectares) | Low |         |           |       |             |
|    |                   | Medium      | 1       | 518.652   | 597.639|             |
|    |                   | High        |         | 655.912   | 1.055.297|            |
A disaster risk study is an approach to show a potential negative impact that may arise from a potential disaster. The potential adverse effects in the table above illustrate the potential number of lives, property losses, and environmental damage that may occur in Merauke Regency. Based on the data above, the local government of Merauke Regency needs to build preparedness on the priority of threat of flood, drought, forest and land fire and extreme wave/abrasion. However, it needs to anticipate a rare threat still but can have a significant impact such as earthquakes and tsunamis [5]. Thus, the purpose of the study is to describe the approach of disaster mitigation conducted by the Government of Merauke Regency to prevent continuous environmental damage.

2. Methods
This research used a descriptive method with a literature study approach. Data were derived from observations and relevant literature sources. The type of data used was primary data by observation and secondary data obtained from journals, books, and documentation.

3. Results and Discussion
3.1. Potential Environmental Damage Related to Disaster Threat
Merauke Regency is geographically located between 1370-1410 East Longitude and 60 00’-9000 South Latitude, with boundaries as follows: (a) North: Boven Digoel Regency and Mappi Regency (b) East: Papua New Guinea (c) South: Arafura Sea (d) West: Arafura Sea. The area is 46.791,63 km2, mostly covered by lowland and swamp area with a total of the swamp area of 1.425.000 Ha and a high land area in some of the northern inland sub districts. This area is generally a low-lying land, having a slope of 0.8%, the coast is swampy and waterlogged, the North and East areas are quite high/bumpy with a bit of hilly. The height of tides are 5-7 m, the high tide enters as far as 50-60 km and some places are intruded by salt water/seawater [6].

Static natural conditions such as geographic, topographic and geometry of the river flow are the cause of a flood. The geographical and topographical state of Merauke Regency which is a low-lying land and swampy is one of the reasons for the flood in Merauke Regency. Besides the dynamic natural events such as rainfall that reaches 1.558,7 mm. The available data shows the difference in the amount of annual precipitation between the southern and northern Merauke regions. In general, there is an increase in annual rainfall in South Merauke area of (1000-1500 mm) in Muting sub district, the amount of the precipitation of 1500-2000 mm/year is in Okaha sub district and some parts of the Muting sub district, and for the rest, the rainfall is higher toward the north area. The difference also applies to the number of wet months that is in the north area; the wet period is very long while in the south, the wet period is relatively short. The long rainy season is an obstacle to the condition of the dirt roads that are damaged every year [6].

On the other hand, a long dry season causes drought. Drought as a complex disaster and characterized by a prolonged water shortage [7]. Drought is one type of natural disaster that occurs slowly (slow onset) with the duration up to the rainy season arrived and had a very wide impact. The consequences of this disaster are a water shortage, ecological resource damage, reducing agricultural production as well as starvation and loss of life [8]. Merauke as a national food barn, drought threats give impact on the decreasing of farmer’s harvest, due to lack of water to irrigate the rice field, besides it is difficult to get clean water for society.

Forest fires often occur during the dry season in some parts of Indonesia, depending on the level of drought in the region. Merauke with a long dry season and a savannah area, becomes prone to forest fires, either due to human negligence or El Nino climate phenomenon. The impacts of forest fires in Merauke are not as severe as Sumatra and Kalimantan but still affect the visibility, disrupt the respiratory system and destroy the existing biodiversity in the forest. The forests and the current biodiversity shall be preserved and not converted to be an inheritance for the future generations.

The threat of abrasion is as a process of coastal erosion caused by destructive ocean waves and ocean currents. The Abrasion or in other words, it is called coastal erosion. Damage to the shoreline is due to
the disruption of the natural balance of the coastal area [9]. Abrasion can occur due to natural and human factors. Natural factor that is the wind that moves at sea causes the current and the wave leading to the beach so that if this process lasts long, it will erode the coast. The type of soil in the coastal river in Merauke Regency has a high level of water permeability, so it is sensitive to erosion. While on the coast, the erosion/abrasion occurs due to the strong currents of ocean waves and no barrier/retaining wall or buffer zone of the beach which is usually a mangrove forest [6].

The human factor to the risk of abrasion is the sand mining that causes the depletion of the sea sand which affects the direction and velocity of ocean currents that will hit the coast [9]. Merauke Regency has mineral and non-metallic rock potential in the coastal sand which provides opportunities for people to mine. The management of coastal sand mining that has been going for so long is the people’s mining because of the local communities themselves who do the drilling using simple tools such as shovels and hoes. The coastal sand mining activities carried out by local people for their long-term lives, from field assessments, various physical damage along with coastal areas, especially in Ndalir, Payum and Bina Loka Desa can be seen.

This activity is generally done in the mangrove ecosystem so that resulting in the abundance of mangrove trees that are cut down and causing damage and decline in the natural function of mangrove forests Mangrove destruction at Payum beach is caused by the activity of the community as a sand miner and utilizing the wood of mangrove as building material [10]. The benefits derived from coastal sand mining are increasing the income of the miners’ groups, giving a contribution to the tax revenue of Class C materials and facilitating the development of the existing infrastructure. However, the negative impacts of these activities are the damage to mangrove forests along the coast, coastal abrasion, decrease of numbers of fish caught and income of fisherman, logged of the residence near the beach by sea water and damage to roads and bridges [11].

Based on the data calculation of the disaster threat and risk in table 1 and table 2 above that is likely to occur, extreme waves and abrasion in Merauke Regency are virtually excluded as a potential disaster with the highest index, which can be threatening at any time. However, based on the results of field observations, data and research results that have been done, the threat of extreme waves and abrasion is one of the grave danger and deserves attention from the government, society and private parties.

![Figure 1. Abrasion at Buti Beach](image)

3.2. Approach of Prevention-Mitigation of Continuous Environmental Damage

In the discussion of the potential damage related to the threat of disaster occurring in Merauke Regency, it can be concluded that it is physically caused by the physiographic condition and human negligence factor. The follow up of the Government of Merauke Regency to the threats that can occur is with the Mitigation approach. Disaster mitigation as a series of disaster mitigation efforts, both through physical development or giving awareness and improving the ability to cope with disaster [12]. The efforts of the local government in disaster risk reduction through the physical and technical development of coastal areas become very important. The importance of these efforts is because, Merauke has a long shoreline of 1.050 km2, extending from the Torasi River in the border of the Republic of Indonesia and Papua New Guinea, eastward to the Syrest River [13]. The mitigation approaches conducted are:
3.2.1. **Breakwater Development.** Breakwaters are infrastructures built to break the waves of seawater by absorbing some wave energy. The breakwater serves to control the abrasion that erodes the shore. Overcoming the flood vulnerability and coastal abrasion that occurred in Merauke Regency, the government through technical institutions builds sea breakwaters off the Lampu Satu beach. This building serves to protect the shore that is located behind it from wave attacks that can lead to coastal erosion. Protection by offshore breakwaters occurs due to the reduced wave energy reaching the waterlogged area behind the building.

![Figure 2. Breakwater](image)

3.2.2. **Management of Mangrove Ecosystems.** The management of the mangrove ecosystem in Merauke Regency is carried out by considering the basic principles of mangrove resources such as 1) Protecting ecological processes and life support. The role of mangrove forests in the continuity of ecological processes and life support systems of marine biota, like filters and decomposers of organic matter coming from the land, is as windbreaks and breakwater; 2) Preservation of diversity of germplasm sources. Mangrove forest whose position as a land and sea connector is a place where a plant or animal lives that is a source of germplasm 3) Sustainable utilization of species and ecosystems that is by controlling the method of use so that achieving optimal and sustainable benefits.

Based on the result of analysis on Mangrove Forest in Merauke Regency, then the development of Mangrove area is as follows:

- **a)** Prohibiting the deforestation of mangrove forests including ban the utilization of mangrove wood to be used as raw material of any activity with criteria of mangrove protected area set at a distance of at least 130 times the average value of the highest and lowest tide difference in a year measured from the lowest low tide line towards the land.
- **b)** Rehabilitation of mangrove forest areas that are damaged and have been designated as conservation forest areas, especially in coastal areas prone to erosion, such as in Okaba and Naukenjerai District.
- **c)** Identify the tourism potential of mangrove forest [6].

![Figure 3. Mangrove Ecosystem Development](image)
3.2.3 Policy on Sand Mining. Non-structural mitigation is done through policies that govern the disaster risk reduction. The consideration of sand mining management has economic value so that its utilization is expected to provide prosperity for the whole society, as well as sustainable and environmentally friendly, then the Government of Merauke Regency regulate it through Regent Regulation No. 14 the Year 2011 concerning Management of Non-Metallic Minerals and Stone Mining Business [14]. This policy governs the licensing of non-metal mineral and rock mining business actors in this case including the sand miners. But in the implementation, it has not shown a positive result.

3.2.4 Dissemination of Information. Dissemination of information is a form of non-structural mitigation by disseminating information about the government efforts to reduce the impact of the disaster. The obligation of information dissemination shall be carried out by the local government. Regional information is provided explicitly in Chapter XXII of Law Number 23 the Year 2014 concerning Regional Government, in article 391 concerning geographical information, it is mentioned that regional development information and regional financial information shall be published to the public [15]. Mass media as an essential element in the process of mass communication is one of the agents of socialization to the policy as well as development programs implemented by the government. The role of mass media to the community in socializing the awareness in maintaining and preserving the surrounding environment, and reducing the risk of disaster has also been done by the Government of Merauke Regency. Through printed media such as newspapers, Radio Republik Indonesia (RRI) electronic media in Merauke and Local Television Broadcasting, the government tries to raise the public awareness to maintain and preserve the coastal areas.

4. Conclusions

Based on field observations, documents and referring to the results of previous research, the threat of high-risk disaster was coastal abrasion because the shoreline was increasingly jutting toward land near the residences and damage road infrastructure. The government implemented a mitigation approach as an effort to prevent the continuous environmental damage and the threats of extreme waves/abrasion, such as the construction of breakwaters, management of mangrove ecosystems, policies related to sand mining and dissemination of information. A synergy between communities, government and private parties in coastal area management are needed to prevent continuous disaster due to the environmental damage so that environmental sustainability can be well preserved and minimize disaster risk.

Acknowledgments

Acknowledgment presented to a) Rector of Musamus University which gives chance and support to this article to be completed; b) The Committee of 1st International Conference on Global Issue for Infrastructure, Environment & Socio-Economic Development (GIESED 2018) hold the conference. Therefore this article has been presented.

References

[1] Kutangegara P M 2014 Membangun Masyarakat Indonesia Peduli Lingkungan (Yogyakarta: Gadjah Mada University Press).
[2] Badan Perencanaan Pembangunan Nasional (BAPPENAS) 2014 Rencana Aksi Nasional Adaptasi Perubahan Iklim (RAN-API) (Jakarta: Kementerian Perencanaan Pembangunan Nasional).
[3] Sultonulhuda, Herdiansyah H, Chrisandini 2013 Panduan Pelatihan Adaptasi Perubahan Iklim dan Pengurangan Risiko Bencana (Jakarta: Dewan Nasional Perubahan Iklim).
[4] Dewi I K and Istiadi Y 2016 Mitigasi bencana pada masyarakat tradisional dalam menghadapi perubahan iklim di Kampung Naga Kecamatan Salawu Kabupaten Tasikmalaya J. Manusia dan Lingk. 23 129-135.
[5] Kementerian Kesehatan RI 2017. Profil Penanggulangan Krisis Kesehatan Kabupaten/Kota Rawan Bencana Kabupaten Merauke (Jakarta: Pusat Krisis Kesehatan Kementerian
Kesehatan RI).

[6] Badan Nasional Penanggulangan Bencana (BNPB) 2016 *Risiko Bencana Indonesia* (Jakarta: Badan Nasional Penanggulangan Bencana).

[7] Kelompok Kerja (Pokja) Teknis Inisiatif Pembangunan Rendah Emisi (Poka TIPRE) Kabupaten Merauke 2017 *Strategi Perencanaan Tata Guna Lahan Mendukung Pembangunan Rendah Emisi Kabupaten Merauke, Kab. Merauke, Provinsi Papua* In: Johana F, Zein B, Isnurdiansyah, Suyanto, eds. (Merauke, Indonesia: Pokja TIPRE Kabupaten Merauke).

[8] Ghulam A, Qin Q, Teyip T, and Li Z L 2007 Modified Perpendicular Drought Index (MPDI): a real-time drought monitoring method *ISPRS J. Photogram. & Remote Sens.* 62 150-164.

[9] Kogan F N 1997 Global drought watch from space *Bull. the Am. Meteorol. Soc.* 78 621-636.

[10] Badan Perencanaan Pembangunan Nasional (BAPPENAS) 2014 *Buku Putih Sanitasi Kabupaten Merauke* (Merauke: Pokja Sanitasi Kabupaten Merauke 2014).

[11] Masiyah S, and Monika N 2017 Analisis ekologi mangrove sebagai dasar rehabilitasi di Pesisir Arafura Samkai Distrik Merauke Kabupaten Merauke Provinsi Papua *J. Ilmiah Agribis. dan Perik.* 10 29-35.

[12] Arisandi M H, Surbakti S B, and Nurhasanah 2014 Eksternalitas penambangan pasir pantai secara tradisional terhadap ekosistem mangrove dan sosial ekonomi masyarakat pesisir di Kabupaten Merauke *J. Manaj. Perik. dan Kel.* 1 1-10.

[13] Badan Nasional Penanggulangan Bencana (BNPB) 2008 *Government Regulation Number 21 Year 2008 concerning Disaster Management Implementation* (Jakarta: BNPB).

[14] Merauke Regency Central Bureau of Statistics 2011 *Merauke Regency in Figures* (Merauke: BPS).

[15] Merauke Municipal Government 2011 *Regent Regulation of Merauke Regency Number 14 Year 2011 concerning Management of Non-Metallic Minerals and Stone Mining Business* (Merauke: Merauke Regency Government Office).