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Analysis of the Biophysical Environmental Impact of Sand Mining in Mawasangka District, Central Buton Regency

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A B S T R A C T

The rise of illegal or unlicensed sand mining by irresponsible individuals has caused damage along the coast of Mawasangka District, Central Buton Regency. This study aims to identify the biophysical environmental impacts due to illegal sand mining in the coastal District of Mawasangka Buton and recommendations for post-sand mining land management. The method used in this study was direct observation to determine changes in the coastline and types of damaged vegetation, normalized difference vegetation index (NDVI) analysis to determine the density of vegetation on post-mining land, and measuring the depth of excavation. The results showed that there had been 321 m of beach abrasion and the types of vegetation damaged were coconut, acacisa and jaran wood trees. The results of the NDVI analysis show that non-green space around the mining area is 33.63 ha, while very low vegetation density is 41.91 ha, and low vegetation is 330.05 ha, while the rest is moderate and high vegetation covering 605.47 ha. Measurement of the depth of excavation ranged from 0.6 m – 2.3 m with good and moderate categories. Management of coastal post-mining land in the Mawasangkan sub-district is directed as pond land and revegetation.

INTRODUCTION

Development is human activity in controlling and processing natural resources. Natural resources are a very decisive factor for human life. One of the natural resource management activities is mining. Mining products can generate enormous income for a country. One of the mining products used for development in the construction sector is minerals or minerals such as sea sand (Taufik et al., 2020). Presidential Decree Number 33 of 2002, defines sea sand as sand minerals located in

Indonesian territorial waters which do not contain group A and/or group B mineral elements in significant amounts from a mining economic perspective. Based on this Presidential Decree, control and supervision of sea sand mining activities includes control and supervision of mining, dredging, transportation, export trade, and so on (Keppres, 2002). Kepmen (1996) requires mining activities of group C type of offshore minerals to be obliged to prepare an Environmental Impact Analysis (AMDAL). On the other hand, according to Law no. 27 of 2007 concerning the Management of Coastal Areas and Small Islands, article 35 part i, states that in the utilization of coastal areas and small islands, everyone is directly or indirectly prohibited from mining sand in areas where technically, ecologically, socially, and/or culture cause environmental damage and/or environmental pollution and/or harm the surrounding community. However, there are still many sea sand mining activities that are carried out illegally and violate established regulations. Permits granted for sea sand mining activities overlap with the designation of coastal areas and small islands, which potential to cause high social disputes, damage environmental ecosystems, and cause ecological disasters(Sujadmiko & Meidiantama, 2022).

According to Ernas et al., (2018) sea sand mining activities are activities of physically transferring sediment or other material from the seabed to a location through dredging, transporting and collecting these materials elsewhere, this can result in increased water turbidity due to mixing of bottom sediments. sea which can cause death to eggs and larvae of marine biota due to loss of sediment habitat. In addition, mining activities also have an impact on environmental changes, such as degraded landscapes, changes in flora and fauna habitat, changes in soil structure, surface and groundwater flow patterns (As'ari et al., 2019). Mining activities in coastal areas often have negative impacts when the activities carried out are not based on predetermined regulations as well as post-mining management. As happened on the Dlodo beach, iron sand mining activities have had an influence on the development of Dlodo Beach tourism which indirectly changes the typology of the beach and has an impact on the beauty of the beach (Febrianto et al., 2018). Sand mining in the coastal area of Galesong also has an impact on the loss of fishing grounds due to dredging of sea sand and causes the water to become turbid (Anggariani et al., 2021). Sea sand mining activities in coastal areas can also result in damage to coastal ecosystems. Damage that occurs to coastal ecosystems will always be followed by environmental problems such as coastal abrasion, sedimentation, flooding and reduced fisheries productivity and the loss of several small islands (Tanuri, 2020).

Sand mining activities in Indonesia have been going on for a long time and are still being carried out today. One of the sand mining activities that occurs in Indonesia is sand mining on the coast. One of the beach sand mining activities in Indonesia is sand mining in the coastal villages of Balobone and Napa Village, Mawasangka District, Central Buton Regency. Balobone Village and Napa Village have beautiful beaches with white sand and overgrown coconut trees around the coast. However, the beauty of the beach is damaged by illegal sand mining activities. Dredging and exploiting the coastal area and then selling it to other areas has resulted in excavated holes along the coast which have damaged the beauty of the beach. The rise of sand mining which is carried out illegally or does not have a mining permit carried out by irresponsible elements has resulted in damage along the coast of

Balobone Village and Napa Village, Mawasangka District, Buton Tengah Regency (Buteng) which is estimated to have an area of damage of up to 9,500 m² (0.95 ha) which of course has a huge impact on the surrounding natural environment and for the people who live around the beach area (Biyu, 2019). In 2021 sand mining activities on the coast of Balobone Village and Napa Village have been closed by the regional government of Central Buton Regency. The closure of this mine is based on circular letter from the Regent of Central Buton number 545/21/2021 to prohibit all sand mining activities in the Central Buton Regency area, including sand mining on the coasts of Balobone Village and Napa Village. Even though there has been a circular letter from the Regent, there are still those who carry out sand mining activities illegally.

Based on this, it is necessary to carry out studies related to the biophysical environmental impacts due to illegal sand mining in the coastal of Balobone and Napa Village, Mawasangka District, Central Buton Regency. The purpose of this study is to determine the impact on the biophysical environment due to illegal sand mining in the coastal of Balobone and Napa Village, Mawasangka District, Central Buton Regency and determine the recommendations for post-sand mining land management.

METHOD

Location and Time

This study was conducted on the coast of Balobobe Village and Napa Village, Mawasangka District, Central Buton Regency, which are located at coordinates between 5°18`30.2″S and 122°16`56.7″E, which was carried out from April to May 2022.

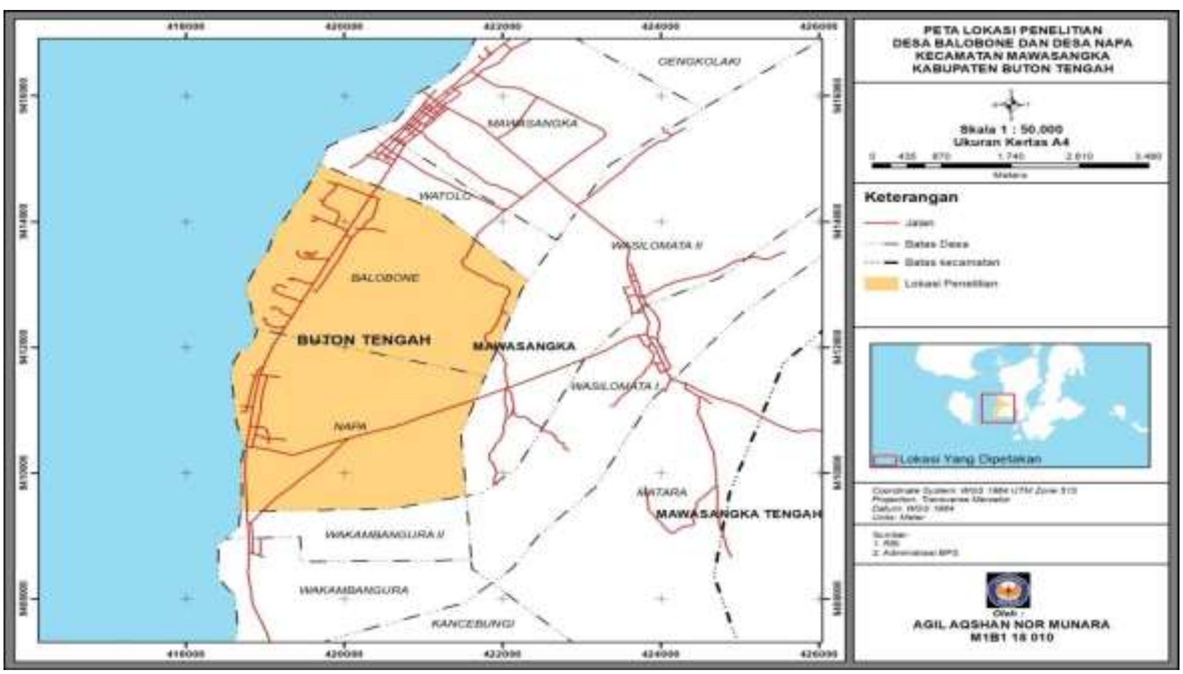

Figure 1. Research location map

Method of Colloecting Data

The types of research data in this study are qualitative and quantitative data. Qualitative data is data that provides an overview of sand mining activities and how much damage to vegetation around the mining site are obtained from direct observation. While the quantitative data in this study are the depth of mining excavation, beach abrasion rate, and the vegetation density index. Data collection techniques are observation and field measurements.

Data Analysis

1. Direct observation in the field regarding how much the shoreline changes have occurred as a result of sand mining and observing the condition of the vegetation around the mining site to compare between the condition of the vegetation in locations that have been mined and locations that have not been mined
2. NDVI analysis in this study is used to determine the density level of the vegetation around the sand mining site by comparing the level of vegetation density before the sand mining started in 1999, when the sand mining was operating in 2020 and after the closing of the sand mining activity in 2022 (Alwi et al., 2022).

$$NDVI = \frac{NIR-RED}{NIR+RED} \text{........(eq.1)}$$

With NIR is near infrared radiation pixel (Band 5) and RED is red light radiation pixel (Band 4)

3. Analysis of the depth of the mine based on the Decree of the state minister for the Environment No. 43 of 1996 (UU RI, 2007) concerning the determination of several indicators to determine the weight of the assessment (score).

Characteristics Wall height/dig depth limit from the initial soil surface:

a. Good, if the excavation wall depth is < 2 m, it is given an assessment weight (score) = 1
b. Moderate, if the excavation wall depth is 2-3 m, it is given an assessment weight (score) = 2
c. Damaged, if the excavation wall depth is > 3 m, given an assessment weight (score) = 3.

RESULT AND DISCUSSION

The aspects of the biophysical environment examined in this study are vegetation, coastal excavation depth and beach abrasion.

Vegetation

The environment and vegetation around the coast are damaged due to the erosion of the coastal plains. The coastal plains which were originally filled with plants such as coconut trees have fallen due to the continuous loss of sand material, where the sand material is a support for these plants. Even land owned by other people that is not sold is also eroded because of the sand material which is easily transported by water (Taufik et al., 2020). There are several types of vegetation found at the sand mining site that were damaged as shown in Table 1 below:

Table 1. Types of Vegetation that are Damaged

No	Vegetation	Latin Name	Condition
1.	Coconut Tree	*Cocos Nucifera*	fell
2.	Acacia	*Acacia*	fell
3.	Jaran Tree	*Lannea Coromandelica*	fell

Based on the results of observations in the field regarding the condition of the vegetation at the sand mining site where three types of vegetation were damaged, namely coconut trees, acacia and jaran wood trees, where the three vegetation were severely damaged.

Vegetation Density in Balobone and Napa Village

Analysis To determine the density of vegetation in Balobone Village and Napa using the NDVI (Normalized Difference Vegetation Index). class classification (Putra, 2018). The use of NDVI to analyze vegetation density in Balobene and Napa Villages is a form of utilizing remote sensing Landsat 9 satellite imagery. Based on Fitriani et al., (2023), NDVI provides information on the density of vegetation index obtained from analysis of satellite imagery involving infrared bands. and band red, besides that the NDVI algorithm is able to distinguish types of non-vegetation cover and vegetation cover on the ground.

Table 2. NDVI Classification

Class	Density	Type of Green Open Space
<0	Non Green Open Space	Water bodies
0-0,1	Very Low	Settlements of open land lined with asphalt or paving or roads asphalt

Class	Density	Type of Green Open Space
0,1-0,5	Low	Ground cover vegetation, such as dirt roads, empty fields, without asphalt or paving
0,5-0,7	Moderate	Vegetation cover land in the form of coconut plantations, mixed gardens, grass vegetation, golf courses, reeds
>0,7	Hight	Forested vegetation

NDVI Prior to sand mining (1999)

Prior to sand mining activities in the coastal villages of Balobone and Napa, the condition of the vegetation around the mining site was still in good condition as well as its density. Several types of vegetation found around the sand mining site include acacia, coconut trees, trees and jaran wood. The density of vegetation in Balobone Village and Napan Village prior to the sand mining activity in 1999 can be seen in the image below.

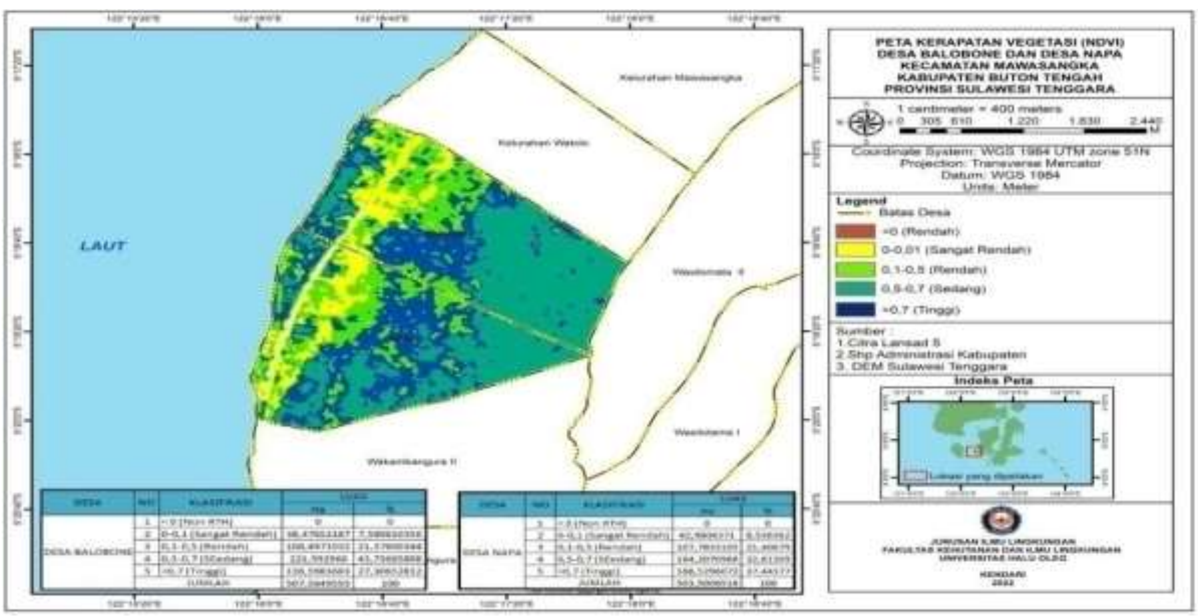

Figure 2. Vegetation Density Map (NDVI) for Balobone and Napa Villages in 1999

Based on the map above, the density of vegetation in Balobone Village before sand mining existed in 1999 for classification 0-0.1 (very low) covering an area of 38.47652187 Ha (7.58%), classification 0.1-0.5 (low) area of 108.4971032 Ha (21.37%), classification 0.5-0.7 (Moderate) area of 221.992966 Ha (43.73%), Classification >0.7 (high) area of 138.5983683 (27.30%) and for classification <0 (non green open space) with an area of 0 Ha (0%). While the density of vegetation in Napa Village at the time before sand mining existed, namely in 1999 for classification 0-0.1 (very low) covering an area of 42.9806371 Ha (8.53%), classification 0.1-0.5 (Low) area of 107.7833105 Ha (21.40%), classification 0.5-0.7 (Moderate) area of 164.2070968 Ha (32.61%), classification >0.7 (high) area of 188.5296072 Ha (37 .44%) and for classification <0 (Non Green Open Space) with an area of 0 Ha (0%).

NDVI During sand mining activities (2020)

During the operation of sand mining activities in the coastal villages of Balobone and Napa Village, the condition of the vegetation around the mining site was damaged as well as its density changed. Several types of vegetation found around the sand mining site likes acacia, coconut trees, and jaran wood trees was found in a damaged condition. The density of vegetation in Balobone and Napa Villages when the sand mine was operating, namely in 2020, can be seen in the image below.

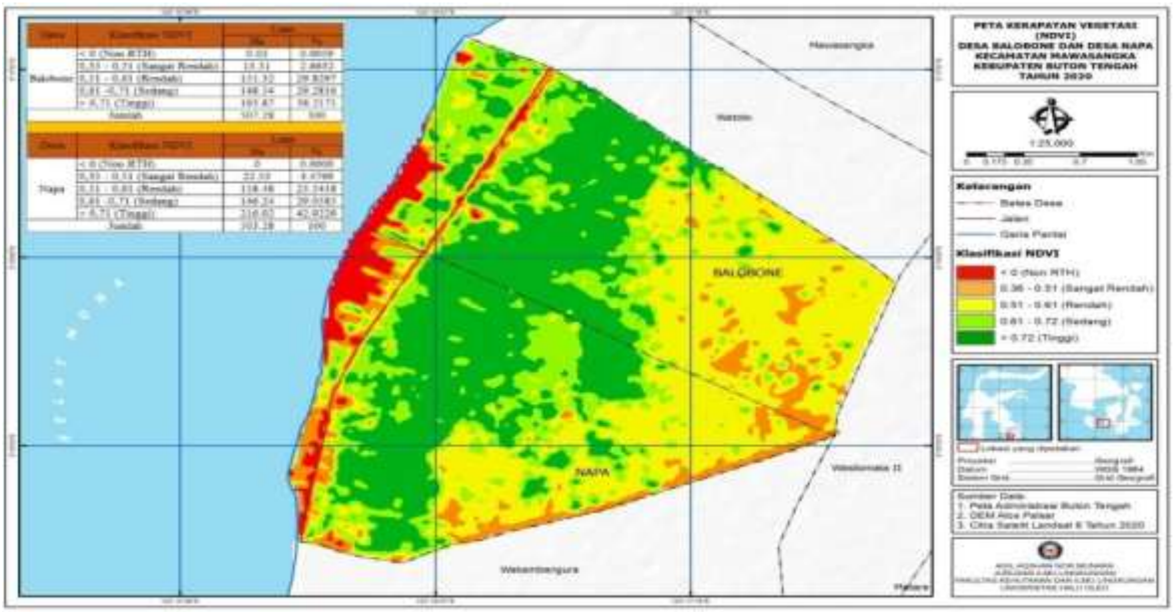

Figure 3. Vegetation Density Map (NDVI) for Balobone and Napa Villages in 2020

Based on the map above, the density of vegetation in Balobone Village when the sand mine was still operating in 2020, for the classification < 0 (Non-Green Open Space) covering an area of 0.03Ha (0.0059%), classification 0-0.1 (very low) covering an area of 13 .51 Ha (2.66%), classification 0.1-0.5 (low) covering an area of 151.32 Ha (29.82%), classification 0.5-0.7 (Moderate) covering an area of 148.54 Ha (29.28 %) and for classification > 0.7 (high) area of 193.87 Ha (38.21%).

While the density of vegetation in Napa Village when the sand mine was still operating in 2020, for the classification < 0 (Non-Green Open Space) covering an area of 0 Ha (0%), classification 0-0.1 (very low) covering an area of 22.53 Ha (4, 47%), classification 0.1-0.5 (low) covering an area of 118.48 Ha (23.54%), classification 0.5-0.7 (Moderate) covering an area of 146.24 Ha (29.05%) and for classification > 0.7 (hight) area of 216.02 Ha (42.92%)

NDVI After sand mining ceases to operate (2022)

After the sand mining activities in the coastal villages of Balobone and Napa, the condition of the vegetation around the mining site was damaged as well as its density changed. Several types of vegetation found around the sand mining site include acacia, coconut trees, and jaran wood trees. The density of vegetation in Balobone Village and Napa Village after the closure of sand mining activities in 2022 can be seen in the image below.

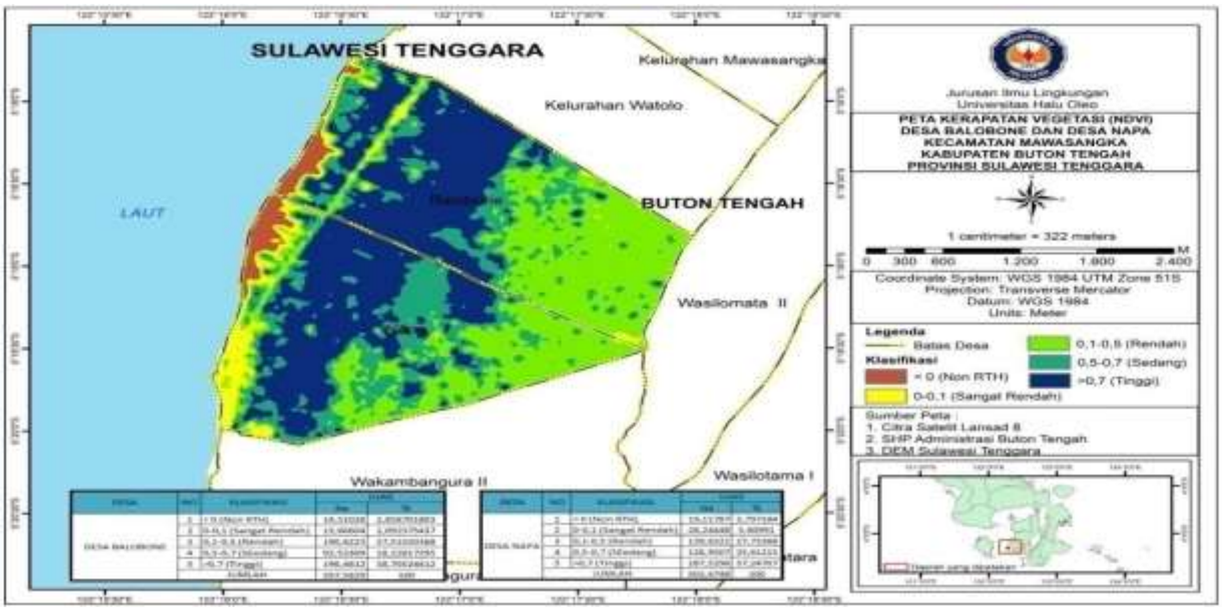

Figure 4. Vegetation Density Map (NDVI) for Balobone and Napa Villages for 2022

For the classification < 0 (Non Green Open Space) covering an area of 14.51028 Ha (2.85%), classification 0-0.1 (very low) covering an area of 13.66604 Ha (2.69%), classification 0.1-0.5 (low) covering an area of 190.4223 Ha (37.51%), classification 0.5-0.7 (Moderate) covering an area of 92.52309 Ha (18, 22%) and for classification > 0.7 (high) an area of 196.4621 Ha (38.70%). Meanwhile, the density of vegetation in Napa Village after mining activities in 2022 for the classification <0 (Non Green Open Space) is 19.11787 Ha (3.79%), the classification 0-0.1 (very low) is 28.24448 Ha (5 .60%), classification 0.1-0.5 (low) covering an area of 139.6321 Ha (27.73%), classification 0.5-0.7 (Moderate) covering an area of 128.9507 Ha (25.61%) and for classification > 0.7 (height) an area of 187.5296 Ha (37.24%).

The following is a comparison of the vegetation density of Balobone Village before and after the closing of sand mining activities can be seen in Table 3 and Table 4 below. Based on the table above, changes in vegetation density based on the NDVI classification from 1999 to 2020, namely for the NDVI classification class 0-0.1 (Very low) underwent a change consisting of a change to the 0-0.1 (Very Low) classification of 0.41 Ha, changed to classification 0.1-0.5 (Low) covering an area of 7.63 Ha, changed to classification 0.5-0.7 (Moderate) covering an area of 5.28 Ha, and changed to classification > 0.7 (High) covering an area of 67.71 Ha . For the 0.1-0.5 (Low) classification, there was a change consisting of changing to the 0-0.1 (Very low) classification for an area of 1.57 Ha, changing to a 0.1-0.5(Low) classification for an area of 30.58 Ha, changed to classification 0.5-0.7 (Moderate) with an area of 18.74 Ha, changed to classification >0.7 (High) covering an area of 163.82 Ha. For classification 0.5-0.7 (Moderate) there was a change which consisted of changing to classification 0-0.1 (Very low) covering an area of 3.56 Ha, changing to classification 0.1-0.5 (Low) covering an area of 270.80 Ha, changed to classification 0.5-0.7 (Moderate) covering an area of 81.38 Ha, changed to classification > 0.7 (High) area of 28.57 Ha. For classification > 0.7 (High) there is a change which consists of changing to a classification of 0-0.1 (Very low) covering an area of 6.43 Ha, changed to classification 0.1-0.5 (Low) covering an area of 105.51 Ha, changed to classification 0.5-0.7 (Moderate) covering an area of 42.32 Ha, changed to classification >0.7 (High) covering an area of 168.40 Ha .

Table 3. Changes in Vegetation Density in Balobone Village and Napa Village from 1999 to 2020

	NDVI	0-0.1 (Very Low) (ha)	0.1-0.5 (Low) (ha)	0.5-0.7 (Moderate) (ha)	>0.7 (High) (ha)
1999	0-0.1 (Very Low) (ha)	0.41	7.63	5.28	67.71
	0.1-0.5 (Low) (ha)	1.57	30.58	18.74	163.82
	0.5-0.7 (Moderate) (ha)	3.56	270.80	81.38	28.57
	>0.7 (High) (ha)	6.43	105.61	42.32	168.40

Table 4. Changes in vegetation density in Balobone and Napa Villages from 2020 to 2022

		2022				
	NDVI	< 0 (Non GOS) (ha)	0-0.1 (Very Low) (ha)	0.1-0.5 (Low) (ha)	0.5-0.7 (Moderate) (ha)	>0.7 (High) (ha)
2020	0-0.1 (Very Low) (ha)	9.96	0.62	0.60	0.57	0.45
	0.1-0.5 (Low) (ha)	8.00	28.44	252.57	101.26	24.51
	0.5-0.7 (Moderate) (ha)	1.51	4.41	60.95	53.74	27.01
	>0.7 (High) (ha)	13.84	7.95	12.26	64.23	330.02

Based on the table above, changes in vegetation density based on the NDVI classification from 2020 to 2022, namely for the NDVI class 0-0.1 (Very low) classification, consist of a change to a classification of <0 (Non GOS) covering an area of 9.96 Ha, changing to classification 0-0.1 (Very Low) covering an area of 0.62 Ha, changing to classification 0.1-0.5 (Low) covering an area of 0.60 Ha, changing to classification 0.5-0.7 (Moderate) covering an area of 0.57 Ha, and changed to classification >0.7 (High) covering an area of 0.45 Ha. Classification 0.1-0.5 (Low) underwent changes consisting of changing to classification <0 (Non-GOS) covering an area of 8.00 Ha, changing to classification 0-0.1 (Very low) covering an area of 28.44 Ha, changing to classification 0 .1-0.5 (Low) covering an area of 252.57 Ha, changing to a classification of 0.5-0.7 (Moderate) covering an area of 101.26 Ha, changing to a classification >0.7 (High) covering an area of 24.51 Ha. Classification 0.5-0.7 (Moderate) underwent changes which consisted of changing to classification <0 (Non GOS) covering an area of 1.51 ha, changing to classification 0-0.1 (Very low) covering an area of 4.41 Ha, changing to classification 0 .1-0.5 (Low) covering an area of 60.59 Ha, changing to a classification of 0.5-0.7 (Moderate) covering an area of 53.74 Ha, changing to a classification >0.7 (High) covering an area of 27.01 Ha. For the classification >0.7 (High) there was a change which consisted of changing to the classification <0 (Non GOS) covering an area of 13.84 ha, changing to the classification 0-0.1 (Very low) covering an area of 7.95 Ha, changing to the classification 0.1- 0.5 (Low) covering an area of 12.26 Ha, changing to a classification of 0.5-0.7 (Moderate) covering an area of 64.23 Ha, changing to a classification >0.7 (High) covering an area of 33.02 Ha.

Sand Mining Depth

Measuring the depth of sand mining excavation is given an assessment weight (score) in accordance with the Decree of the State Minister for the Environment No. 43 of 1996 (KEPMEN, 1996) concerning the determination of several indicators to determine the weight of the assessment (score),

Wall height/depth of sand mining excavation at the time of mining (2020)

Measurement of the depth of excavation at several different points on the sand mining site is shown in Table 5 below.

Table 5. Wall height/depth of sand mining excavation at the time of mining (2020)

No	Location (point)	Wall height/ depth of sand mining	Score	Categori
1.	I	1.5m	1	Good
2.	II	2.1 m	2	Moderate
3.	III	2.3m	2	Moderate
4.	IV	1.4m	1	Good
5.	V	1.5m	1	Good
6.	VI	0.6 m	1	Good

Based on the results in the table above, when the mine was still operating, the excavation depth reached 2 meters in the first, second, and third locations where the excavation depth reached 2 meters, 2.1 meters, and 2.3 meters more was given an assessment weight (score) = 2 and categorized as moderate, while those with a height below 2 meters are in the fourth, fifth, and sixth locations where the depth of the sand mine excavation is 1.8 meters, 1.5 meters and 1 meter is given an assessment weight (score) = 1 and categorized as good.

Wall height/depth of post-mining sand mining excavation (2022)

Measurement of the depth of excavation is carried out at several different points on the sand mining site as shown in Table 6 below. Based on the results in the table above, the depth of excavation for sand mines after the mine was closed which reached 2 meters occurred in the second and third locations where the excavation depth reached 2.1 meters and 2.3 meters was given an assessment weight (score) = 2 and categorized as medium, while those with a height below 2 meters are in the first, fourth, fifth, and sixth locations with the depth of the sand mine excavation being 1.5 meters, 1.4 meters, and 0.6 meters given a weight rating (score) = 1 and categorized as good.

Table 6. Wall Height/Depth of Sand Mining Dig in 2022

No	Location (Point)	Wall height/ depth of sand mining	Score	Category
1.	I	1.5m	1	Good
2.	II	2.1 m	2	Moderate
3.	III	2.3m	2	Moderate
4.	IV	1.4m	1	Good
5.	V	1.5m	1	Good
6.	VI	0.6 m	1	Good

The depth of mine excavation in 2020 is 2 meters deep and in 2022 has been reduced to 1.5 meters. At the second excavation point, the depth of the mine in 2020 and 2022 will not change at all. Whereas at the third point the depth of the mine excavation reached 2.3 meters and did not change either when the mine was still operating (2020) or when the sand mine was closed (2022). At the fourth point, the depth of the mine excavation will reach 1.8 meters in 2020 and will decrease to 1.4 meters in 2022. For the fifth point, the depth of the mine excavation will not change, which will remain as deep as 1.5 meters. And at the sixth point the depth of the excavation will reach 1 meter in 2020 and in 2022 the depth will decrease to 0.6 meters. The change in the depth of the sand mine excavation from 2020 to 2022 is due to the fact that some of the excavation sites have been covered with limestone in accordance with a statement from the government, namely the Environmental Service of the Central Buton Regency which told miners to replace the sand taken with limestone even though it was replaced in the Batur limestone field. does not match the sand taken.

Beach Abrasion

Coastal abrasion is a process of beach erosion caused by the power of sea waves and ocean currents or the destructive tides of ocean currents. The results of direct observations regarding the level of coastal abrasion that occur can be seen in Table 7 below:

Table 7. Coastal Abrasion Levels

No	Years	Coastal Abrasion
1.	1999 (Before mining activities)	There has been no beach abrasion
2.	2020 (during mining activities)	The farthest abrasion that occurred was 321 m
3.	2022 (After mining activities was stopped)	The farthest abrasion that occurred was 321 m

Coastal abrasion is damage to the coastline due to the release of beach materials, such as clay sand which is continuously hit by sea waves or caused by changes in sediment transport in coastal waters (Fajri et al., 2012).

Based on field observations to identify the level of beach abrasion that occurs as a result of sand mining activities on the coast of Balobone and Napa Villages as well as interviews with the community, in 1999 prior to sand mining activities there was no beach abrasion, in 2020 when sand mining activities were still operating there had been abrasion the beach where the farthest beach abrasion occurred as far as 321 m. Whereas in 2022 when the sand mining activities have closed the beach abrasion that occurs is still the same as in 2020 when the sand mining activities are still operating. The results of interviews conducted with the community regarding beach abrasion that occurred as a result of sand mining activities on the coast of Balobone and Napa Villages, Mawasangka District, Central Buton Regency, it is known that beach abrasion has occurred since the first time sand mining was carried out on the coast of the Village. According to the community, this beach abrasion occurred at first because the miners were excavating only on the beach so that the community was not worried about the impact of the sand mining on them, but over time the sand quarry continued to expand until it approached residential areas. As a result of the sand excavation that continues to expand, people are starting to worry about their homes because the sea water when the tide is getting closer to residents' settlements.

Recommendations For Post Mining Land Management

Management of ex-mining land is a complex problem faced by the government and society. The large number of miners who are not responsible for reclamation after taking mining commodities causes various disasters. The abrasion that occurs on the coast of Mawasangka District is one of the real impacts caused by sand mining activities. Management of post-mining land such as on the coast of Mawasangka District must include operational aspects and economic value, taking into account environmental protection efforts, where management must be integrated with economic activities as a model of substitution for mining activities, tourism-based landscape arrangement to support sustainability programs.

An alternative that can be chosen as an effort to manage the former sand mining site in Mawasangka District is to convert the ex-excavated land into ponds. As was done in the ex-sand mining land of Bandar Batauga Buton Selatan, which converted the excavated land into a medium for milkfish cultivation. According to Jaudin et al., (2022), the construction of a milkfish pond in a former mining pit in Bandar Batauga is able to provide a profit of 63% so that this business is feasible. Utilization of ex-sand mining land in coastal areas is also carried out in the Cipatujah Coast, Tasikmalaya Regency, West Java, which utilizes post-iron sand mining land as vanamei shrimp farming ponds. The use of post-iron sand mining areas to become vanamei shrimp farming areas has created new jobs for the community and the environment which was initially degraded due to iron sand mining has stabilized (As'ari et al., 2019).

Utilization of ex-mining land into ponds can also be combined with land reclamation to preserve coastal vegetation and reduce the impact of climate change, as has been done on PT Timah's ex-mining land in the Bangka Belitung Islands Province. Reclamation that is carried out is generally in the form of revegetation reclamation, namely the reclamation model by backfilling excavated holes with overburden (soil cover) and then reforestation (greening) with fast-growing plants or other local plants(Syahrudin, 2021). Several adaptive plants that can be re-cultivated on the coast of Mawasangka District are coconut and hibiscus plants.

CONCLUSION

The biophysical environmental impacts that occur as a result of sand mining activities in the coastal areas of Balobone and Napa Villages include vegetation damage due to mining, where plants at mining sites such as coconut trees, jaran wood trees, and acacia died because there is no more soil around them to live on, decrease in vegetation density at several points of ex-mining locations and beach abrasion during and after mining activities. Based on NDVI analysis, the largest change in NDVI for the 1999 and 2020 periods occurred from classification 0.5-0.7 (medium) changing to classification 0.1-0.5 (low) which is an area of 270.80 Ha, while the smallest change in density occurs in classification 0-0.1 (very low) which is 0.41 Ha. And from 2020 to 2022 where the biggest change occurs from the classification > 0.7 (high) changing to an area of 33.02 Ha, while the smallest change in density occurs in the classification 0-0.1 (very low) to a classification > 0.7 (high) which is an area of 0.45 Ha. Former mining excavations are 1 to more than 2 meters deep, and the highest beach abrasion is 321 m in 2020 and 2022.

REFERENCE

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