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ASSESSING MANDEH REGION AS THE CENTER OF MARINE ECOTOURISM IN WEST SUMATRA PROVINCE, INDONESIA: MASS TOURISM ISSUE AND VULNERABILITY ASPECTS

Ulung J. Wisna^{1,2)}, Try Al Tanto¹⁾, Nia Naelul Hasanah Ridwan¹⁾, Guntur A. Rahmawan^{1,3)},
Ruzana Dhiauddin¹⁾, Koko Ondara¹⁾, & Wisnu A. Gemilang¹⁾

¹⁾Research Institute for Coastal Resources and Vulnerability, Ministry of Marine Affairs and Fisheries, Indonesia

²⁾Physical Oceanography Laboratory, Faculty of Science, University of the Ryukyus, Japan

³⁾Department of Water and Coastal Resources Management, Bung Hatta University, Indonesia
Jl. Raya Padang-Painan KM 16, Komp. PPS Bungus, Padang 25245 Indonesia

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ABSTRACT

Nowadays, Mandeh Region has developed significantly as the center of marine ecotourism in West Sumatra Province. Many local and international tourists were visiting this site. Due to those conditions, many threats emerged, such as mass tourism evoking damages and pollutions. This study aimed to examine the feasibility of the Mandeh Region for tourism activity and identify the impacts of mass tourism. A direct survey has been conducted. We assessed water quality, accessibility, and social conflicts using a scoring method. A modified matrix categorizing some parameters as the underlying data for marine tourism sustainability was used. We also developed Smartline and CVI model to assess the vulnerability level along Mandeh coastal bay. Local zonation was recommended to reduce more environmental damages. We examined the feasibility of the Mandeh region as a place for ecotourism that reached 72.46 %, indicating this area is sufficiently feasible. The absence of local regulations before the Mandeh Region was established as the center of marine ecotourism resulted in mass tourism phenomena that elevated marine litter accumulation. Moreover, many resorts near the coast have recently played a role in triggering pollution and damage. Advanced regulation and management are necessary to diminish negative impacts on both the environment and society.

Keywords : Marine ecotourism, Mandeh region, mass tourism, environmental damages.

INTRODUCTION

Pesisir Selatan Regency is one of the westernmost coastline cities in Sumatra. This region has been famous recently because of its successful ecotourism development (Mukhtar *et al.*, 2016). Mandeh is the area of significance in the Pesisir Selatan Regency. Many natural attractions exist, such as marine ecotourism, cultural heritages, diving sites, and the magnificent view from the hilly slopes (Gemilang *et al.*, 2020). However, this region is also vulnerable to earthquakes, landslides, and other coastal hazards because it is positioned between the subduction zone and mountainous area and directly bordered by the Indian Ocean (Santoso *et al.*, 2011).

“The paradise in the south” is an epithet given for Mandeh coastal bay, well-known for its underwater beauty. Nowadays, this region has become the center for marine and fisheries activities. Marine and heritage ecotourism is the main program promoted by the local and central government. The successful development of tourism in the Mandeh region has made this area free from the title of the most impoverished region in West Sumatra. However, this status is not gone well; many impacts on the environment and social issues are currently revealed (Dillenia & Arief Troa, 2016).

Due to the substantial potency of the Mandeh region as a tourism area, land dispute problems occurred. Locals also reported that the accumulation of coastal debris in the tourism area increased significantly. Pressures to the coastal area also commenced raising the vulnerability level within the vital area. Ecosystem damages such as regional coral bleaching, water quality degradation, algal blooming, etc., have taken place within Mandeh coastal bay due to mass tourism and rapid urban development. Moreover, the presence of many new resorts along the Mandeh coastline contributes to dramatic land-use change. Nowadays, the complex issue faced by local government is how to control mass tourism and diminish the environmental problems (Holladay *et al.*, 2018).

An assessment of the ecotourism aspect is essential to create a possible solution recommended to the local and central government. The mass tourism issue must be overcome and the vulnerability aspect in the tourism area. A previous study (Syam, 2017) arranged the strategy to organize mass tourism and reduce ecological damage. Also, (Gemilang *et al.*, 2020) defined that Mandeh Bay is moderately prone to coastal hazards, and the tourism area needs to be managed for sustainable environmental resilience. In contrast, this study will reveal the feasibility level of Mandeh coastal bay as the center of the ecotourism region in West Sumatra through scoring and spatial

method. In this study, we assessed the feasibility of marine tourism by modifying the matrix of the marine tourism feasibility index previously developed by Tanto *et al.* (2017) and Arlius *et al.* (2017). Moreover, GIS-based approaches are also used to support the impact of mass tourism in the Mandeh Region. Thus, this study aims to assess the vulnerability level and the feasibility of the Mandeh tourism area and initiate future policy and management to overcome the environmental issue.

METHODOLOGY

Study Site

Administratively, Mandeh Region is located around Carocok Village, Koto IX Tarusan Sub-District, Pesisir Selatan Regency. The development in tourism in Mandeh had directed as the object of marine ecotourism since 2002. The increase in urban development and the number of tourists occurred after establishing this area as the national tourism region. During the last five years, especially in 2013-2014, the increase in the frequency and the number of tourists in the Mandeh Region occurred. It was dominated by the domestic tourist of 80 % and 5% for the international visitor (Mukhtar *et al.*, 2016).

Socio-economically, most of the society in Mandeh Bay are fishers. Marine and fisheries potencies are significant, but only 35% have been exploited. Capture fisheries production reached approximately 25,575.21 tons in 2008, with the number of fishers around 18,775 people. The aquaculture sector is also productive, with around 103.6 tons within 1,792 hectares area (Wisha *et al.*, 2018).

The area of the coral reef ecosystem is approximately 521.57 hectares scattered along the coastal region. Unfortunately, around 85.25 % of the coral reef ecosystem has been damaged. The dense coral cover is found in Cingkuak and Penyul Island. Mangrove forest area reaching 622.82 hectares is scattered in all protected coastal regions. The highest mangrove cover is located in Koto Xi Tarusan Sub-District with around 37.3 % (Wisha *et al.*, 2018).

Mandeh Bay is included in the area prone to hazards and disasters in the form of earthquakes, floods, landslides, wave overtopping, and tsunami (Hermon, 2016). It is induced by this region's strategic position, which is positioned within the confluence of continental plates. The land-use changes have contributed to raising the vulnerability level of Mandeh coastal bay. So far, coastal hazards have become obstacles in the regional development efforts for elevating public welfare.

With the increase of tourism visits, the local

government has promoted many underwater tourism objects such as the iconic MV Boelongan Netherland shipwreck, well-known as the most visited diving site in Mandeh Bay. In 2008, it was recorded that as many as 88,458 tourists visited the Mandeh ecotourism area with around 201 people from overseas, and the rest 88,257 people were domestic. The increase rate in the tourism sector is 16 % per year. (Wisha *et al.*, 2018).

The Assessment of Marine Ecotourism

As mentioned above, the icon in Mandeh Bay is the MV Boelongan Shipwreck site. In this case, we will assess the feasibility of this site as a diving site using a matrix to evaluate the ecotourism parameters shown in Table 1, and the supporting parameter is shown in Table 2.

To complete the data above, we conducted a field survey in 2019, including a water quality and oceanography survey, site diving using SCUBA, distributing a questioner, and collecting secondary data from the local government, such as the number of tourist visits in Mandeh Region. We assessed the four main sites within Mandeh bay (MV Boelongan Shipwreck Site, Sironjong Island, Sutan Island, and Cubadak Island).

Spatial Analysis; Land-use Changes, Regional Zonation, And Coastal Vulnerability Index

We analyzed the land-use changes by comparing two different periods of a satellite image. We can identify the influence of rapid urban development on

Table 1. Feasibility matrix of marine ecotourism

Parameter	unit	Score	Feasibility Criteria			
			S1(5)	S2(3)	S3(1)	N(0)
The 1st category (70 %)						
Water Visibility	meter	5	>10	>5-10	3-5	<3
Tourism Object Condition	-	5	Very good	Good	Poor	Very Poor
The depth of the tourism object (If any)	meter	3	5-15	>15-20 & >4-5	>20-30 & 3-4	>30 & <3
The 2nd category (30%)						
Current Speed	cm/s	5	0-15	>15-30	>30-50	>50
pH	-	4	7-8	6.1-6.9 & 8.1-8.5	5.1-6 & 8.6-9	<5 & >9
Salinity	o/oo	4	33-34	31-<33 & >34-35	30-<31 & >35-36	<30 & >36
Temperature	oC	4	26-28	>22-<26 & >28-30	18-22 & >30-33	<18 & >33
COD	mg/L	2	<10	>10-15	>15-25	>25

Source: (Tanto et al., 2017) & (Arlius et al., 2017) modified by authors

Table 2. FeSupporting parameters for ecotourism

Parameter	unit	Score	Feasibility Criteria			
			S1(5)	S2(3)	S3(1)	N(0)
Accessibility	-	5	easy	moderate	arduous	Very arduous
Land-use conflict	-	4	Never	sometimes	often	Very often
Security	-	3	Safe	Less safe	Very less safe	Not safe
The Distance from City Center	-	1	Close	Moderately close	Far	Very Far

Information:

- S1 Category : Very feasible with the score of 75-100 %
- S2 Category : Moderately feasible with the score of 50-75 %
- S3 Category : Conditionally feasible with the score of 25-50 %
- N Category : Not feasible with the score of <25%

altering the land use in Mandeh Bay from this stage. The local government reported that a lot of resorts had been built along the coastline illegally. Because of the indigenous customary law, government regulation seems unpowerful enough to slay the illegal resort in Mandeh Bay. Thus, we mapped the coastal utilization and potential zone. Those maps consist of spatial coral mapping analyzed using the Lyzenga method (Lubis *et al.*, 2018) and Landsat 8 OLI digitations.

As we mentioned in the introduction, Mandeh Region is prone to coastal hazards. Due to this condition, A survey assessing the vulnerability level in the coastal area of Mandeh is crucial, knowing that Mandeh is a vital area. We used a Smartline method (Sharples *et al.*, 2009), considering several significant parameters determining the vulnerability level as follow:

- Indicative mapping determines the geological condition as a fundamental factor.
- The regional assessment examines the geomorphic integrated beaches to vulnerability variables such as climate conditions, sea waves, tidal range, and vertical tectonic movements.
- Site-specific assessment to identify geological, geomorphic, topographic, oceanographic, and climate factors predisposing the coastal system.
- Social vulnerability and risk assessment to determine the socio-economic condition.

From the analyzed parameters above, we used a scoring method to classify the vulnerability criteria. Score 1 represents the deficient category, and rating 5 represents a very high category. Moreover, we also employed a CVI (Coastal Vulnerability Index) method (Dhiauddin *et al.*, 2019; Gemilang *et al.*, 2020; Gornitz *et al.*, 1992) with the formula as follow:

$$CVI = \sqrt[n]{X1 * X2 * X3 * X4 * \dots * Xn} \dots\dots\dots 1)$$

where,
 x : the score of every parameter assessed,
 n : the number of parameters employed in this study.

RESULTS AND DISCUSSION

Feasibility of Mandeh Coastal Bay for Ecotourism Interest

Table 3 shows the result of the feasibility assessment in Mandeh Coastal Bay. Overall, Mandeh bay is sufficiently feasible as the ecotourism center with the S2 category (72.46 %) for all the observed stations. At station 1 (MV Boelongan Netherland shipwreck site), the condition of the tourism object is excellent and accessible for beginner divers, but the visibility is sufficiently turbid during ebb tides. At station 2 (Sironjong Island), the tourism object's condition is quite attractive, which everyone can access. Still, we scored lower because of its fewer visits by the tourist (not properly managed). Sutan Island (station 3) is the most visited island; the attraction of the underwater view is breathtaking. Unfortunately, this island is over-explored, mass tourism commenced to pollute the surrounding area, and the accumulation of marine debris emerged, which is why we score lower for category 2. The last station is located on Cubadak Island. It is the first island successfully developed by foreign investors. The tourism object condition is quite good and can be accessed by everyone, but the marine debris issue exists in this area because of mass tourism.

To conclude, Mandeh coastal bay is moderately feasible for espousing ecotourism activities. Several problems like mass tourism-induced marine debris accumulation and pollution, the rapid urban development (the presence of many resorts in the coastal area), and many other properties are caused by a lack of regulation to manage the ecotourism area. Limitation of the number of tourist visits is crucial to be implemented so that the pressure of mass tourism to the objects can be diminished.

Like the ecotourism parameters, the assessment of the supporting parameter resulted in moderate feasibility for espousing ecotourism. All sampled areas are easily accessed due to shortcut crossroad Padang-Mandeh, reducing the distance and travel time. However, the hilly track sometimes becomes an obstacle causing slips and accidents. Water transportation such as a boat for tourists is also available with a travel package or by request. On the other hand, the land-use issue

Table 3. FeSupporting parameters for ecotourism

Ecotourism Object	Shipwreck site	Sironjong Island	Sutan Island	Cubadak Island
Category I (%)	52.77	42	52.97	42
Category II (%)	25.33	22.93	22.63	24.23
Feasibility level	S2	S2	S2	S2
The Average of Feasibility Level (%)				72.46

seems like pressure on the environment, as Wisna *et al.* (2021) reported. In terms of security, to date, no overwhelming criminality issues written by locals.

Marine and Land Debris Issue

As mentioned in the last sub-section, rapid urban development and mass tourism problems in Mandeh Bay is the increase of tourist waste within the eco-tourism area. This issue is crucial because it can hamper the biota survival ability and exacerbate the environmental quality (Alexandrakis *et al.*, 2015).

The existence of many resorts along the coast of Mandeh contributes to induce coastal pollution and damages. Locals reported the regional coral bleaching in Manjuto Beach in 2019 (Wisna *et al.*, 2021). The coral bleaching event uncommonly happened whereby the anomaly in salinity and pH was identified. It is predicted as a role of the increase in household waste. Several coral habitats were also demised due to the construction of the traditional quay-connected resort and the shortcut railroad connecting Padang City and Pesisir Selatan Regency.

In 2015, a domestic tourist captured a photo showing the severity of waste disposal in the Top View of Mandeh (Figure 1). In that year, the visits to local and overseas tourists reached their peak level (Figure 2). Over five years (2010-2015), the number of visits to Mandeh Bay gradually increased, started to decline in 2016, and tended to elevate in 2017. While in 2018, the number of tourism visits declined significantly, with around 30 % subtraction.

In 2018, one local online news reported that the concentration of marine debris commenced increasing, dominated by plastic debris (Figure 3). This condition indicates that the local accumulation of marine debris resulting from household waste is tremendously alarming. This reality is not only the responsibility of the local and central government but also everybody's responsibility. The increase of marine debris is undoubtedly avoided when the rapid urban development and mass tourism phenomena occur. On the other hand, the role of local government in the form of advanced regulation to curtail the number of tourism visits is necessary. The implementation of

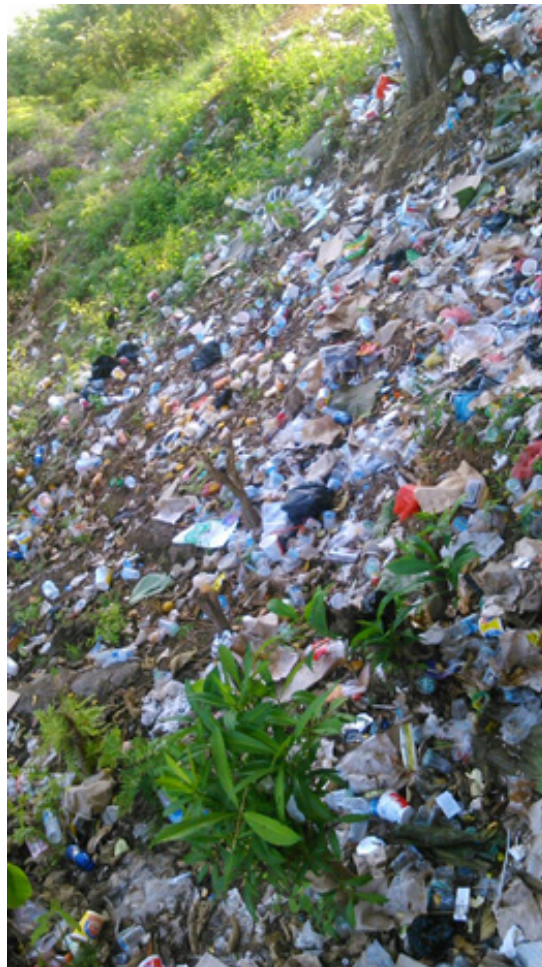


Figure 1. The evidence of tourist debris in the Top View of Mandeh.
Source: Courtesy Asep Wijaya, 2015.

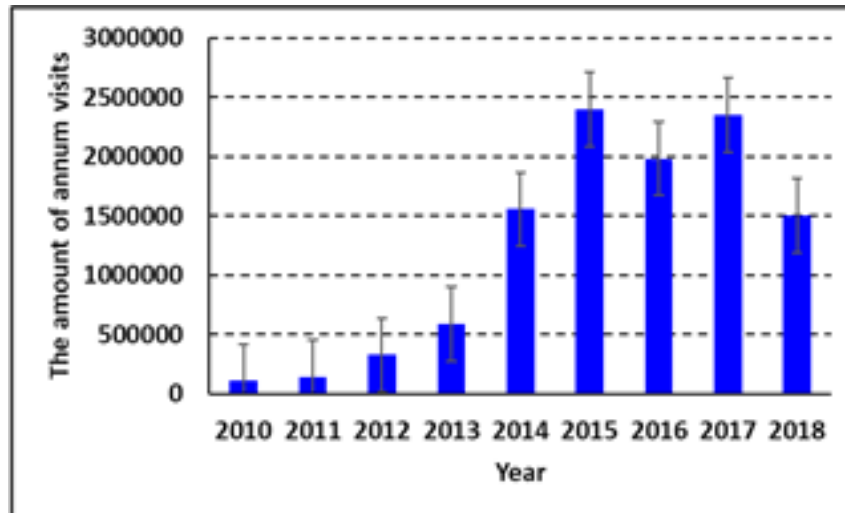


Figure 2. The amount of tourist visits in Mandeh Region.
Source: Department of Tourism, Creative Economy, Youth, and Sports, Pesisir Selatan Regency, 2018.



Figure 3. The plastic debris within Mandeh Bay collected by locals.
Source: Courtesy Antara News, 2018

local management is too late, resulting in social and environmental problems.

Local Zonation and Land-use Changes

We categorized the utilization zone into three main zones: settlement area, aquaculture, and tourism zone (Figure 4). It shows that the land-use change in Mandeh Region is taking place. The opposite condition is found in Cubadak Island, whereby the settlement is not rapidly developed. We can consider that Mandeh Bay is a perfect place for aquaculture because it is a semi-enclosed bay where the ocean dynamics tend to be weak (Rahmawan *et al.*, 2020). Several fish cages were erected within the bay to boost aquaculture

productions.

Land-use changes mainly occurred in the Mandeh Village. Moreover, the rapid development took place when the connecting road Padang-Pesisir Selatan was opened for the public. Several points have pinned in Figure 5 shows that many areas had been altered. From Sungai Pinang up to Mandeh Village, there are many new constructions in tourism interests. During the process of development, locals reported that this activity was damaging forests and ecosystems as well.

Besides, the zonation system can divide areas according to its function; it is essential to reduce the

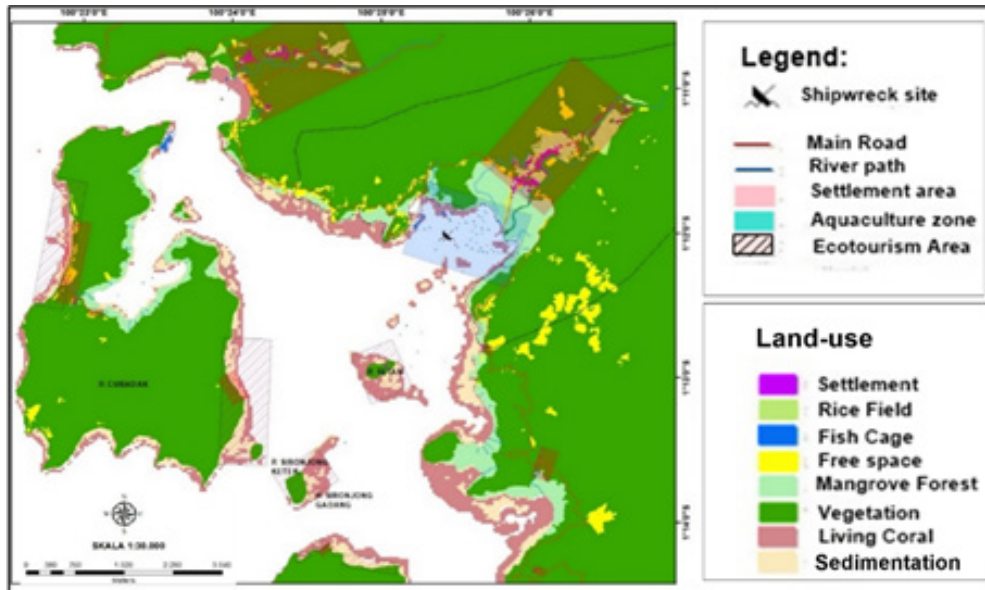


Figure 4. The map of Utilization and Potential Zone within Mandeh Bay

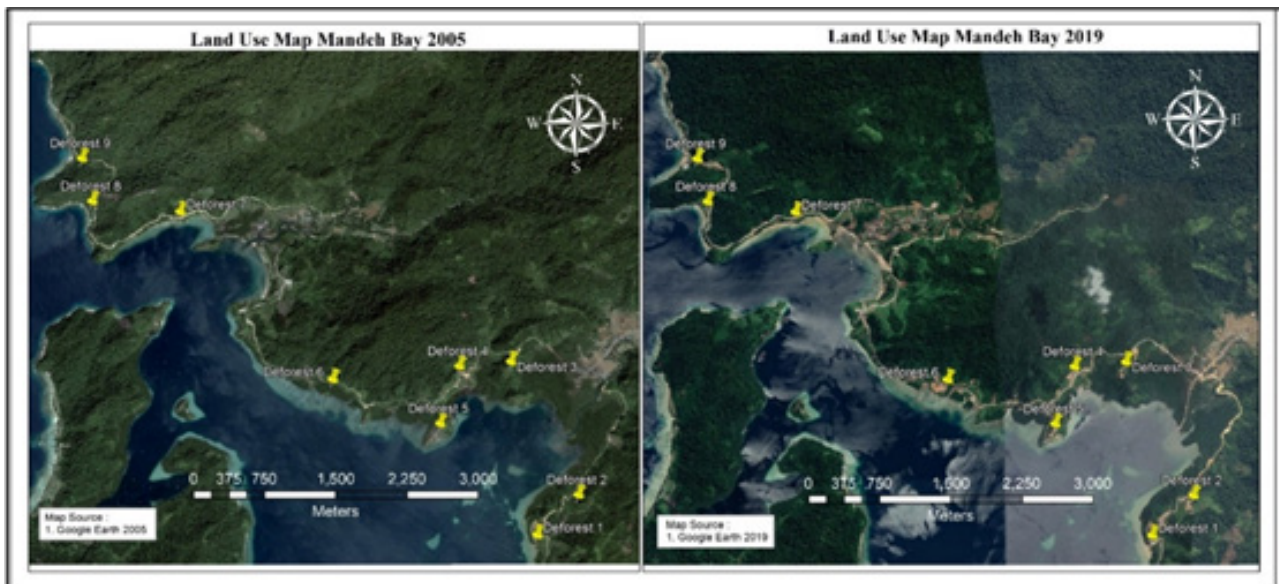


Figure 5. Point of land-use changes over 14 years in Mandeh Region.

pressure on tourism objects and the environment. Regulation and management in local zonation need to be well-implemented in the Mandeh region. The MV Boelongan shipwreck is a fragile underwater object (Dillenia & Troa, 2016). Successive damages might threaten this site in the form of over-capacity diver diving in the surrounding shipwreck. If the local government cannot manage this underwater heritage, we will not see the whole shipwreck in the future.

The transformation of mangrove forests in Mandeh Bay takes place, resulting in erosion in several sites. The unstable coastal features are caused by the absence of vegetation so that the natural protection in a coastal area is being vanished (van Wesenbeeck *et*

al., 2015). This condition is dangerous for the coastal community. As mentioned above, the Pesisir Selatan Regency is prone to hazards and disasters that might be destructively damaging the settlement and tourism area within Mandeh Bay.

Even though the development in the tourism area is suitable for the investment and economy sector, the significant land-use change in Mandeh Region is believed to induce other new problems such as land disputes, dumping waste accumulation, ecosystem damages, etc.

Coastal Vulnerability Model Assesment

From the survey assessing some physical

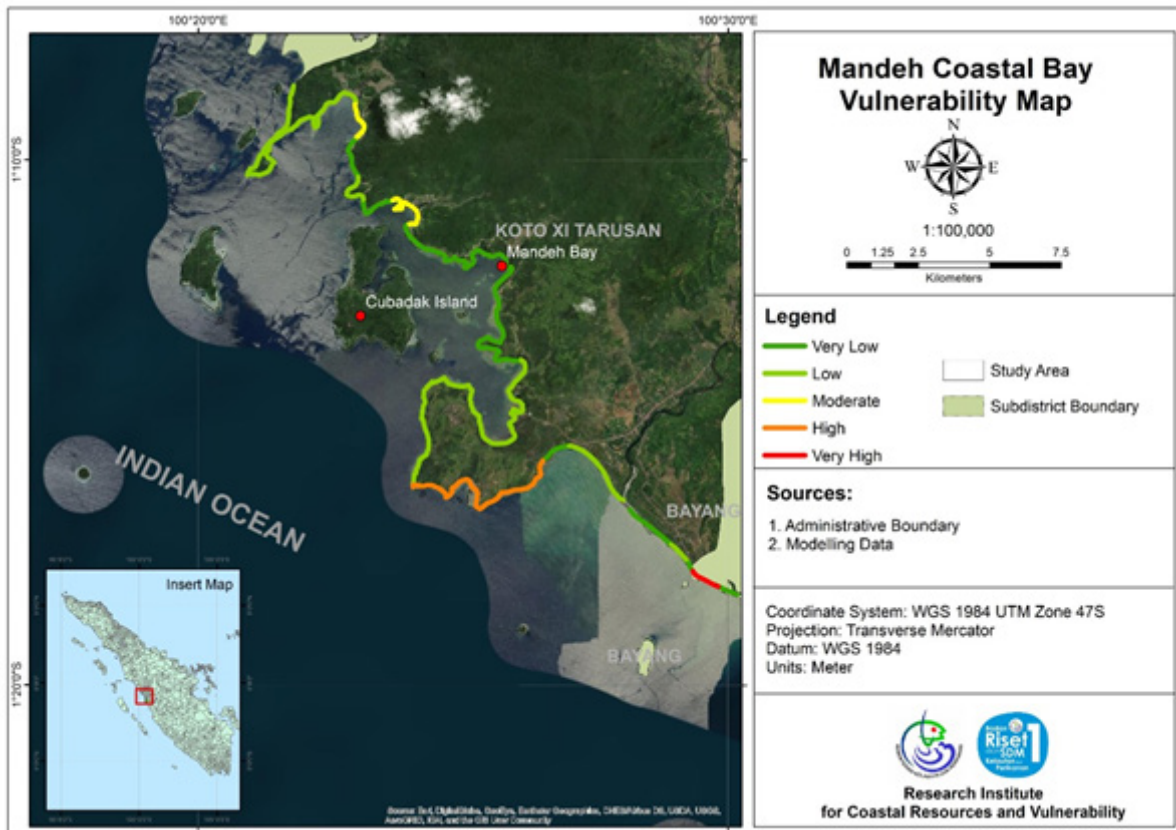


Figure 6. The map of coastal vulnerability level in mandeh Bay.

parameters using the Smartline and CVI model, we can say that Mandeh Bay is quite vulnerable to hazards and disasters. Within the bay, the coastal vulnerability level is deficient due to Cubadak Island's existence in the outer part of Mandeh Bay. This continental formation makes Mandeh Bay become a semi-enclosed protected area. We also gained the coastline changes percentage in Mandeh Region that within the last 12 years, 22% of Mandeh coastline was experiencing accretion. This condition is caused by the high sediment intake from the Mandeh River due to the rapid urban development in the coastal area. However, approximately 24 % was stable, 47% underwent low-scale abrasion, and 2% was the eroded area (Figure 6).

Based on CVI calculation, we found that 48 % of the total area of Mandeh Bay is categorized as a shallow vulnerability area. However, some areas are prone to hazards and disasters, with around 16 % and 36 % moderate to low vulnerability. Even though Mandeh Bay is suitable for tourism based on the vulnerability state, excellent coastal management is necessary.

The nowadays issue is the high sedimentation and environmental problems within Mandeh Bay (Syam, 2017). Rapid urban development has contributed to the enhancement of coastal vulnerability. An advanced regulation is crucial to control the mass tourism and

over-exploration in Mandeh Coastal Bay. Local people and governments play a critical role in diminishing the impact of developments by which they can manage and protect their natural resources and heritages as a regional asset (Yusnikusumah & Sulystiawati, 2016).

CONCLUSION

Mandeh Bay is sufficiently feasible for espousing marine ecotourism activities. Mass tourism and rapid urban development have a significant role in environmental degradation, causing the accumulation of marine and land debris. The increase in visits number contributes to the deteriorating quality of the ecotourism area; many resorts and souvenir stores had been built by damaging the mangrove forest area. Local zonation is essential to limit the pressure to ecotourism areas, thereby declining the social and environmental issues. Land-use changes are likely to reflect the high level of development, which induces the bay's sedimentation issue. Mandeh coastline is categorized to moderate - shallow vulnerable area showing that this region is suitable to be established as the center of marine ecotourism in West Sumatra Province. However, and advanced regulation and coastal management are crucial to diminish the impact of mass tourism and rapid development on social and environmental aspects.

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