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NO GO MINING ZONE IN THE CORE OF PELING ISLAND BANGGAI ARCHIPELAGO CENTRAL SULAWESI

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NO GO MINING ZONE IN THE CORE OF PELING ISLAND BANGGAI ARCHIPELAGO CENTRAL SULAWESI

THE WRITING TEAM:

Givents

Ocsanto

Yulia Astuti

Mikha Monastor

Ismizatil Aliyah Rahman

Funded by the European Union

INTRODUCTION

Alhamdullilah, Praise and Gratitude to Allah S.W.T for His mercy and grace to us so that the writing team has reached the stage of presenting the final report "No Go Mining Zone In The Core of Peling Banggai Island Central Sulawesi", Year 2025.

This final report contains an introduction that contains the objectives and methods of the study, a discussion of the projected impacts of the limestone mining plan in the core of the Banggai Islands including the distribution of WIUP and IUP, climatic conditions, forest and land cover, NDWI maps, projected flooding, water and air quality, threats to coral reef ecosystems and biodiversity, including economic and social impacts and at the end there are suggestions and recommendations.

This activity was organized in collaboration with WWF Indonesia and the Auriga Nusantara Foundation.

Hopefully this report will be useful for all of us.

Palu, May 2025

THE WRITING TEAM

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CHAPTER I
INTRODUCTION

1.1 Background

In the mining industry, No-Go Zone refers to a specific area that should not be exploited or entered for mining activities for environmental, social, legal or safety reasons. The concept aims to balance the needs of economic and ecological sustainability.[1]

The No Go Zone itself has several criteria, namely biological criteria such as species richness, endemism and geological criteria with specific characteristics and measures, which provide important ecosystem services such as clean water, climate regulation and soil maintenance.

Companies must have a sense of responsibility to make moral decisions, in addition to thinking about greater profits, companies must ensure that mining practices are conflict-free with local communities and have less environmental impact.

In a global context with demand for critical minerals increasing with the energy transition, the need for a rights-based approach to mining, focused on respect is more relevant than ever. [2]

This approach relies on the meaningful and inclusive engagement and participation of affected local communities or indigenous peoples in decisions about whether and how mining should take place on their lands and how they acquire the benefit.

While obtaining consent is often difficult, it is important to build trust and ensure that development can take place without harm and in a way that benefits local communities. Designating no-go zones for mining is a matter of fairness.[3]

In Indonesian context, the laws and regulations are actually very good in protecting the interests of the community and protecting biodiversity, such as the Amendment to Law Number 5 of 1990 concerning Conservation of Natural Resources and Ecosystems. However the implementation of the implementation of these rules is not carried out as it should. The weak enforcement of environmental law has an impact on massive environmental degradation and has led to a flurry of conflicts that have not been resolved.

(1) No Go Areas for Mining (2024 June 19) access on march 2025, from the article https://www.helenaaurorarange.com.au/no-go-areas-mining.
(2) Should mining companies consider no-go zones where isolated Indigenous peoples live? (2025 January 16), access from the article https://news.mongabay.com/2025/01/should-mining-companies-consider-no-go-zones-where-isolated-indigenous-peoples-live-commentary/#:~:text=The%20idea%20of%20establishing%20no,reduced%20investment%2C%20or%20market%20exclusion.

Since the nickel boom in Sulawesi, especially in Morowali and North Morowali districts, in 2019, the demand for limestone needs has continued to increase, this is because limestone is an additional material for smelting and refining steel, as well as a mixing material for feronickel and nickel pig iron.[4] Along with this, small islands around Sulawesi waters have not escaped the expansion of mining business licenses with limestone commodities, including the karst ecosystem area in Banggai Islands Regency.

The Banggai archipelago itself is part of the Kalapa Island Karst Hills Complex ecoregion[5] , which is a coralline organic plain of carbonate sedimentary rock.[6] It has natural vegetation and has animal species that are different from the surrounding mainland of the large island of Sulawesi, these species include bird species; brinji emas banggai (Hypsipetes harterti), banggai crow (corvus unicolor), and banggai forest flycatcher (cyornis pelingensis)[7] plant species such as ubi banggai (Dioscorea sp) and marine species such as banggai cardinal fish (pterapogon kauderni).

It is known that limestone licenses issued by the Central Sulawesi provincial government in Banggai Islands Regency, reached 39 reserve licenses and 1 production operation license that controlled an area of 113.70 Ha[8] . The issuance of these licenses certainly adds to the pressure on terrestrial and coastal and marine ecosystems on the island. The determination of the mining business area (WIUP) in the area inhabited by the Banggai tribe and the sea-sea tribe was not consulted and negotiated with the community, so that local protection areas, such as springs, plantation areas and traditional fishing areas were included in the mining concession.

The importance of protecting community-managed areas, biodiversity, cultural sites and water sources in this region, is a strong reason to map the no go zone area aimed at harmonizing economic and environmental needs in the Banggai Islands.

3. 'No-Go' mining zones can protect nature as renewable energy surges (2024, November 7), di akses dari artikel https://www.context.news/nature/opinion/no-go-mining-zones-can-protect-nature-as-renewable-energy-surges
4. https://celebessi.co.id/batu-gamping/
5. sk.8/menlhk//setjen/pla.3/1/2018 tentang penetapan ekoregian wilayah indonesia
6. sk.1272/menlhk/setjen/pla.3/12/2021 tentang penetapan karateristik bentangalam dan karateristik vegetasi alami wilayah ekoregion Indonesia skala 1:250.000
7. https://komiu.id/category/galeri/burung/
8. https://geoportal.esdm.go.id/minerba/

1.2. Tujuan kajian

The objectives to be achieved from this review activity are:

Analyzing the potential of ***no go mining zone*** based on the distribution of local protection areas, biodiversity endemicity, forest and land management and coastal including the socio-economic conditions of the community in the Core of Peling Island, Banggai Archipelago, Central Sulawesi Province.

1.3 Scope of the Study

The scope of the study area includes Bulagi Subdistrict, Liang Subdistrict, Central Peling Subdistrict and Tinangkung Subdistrict, Selection of this area, because some of the surrounding villages such as Komba-Komba Village in addition to having limited water sources, this area is also the largest seaweed seed provider and cultivator center in Banggai Islands and in addition in the area of Balayon Village and Boyomaute Village mining business licenses have Production Operation status.

1.4. Study Method

1.4.1 Social Data collectionl

The types of data used in this study are secondary data and primary data, both qualitative and quantitative in nature. Primary data was collected through direct observation, interviews and FGDs. Secondary data was obtained from literature studies from relevant sources in the form of reference books, scientific journals and official data collected from relevant agencies.

1.4.2 Spatial Data Collection

Data processing using the mapbiomas collection 2.0 platform was carried out to interpret the forest and land cover data, which was overlaid with the distribution of WIUP and IUP OP in Banggai Islands.

Processing image data to assess the wetness level of an area through NDWI (Normalized Difference Water Index), identifying landslide and flood inundation prone maps including overlaying with coral reef cover using Allen Coral Atlas data.

These data were delineated to determine buffer and protection areas as well as community-managed areas indicated as no go mining zones

1.4.3 Water and air quality measuremen

1. Water Quality

AThe water quality test kit labeled "14 in 1 Test Strip" allows us to measure 14 water quality parameters quickly and conveniently. Tests include parameters such as lead, iron, chromium, sulfite, chlorine, bromine, nitrate, nitrite, mercury, chloride, water hardness, pH, and total alkalinity.

Using this tool by dipping the test strip into the water sample for a few seconds, then lifting and removing excess water by shaking the strip. After a while, observe the color change that appears on the strip and match it with the color scale recorded on the bottle. [9]

Figure 1.1. Test strips

2. Air Quality

Figure 1.2. Air Quality Monitor

Air quality monitors are used to measure and monitor air quality, both indoors and outdoors, using sensors that detect pollutants such as particulate matter (PM2.5, PM10), formaldehyde concentration, TVOC levels, temperature, and humidity.

The use of the tool is by placing the monitor in a place that is often visited by people and not too close to direct pollution sources, then the Air quality monitor is calibrated first to ensure the accuracy of the data readings. After calibration, the tool can be used directly, the sensor will automatically detect and measure various pollutants and air parameters. The detected data will be processed and presented in the form of an air quality index.

3. Observation and analysis of bird species using the exploration method

a. Birdwatching

Birdwatching using the exploratory method involves exploring an area or location to record the species and number of birds observed. Observation data is processed to analyze bird species diversity.

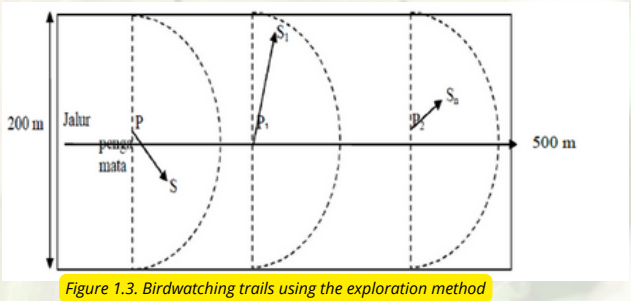


Figure 1.3. Birdwatching trails using the exploration method

b. Diversity Index Analysis

Bird diversity was calculated using the Shannon-Wienner diversity index (Odum, 1971), with the following formula:

H'= -∑ Pi ln (Pi), where Pi = (ni/N)
Description:
H' = Shannon-Wiener diversity index,
ni = Number of individuals of the species
N = Number of individuals of all

Shannon-Wiener diversity index value criteria (H')
H' ≤ 1 : low diversity
1< H' < 3 : Medium diversity
H' ≥ 3 : High diversity

9. Sony Susanto dkk Analisis Kualitas Air untuk Pengelolaan Sumber Daya Air Berkelanjutan dengan Pengujian Air Klorin. Jurnal Pengabdian Masyarakat Waradin Volume. 5 No. 1 Januari 2025

CHAPTER II
PROJECTED IMPACTS OF THE LIMESTONE MINING PLAN IN THE CORE OF PELING ISLAND BANGGAI ARCHIPELAGO

2.1 Distribution of Mining Licenses in the Core of Peling Island

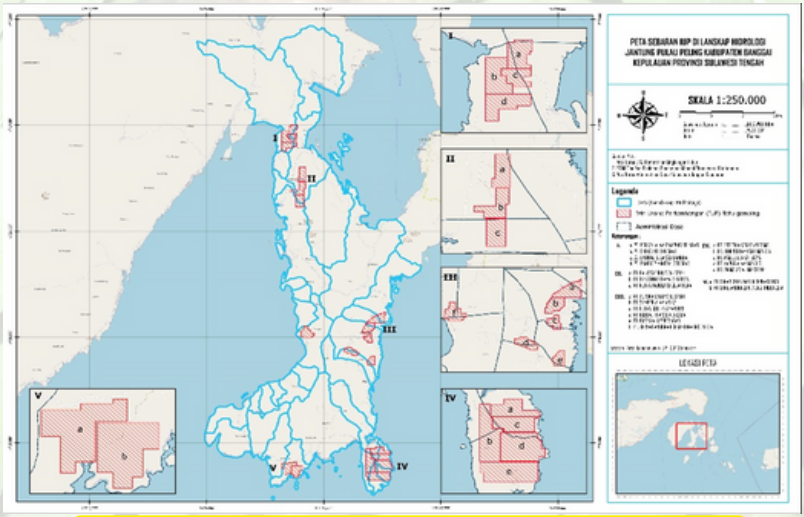


Figure 2.1. Map of WIUP and IUP Distribution in the Core of Peling Island Banggai Archipelago

Referring to ESDM geoportal data in 2025, the distribution of mining licenses in the core of Peling Island, including mining business license areas (WIUP) or commonly called reserve areas and production operation mining business licenses (IUP-OP) totaling 20 licenses with a total land area of 1,593.54 hectares.

Table 2.1. Distribution of IUPs in the Core of Peling Island, Banggai Archipelago

Kluster	Badan Hukum	Nomor SK	Status	Ha	Pejabat Berwenanang
I	PT. Berkah Alam gamping selaras	540/166/WIUP/DPMPTSP/2024	WIUP	66,00	Gubernur
	PT. Dekha Inti Selaras	540/165/WIUP/DPMPTSP/2024	WIUP	85,00	Gubernur
	PT. Bangkep Mineral Selaras	540/167/WIUP/DPMPTSP/2023	WIUP	86,00	Gubernur
	CV. Endital Selaras Banggai	540/200/WIUP/DPMPTSP/2023	WIUP	46,24	Gubernur
II	PT. Calvary Bukit Anugrah	540/219/WIUP/DPMPTSP/2023	WIUP	98,82	Gubernur
	PT. Sungonno Damai Sentosa	540/72/WIUP/DPMPTSP/2024	WIUP	99,23	Gubernur
	PT. Putra Tadulako Sejahtera	-	WIUP	97,32	Gubernur
III	PT. Aurora Cahaya Lestari	540/134/IUP-OP/DPMPTSP/2020	IUP	113,70	Gubernur
	PT. Sumber Alam Adika	-	IUP	88,00	Gubernur
	PT. Putra Sumber Mandiri	540/55/WIUP/DPMPTSP/2023	WIUP	42,00	Gubernur
	PT. Global Tharas Persada	540/93/WIUP/DPMPTSP/2024	WIUP	66,53	Gubernur
	PT. Giadaya Kapoer Abadi	540/92/WIUP/DPMPTSP/2024	WIUP	50,60	Gubernur
	PT. Berkat Anugrah Sejahtera Indonesia	540/159/WIUP/DPMPTSP/2024	WIUP	99,29	Gubernur
IV	PT. Estetika Karya Abirama	540/176/WIUP/DPMPTSP/2023	WIUP	99,00	Gubernur
	PT. Sinergi Tambang Mandiri	540/175/WIUP/DPMPTSP/2023	WIUP	161,00	Gubernur
	PT. Maleo Berkah Jaya	540/177/WIUP/DPMPTSP/2023	WIUP	99,00	Gubernur
	PT. Kapur Alam Mandiri	540/173/WIUP/DPMPTSP/2023	WIUP	196,00	Gubernur
	PT. Prima Asia Limestone	540/174/WIUP/DPMPTSP/2023	WIUP	188,00	Gubernur
V	PT. Sinar Granimar Internasional	540/178/WIUP/DPMPTSP/2024	WIUP	95,60	Gubernur
	PT. Singlandgreen Energi Indonesia	540/170/WIUP/DPMPTSP/2024	WIUP	89,50	Gubernur

2.2 Rainfall In The Heart of Peling Island

Based on the results of processed monthly rainfall data published by the Lore Lindu Bariri Global Atmospheric Monitoring BMKG (Indonesian Agency for Meteorology, Climatology and Geophysics) Station for the 2020-2024 period, in Bulagi District, Liang District, Central Peling District and Tinangkung District, which is the Core of Peling Island.

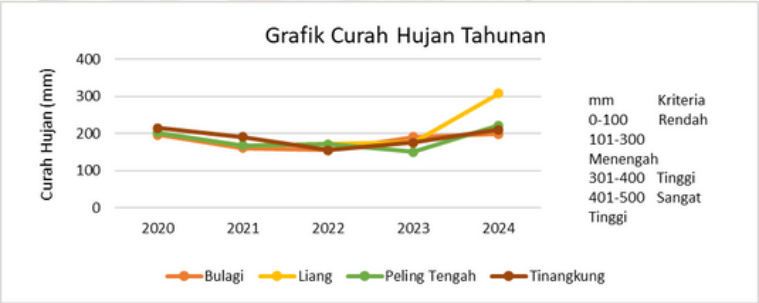


Figure 2.2. Rainfall Graph

Average rainfall has increased from 2020 to 2024. The year 2020 has the lowest average (204.14 mm), while the year 2024 shows the highest average (234.77 mm). This shows that overall rainfall in the region has tended to increase in the last five years, although there are annual variations between locations.

Increased rainfall can have important implications for agriculture, water availability and local ecosystems. Significant increases in rainfall, particularly in Liang and Central Peling, may be potentially beneficial for the agricultural sector if managed well, but can also increase the risk of flooding if rainfall is very high in a short period of time . This data is confirmed on May 21, 2024 there was a flood in Okumel Village, Liang Sub-district which submerged 2 schools.

Rainfall data shows varying trends between locations and years. It is important for the government and relevant sector stakeholders to regularly monitor and adjust agricultural and water resources management strategies to adapt to these changing rainfall patterns.

2.3 Forest & Land Cover in the Core of Peling Island

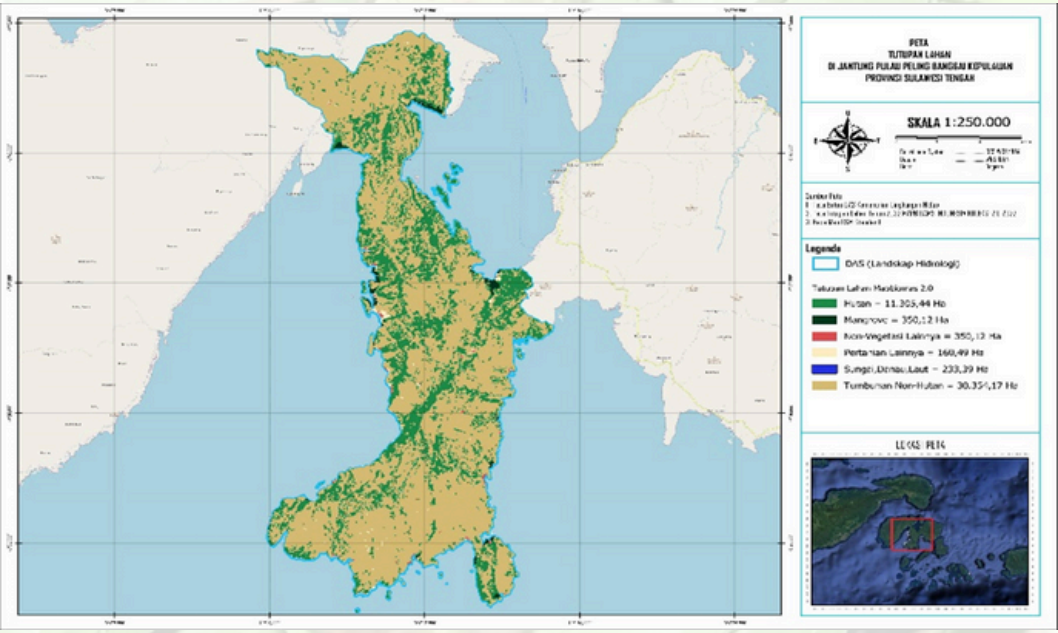


Figure 2.3. Forest and land cover in Peling Island Neck of Banggai Islands

Referring to the data classification results of the mapbiomas collection 2.0 data platform. in 2022 the forest and land cover in the core of the Banggai Islands includes :

1. Non-forest plant cover is 30,354 Ha, consisting of shrubs, grasslands and open land.
2. Forest cover of 11,305 Ha
3. 350 Ha of Mangroves
4. Other Agricultural Land 160 Ha.

The loss of forest cover in this area was due to the operation of forest use rights (HPH) in the 1980-1990s.Another factor is land management by the community with a rotating system or moving based on the type of commodity such as Banggai sweet potatoes, corn and other horticultural crops. The community rotation system is generally around 5 years.

One family in the Banggai community on the island has four plots of land to cultivate. After 5 years and harvesting the crops, they will move to another land to continue the same process, then return to the original place.

10 .Hunggul Y.S.H Nugroho & Indah Novita Dewi "Watershed Management & Soil and Water Conservation. 2022: Jogyakarta: CV. Andi Offset. Page 190-191

Bosch and Hewlett (1982), The effect of vegetation management on water yield states that annual flow will increase if there is no vegetation or the amount of vegetation is reduced considerably. In general, an increase in water flow is caused by a reduction in the amount of water evaporated by vegetation through transpiration, resulting in greater surface and groundwater flow. The amount of water flow will increase if:

- Vegetation is cut down or reduced in considerable amounts.
- Vegetation type changed from deep-rooted to shallow-rooted plants
- Ground cover vegetation was changed from plants with high interception capacity to plants with lower interception capacity.[10]

Land use by the community in this area greatly affects the soil's ability to absorb and release water

2.4 Soil Wetness Levels in the Core of Peling Island

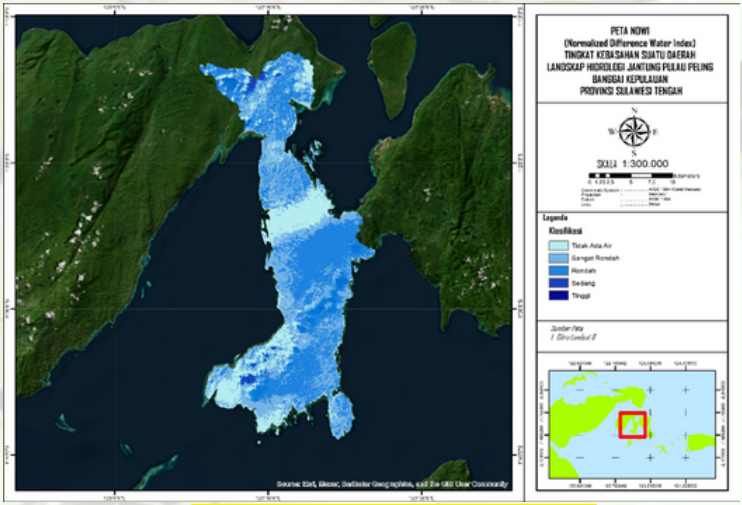


Figure 2.4. Soil Wetness Levels in the Core of Peling Island

NDWI is a map that describes the level of wetness in an area, in the context of the Core of Peling Island, the southern and western parts of the Island show moderate to high NDWI values, meaning that the area has higher levels of soil moisture, this is influenced by dense vegetation, wet soil, or proximity to water sources.

The northern and central parts show lower wetness values. If these areas are cleared for mining, road construction or plantations, the soil's ability to store water will be lost increasing the risk of seasonal flooding and drought in other areas.

2.5 Rainwater Inundation Projections

Based on rainwater inundation projection processed using sentinel - 1 SAR GRD (Synthetic Aperture Radar Ground Range Detected) satellite image with a scale of 1:250,000. Shows areas that have the potential to experience inundation when rainfall is high.

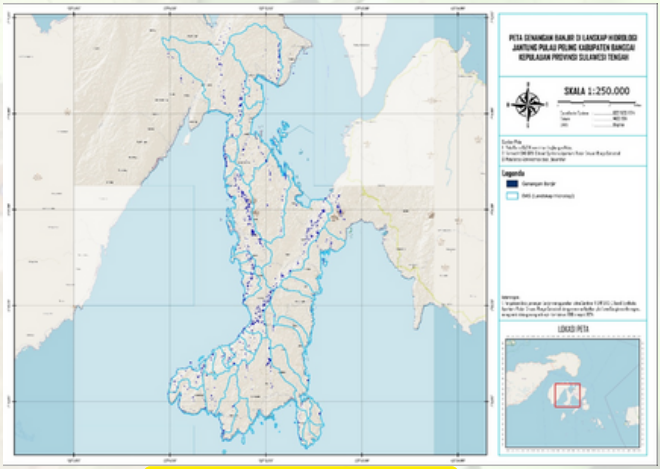


Figure 2.5. Rainwater inundation detection

In this area, during the period 2015-2020, there were 37 villages that were frequently flooded during the rainy season, with rainfall intensity ranging from 300-500 mm.

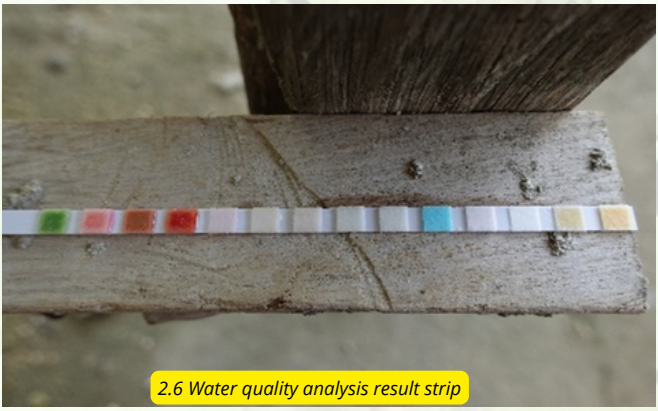
If this landscape is exploited by mining, changes will occur in the upstream, middle and downstream watersheds. Loss of infiltration area in the watershed which functions as water infiltration and storage, will disrupt the function of the watershed, leading to natural disasters such as floods and landslides.

2.6 Potential Loss of Water and Clean Air Resources

2.6.1 Water Quality.

Based on field data processing, there are several water springs in the three sample villages:

1. Balayon Village has nine springs, two of which are used for consumption, six of which are used for irrigating gardens and one near a residential area that is used for Natural Swimming Pool Tourism.
2. Boyomoute Village, there are 3 springs and only 2 of them can be used by residents for consumption, while 1 of them has a decreasing water discharge, this is due to 1.land clearing done by cutting down trees around it, so that this spring point is only used by residents to water plants in the garden.



2.6 Water quality analysis result strip

3. Komba-komba village has one spring that is used for consumption. This spring is located on the border of Komba-komba and Balombong villages, and there are four wells that are used for washing and bathing.

The results of water analysis in Balayon Village, show that the water is relatively clean and free from various harmful contaminants. However, the absence of disinfectants (chlorine and bromine) is a concern, especially for water consumption. Hardness and pH levels are within acceptable limits, however further monitoring is required to ensure that the water remains suitable for use and consumption .

Figure 2.7. Checking the Water Source in Boyomaute Village

The results of the water analysis in Boyomoute Village, showed good quality and relative safety. With the absence of harmful contaminants and other parameters within reasonable limits, this water can be considered safe. However, it is important to remember to monitor nitrate levels and ensure appropriate treatment, especially in relation to water disinfection, to keep it safe from harmful microorganisms. Meanwhile, hardness and pH levels are within healthy ranges, and high alkalinity adds stability to the water quality.

The results of the analysis in Komba-komba village, show that the water quality is good and safe. The absence of harmful contaminants and other parameters are within reasonable limits, making this water suitable for use. However, it is important to remember the importance of water treatment and disinfection, especially to keep it clean from microorganisms, as well as regularly monitoring nitrate levels. Good hardness and pH levels, along with high alkalinity, contribute to the stability of the water quality over time.

2.6.2 Air Quality

Air quality measurements were conducted in Balayon Village, Boyomaute Village and Komba-Komba Village. Air quality measurements were carried out 4 times, in the morning, afternoon, evening and night.

Figure 2.8. Air quality measuring device

In measuring air quality using measuring instruments, with indicators measured in the form of particulates measuring ≤2.5 micrometers, particulates measuring ≤1.0 micrometers, particulates measuring ≤10 micrometers, HCHO (Formaldehyde) concentration, TVOC (Total Volatile Organic Compounds) levels, air temperature, and humidity.

a. Balayon Village.

Figure 2.9. Air quality sampling in Balayon Village

Air quality in Balayon Village shows PM2.5 values (particulates ≤2.5 micrometers in size) are at low levels, indicating that the concentration of fine particles in the air is safe to breathe.

PM1.0 (Particulates ≤1.0 micrometer) concentrations were also relatively stable throughout the day and at low levels, indicating good air quality. Although there was a slight increase in PM10 (Particulates ≤10 micrometers) values in the afternoon and evening, all values remained within safe limits. HCHO (Formaldehyde) concentrations remain low , although there is a slight increase during the day. Formaldehyde is a substance to watch out for, but this value is still below the harmful threshold.

TVOC (Total Volatile Organic Compounds) levels showed fluctuations, with the highest values during the day. Despite this, concentrations were still within acceptable levels . The highest air temperature was recorded in the afternoon, contributing to warmer weather conditions. Humidity was relatively high in the morning and evening, while lower during the day. The air quality (AQI) was declared "Excellent" consistently throughout the day, indicating that the air in the neighborhood is safe for activities.

b. Boyomoute Village

Air quality in Boyomoute Village shows that PM2.5 values (particulates ≤2.5 micrometers) fluctuate, with the highest concentrations at night. Despite the increase, all values are still relatively low and do not indicate a health risk.

PM1.0 (particulate matter ≤1.0 micrometer) concentrations remained low and also varied with time. Values in the morning and evening were higher, but remained within safe thresholds. PM10 (Particulates ≤10 micrometers) showed an increase in concentration from morning to night, with the highest levels at night. These values remain within acceptable limits, but warrant attention if this trend continues.

HCHO (Formaldehyde) showed fluctuations, with the highest values in the morning. Overall, these values remained within safe limits, although the afternoon measurements showed the lowest concentrations.

TVOC (Total Volatile Organic Compounds) showed significant variations, with the highest concentration in the morning and the lowest in the afternoon. Although there were fluctuations, all values were within the safe zone. The highest temperatures were recorded during the day, which may have contributed to the levels of certain pollutants. A decrease in temperature was observed in the afternoon to evening. Relative humidity was higher in the afternoon and evening compared to the daytime, which may have contributed to the perceived improvement in air quality. Air quality was declared "Excellent" throughout the day, indicating that the air in this area is safe for activities, with no health risks to residents.

c. Komba-Komba Village.

Air quality in Komba-komba Village shows PM2.5 (particulate matter ≤2.5 micrometers) concentrations are consistently low throughout the day, except at night where there is an increase to 9 µg/m³. Despite the increase, the value is still within safe limits.

PM1.0 (particulate matter ≤1.0 micrometer) concentrations also remained at low levels with a slight increase at night. However, it is still considered safe for health. PM10 (Particulates ≤10 micrometers) also showed an increase at night. Despite the increase, overall, the values are still within safe limits for air quality.

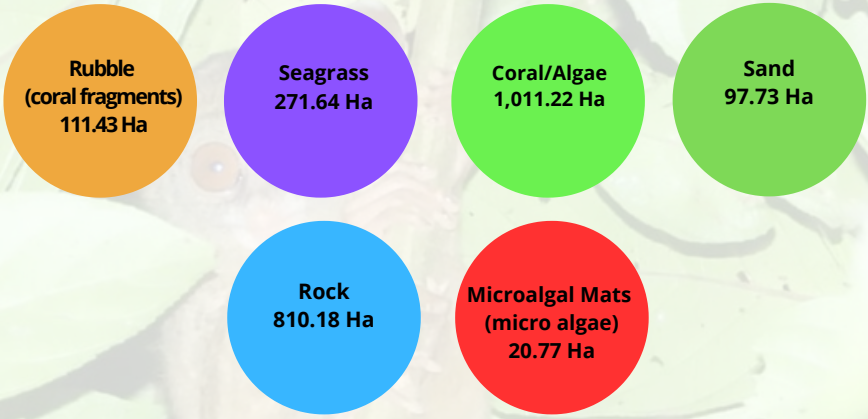
Figure 2.10. Komba-Komba Village Air Quality Sampling

The concentration of HCHO (Formaldehyde) fluctuates, with a peak during the day. Values at night are very low, indicating better air conditions.

TVOC (Total Volatile Organic Compounds) showed significant fluctuations, with the highest values during the day and the lowest at night. Levels during the day were slightly at risk, but still within acceptable limits. The highest temperature was recorded during the day, with a drop in temperature in the afternoon and evening, which may have contributed to the fluctuations in air quality. Humidity was relatively high in the morning, which may affect the perception of air quality. Humidity decreased during the afternoon and then increased again in the afternoon and evening. The air quality (AQI) was declared "Excellent" throughout the day, indicating that the air in this area is safe for outdoor activities and does not pose any health risks.

2.7 Threats to Existing Coral Reefs.

Referring to the Allen Coral Atlas 2025 data, the reefs in the heart of Peling Island are divided into several categories including :



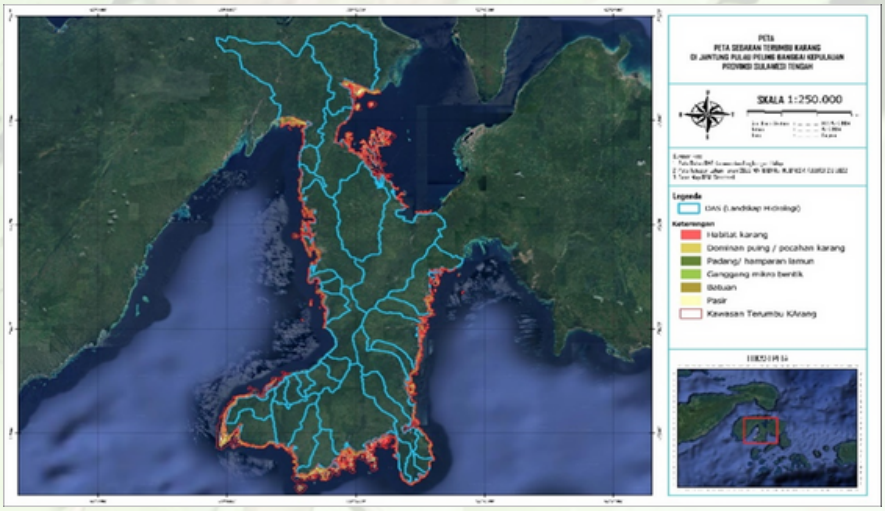


Figure 2.11. Map of Coral Reef Distribution in the Core of Peling Island, Banggai Archipelago

The current condition of coral reefs is mostly damaged by destructive fishing activities.

Another factor is that several large watersheds in the Core of Peling Island, such as the Kayubet watershed, Komba-Komba watershed and Tg. Tinangkung, contribute to sediment flow on the island's coast. Unsustainable land use is a major factor in the increase of sediment in river estuaries.

Is feared that the issuance of a rock mining license on this island will lead to more sediment on the coast, which can damage corals.

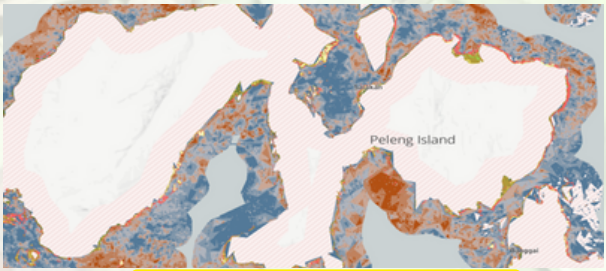


Figure 2.12. Allen Coral Atlas 2025 Seawater Turbidity

2.8 Projected biodiversity loss in the Heart of Peling Island

a.Bird Diversity Index

Figure 2.13. (Brinji Emas Banggai) :KOMIU Foundation Team Photo

Birdwatching was conducted for 14 days in this area, this monitoring succeeded in identifying as many as 47 bird species from 24 families observed, there were 16 Sulawesi Endemic bird species, including Sikatan-rimba banggai *(Cyornis pelingensis),* Brinji Emas Banggai *(Hypsipetes harterti),* Chili Panggul Kelabu *(Dicaeum celebicum),* Pekaka Bua-bua *(Pelargopsis melanorhyncha),* Sulawesi Snake Eagle *(Spilornis rufipectus),* Kapasan Sulawesi *(Lalage leucopygialis),* Kekep Sulawesi *(Artamus monachus),* Pergam Putih *(Ducula luctuosa),* Sula Serindit (Loriculus sclateri), UncalSulawesi *(Macropygia albicapilla)*, Walik Banggai *(Ptilinopus subgularis),* Paok Sula *(Erythropitta dohertyi)*, King Perling Sula (Basilornis galeatus), Kacamata Dahi Hitam *(Zosterops atrifrons),* Sikep Madu Sulawesi *(Pernis celebensis).*

Table 2.2. Diversity Index (H')

Titik Stasiun *(Point count)*	Jumlah Spesies	Indeks Keanekaragaman
Jantung pulau peling	47	2.96**

Description:
**Medium Diversity

Bird diversity in the core of Peling Island was recorded in the category with a moderate diversity index. This is because at the heart of Peling Island, forest cover has been reduced, the loss of forest cover was caused by the operation of forest use rights (HPH) in the 1980s - 1990s. Nevertheless, there were still 16 endemic bird species observed, but some of them were categorized as Near Threatened.

b. Indeks keragaman fauna

Tarsius Pelengensis is also one of Sulawesi's endemic primates known for its large eyes and nocturnal activities. Based on the results of field surveys, we managed to document tarsier populations in 6 forest points in Banggai Islands Regency, precisely in the core of Peling Island.
These tarsiers are found living in small groups, taking refuge in bushes and trees.

Figure 2.14. (Tarsius pelengensis) KOMIU Foundation Team Photo

The presence of tarsiers in the Banggai Islands adds to the region's rich list of endemic fauna. However, this discovery is also accompanied by concerns, considering that threats to tarsier natural habitats such as deforestation, forest fragmentation, and illegal hunting still occur frequently. Therefore, there is a need for attention and joint efforts from various parties, including local governments, non-governmental organizations, and local communities, to protect and preserve tarsier habitat.

Flying lizards (Draco) are also found in the core of Peling Island, Banggai Islands Regency, a testament to the region's rich biodiversity. The flying lizard, known for its unique ability to glide between tree branches using a membrane of skin between its legs, is one of the typical fauna of tropical forests in Southeast Asia including Indonesia.

Gambar 2.15. (Draco) Kadal Terbang, KOMIU Foundation Team Photo

Flying lizard populations are found in several spots such as humid areas of primary and secondary forests. The flying lizard's easily recognizable appearance, with its flattened body and striking colors on its wing membranes, is an attraction in itself.

The presence of these flying lizards confirms that Banggai Islands Regency has a well-maintained ecosystem, capable of supporting the lives of rare and endemic species. However, threats to their habitat such as deforestation, land clearing, and poaching should be watched out for.

2.9 Projected Impacts on Key Economic Commodities in the Core of Peling Island

The agricultural products of the community in the heart of Peling Island consist of several leading commodities including:

Table 2.3. Leading Agricultural Commodities of the Peling Island Community

No	Komoditas	Harga
1.	Kemiri	Rp. 8.000. per/kg
2.	Ubi Banggai	Rp. 14.000./kg
3.	Jambu mete	Rp. 7.000. per/ kg
4.	Manggis	Rp. 25.000./kg
5.	Durian	Rp. 50.000./ikat
6	Kacang Tanah	Rp. 25.000./liter
7	Nilam	Rp. 950.000 – Rp. 1.000.000 /liter

While in the marine sector, the community, especially in Komba-Komba Village, cultivates seaweed, which is the main center of seaweed production in Banggai Islands.

Table 2.4. Komba-Komba Village seaweed production

Produksi Rumput Laut Desa Komba-Komba			
2020	**2021**	**2022**	**2023**
215	283	463	310
319	375	524	331
308	362	557	329
242	286	545	205
291	354	641	284
302	304	556	294
344	371	583	324
2.028 Kg	**2.335 kg**	**3.869 kg**	**2.077 Kg**

The potential of these coastal resources, by the Central Government, is realized in the seaweed downstreaming program because it is seen as having enormous potential, which is believed to have a positive impact on the coastal economy and employment in the Coastal region and has been outlined in the national medium-term Development Plan (RPJMN) 2025-2029.[11] This is in line with the development direction of the Central Sulawesi provincial government 2025-2029, which integrates the establishment of the Banggai Islands Regency as a seaweed downstream area.[12]

The existence of limestone mining licenses on the island will certainly affect seaweed growth due to increased sedimentation from mining activities which can certainly reduce the quality and production of seaweed in the Banggai Islands.

2.10 Potential For Social Conflict.

The entry of rock mining investment on the island has created pros and cons among the community. For the pro-mine community, in addition to receiving compensation for land sales, they were also promised employment. Meanwhile, those who are against are worried about the environmental impact caused, but there are also those whose areas are not included in the compensation plan so they become cons.

Land tenure on the island in plantation and agricultural areas is dominant only has a land ownership certificate (SKPT) while in residential areas they dominantly have certificates of ownership (SHM).

This investment triggers jealousy between the community receiving and rejecting the mine, so it requires an active role for the local government to conduct socialization, especially inviting the community to participateactively in making decisions using the principle of Free, Prior and Informed Consent (FPIC) which means free, prior, and informed consent without coercion.

11. Presidential Regulation No. 12 of 2025 on the National Medium-Term Development Plan 2025-2029, Annex IV.
12 . BAPPEDA of Central Sulawesi Province, Preliminary Draft of RPMD of Central Sulawesi Province 2025-2029

2.11 Education Level and Labor Absorption in the Rock Mining Sector

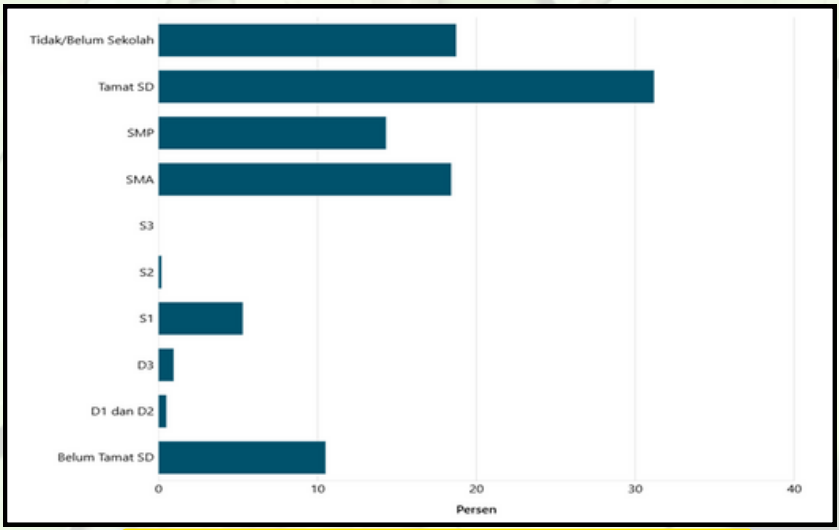


Figure 2.16. Percentage of Banggai Islands population by education level December 2024

Data from the Directorate General of Population and Civil Registration (Dukcapil) shows that the population of Banggai Islands Regency, Central Sulawesi, will reach 130.01 thousand people in 2024. However, only 6.88% of the population had completed higher education in December 2024.

The proportion of people with D1 and D2 education is 0.48%, while D3 is 0.94%. Then, the population with S1 education reached 5.29%, S2 0.17%, and S3 0.002%. Furthermore, the proportion of the population with high school graduates amounted to 18.41%. Junior high school and elementary school graduates are 14.31% and 31.18% respectively. Meanwhile, there are 10.5% of the population of Banggai Islands Regency who have not graduated from elementary school. The number of people who are not yet in school is 18.72%.[13] This certainly affects the absorption of labor in the rock mining sector which in general will recruit workers with types of work including :

1. **Technical workers:** mining engineers, geologists, heavy equipment technicians or operators, machine maintenance technicians.
2. **Production operations work:** Mine operations manager and supervisory personnel
3. **Supporting Occupations**: Occupational health and safety (OHS) experts, environmental experts, finance/accounting experts and administrative staff.

When viewed with the level of education of the people in the study area, in terms of labor qualifications, the available labor force currently does not meet the criteria, so labor recruitment will certainly rely on workers from outside this region.

Although employed, the labor force absorption in the company will only absorb certain jobs such as, vehicle traffic controllers, security and heavy equipment operators who must obtain certification.

13. Irfan Fadhlurahman. Presentasi Penduduk Banggai Kepulauan Menurut Jenjang Pendidikan Desember 2024 (2025 April 18) di akses pada artikel https://databoks.katadata.co.id/demografi/statistik/b1fec04ce11c7f3/1431-penduduk-kab-banggai-kepulauan-lulusan-smp-pada-akhir-2024#:~:text=Berikut%20ini%20rincian%20jumlah%20penduduk%20Kabupaten%20Banggai,*%20Tidak/Belum%20Sekolah:%2024%2C33%20ribu%20jiwa%20(18%2C72%)

CHAPTER III
CONCLUSION

3.1 Conclusion

- The issuance of 20 permits for mining business areas (WIUP) and mining business licenses (IUP) for Production Operations in the core of Peling Island, controlling an area of 1,593.54 hectares and the concessions intersect with protection areas, water sources and areas managed by the community as economic resources.
- The community's nomadic farming method with a 5-year cycle affects the forest and land cover in the core of Peling Island.
- Over-exploitation of these landscapes will degrade the watersheds at the core of the island and increase the risk of flooding and drought. These conditions contribute to sediment flows on the island's coasts.
- The air quality at the sample sites is relatively clean and free from various harmful contaminants. However, the absence of disinfectants (chlorine and bromine) is a concern, especially for water consumption. Hardness and pH levels are within acceptable limits. However, it is important to remember the importance of water treatment and disinfection, especially to keep it clean from microorganisms, as well as regularly monitoring nitrate levels. Good hardness and pH levels, along with high alkalinity, contribute to the stability of water quality on the island
- The air quality at the sample sites showed PM2.5 (particulate matter ≤2.5 micrometers) values to be at low levels, indicating that the concentration of fine particles in the air is safe to breathe. HCHO (Formaldehyde) concentrations remain low. TVOC (Total Volatile Organic Compounds) levels showed fluctuations, with the highest values during the day. Nonetheless, concentrations were still within acceptable levels and the Air Quality Index (AQI) was consistently "Excellent" throughout the day, indicating that the air in the neighborhood was safe for activities.
- Bird diversity in the core of Peling Island was categorized with a medium diversity index. 16 endemic bird species were observed, but some of them are categorized as Near Threatened. In addition to birds, there are other endemic species including Tarsius pelengensis and flying lizard (Draco). The relatively good ecosystem conditions in this area are able to support the life of rare and endemic species. However, threats to their habitat such as logging, land clearing, and limestone mining will have a direct impact on these species.

- The plan to mine limestone in the core of Peling Island will indirectly affect the production of the island's leading commodities such as Ubi Banggai (Banggai Yam) and seaweed, which can trigger social conflicts on the island.

3.2 Rekomendasi

The limestone mining plan in the core of Peling Island Banggai Archipelago, becomes a major issue when the mining concession is located in local protection areas, endemic species habitat of Peling Island, productive plantation areas and coral reef spots are expected to be affected. These areas are then delineated into indicative maps of No Go Mining Zone.

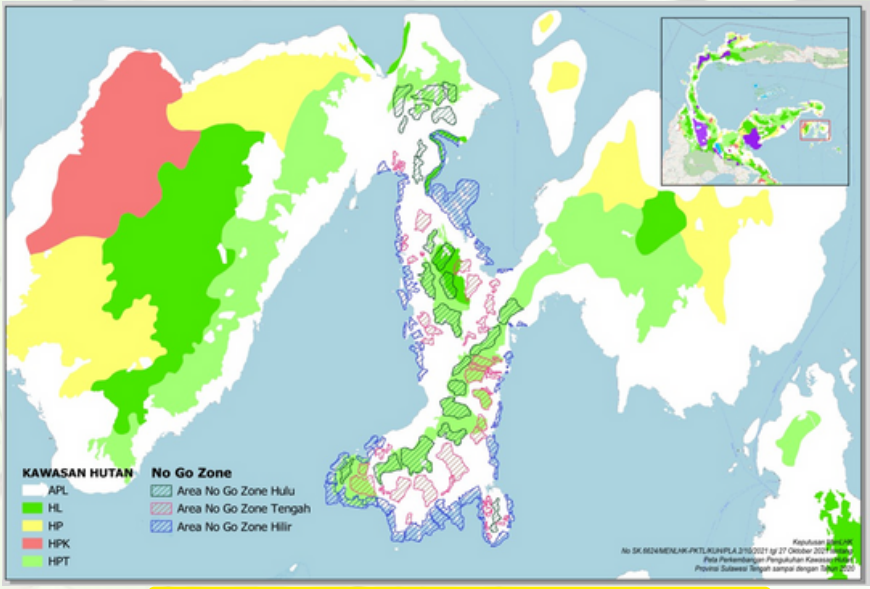


Figure 3.1 Map of No Go Mining Zone Area of Peling Island Core of Banggai Archipelago

This map is used to balance economic and environmental aspects. It is recommended that the district and provincial governments of Central Sulawesi use this map to provide technical recommendations for limestone mining companies investing in the Banggai Islands.

Indicative map of No Go Mining Zone in the core of Peling Island is divided into 3 zones including:

Indicative Map No Go Mining Zone Upper Section

Indicative Map No Go Mining Zone Upstream, has an area of 6,504.05 Ha, located in a highland or mountainous area characterized by large river flow velocities, so that it is able to carry large particles and the level of erosion at the bottom of the river is high compared to riverbank erosion, the slope gradient is quite high and the river body is narrow, and there are many large stones in the river. In addition, natural forest cover is still available which functions to infiltrate rainwater into the soil.

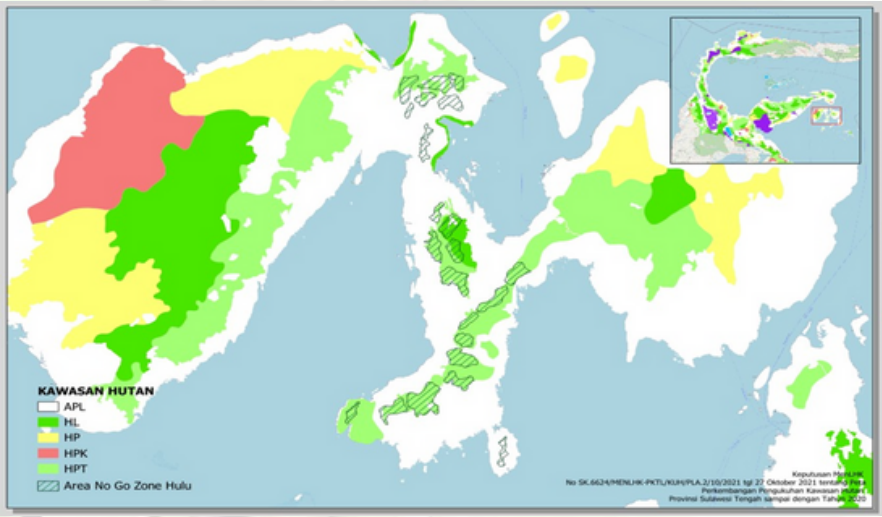


Figure 3.2. Map of No Go Mining Zone Area Upstream of Peling Island Banggai Archipelago

Indicative Map No Go Mining Zone Center section.

Indicative Map No Go Mining Zone The central part, **the area reaches 6,759.66 Ha**, this determination is based on the function of utilization of the ar river that is managed to be able to provide benefits for social and economic interests, which among others can be indicated from water quality, the ability to channel water and groundwater levels, as well as related to irrigation infrastructure such as river, reservoir and lake management.

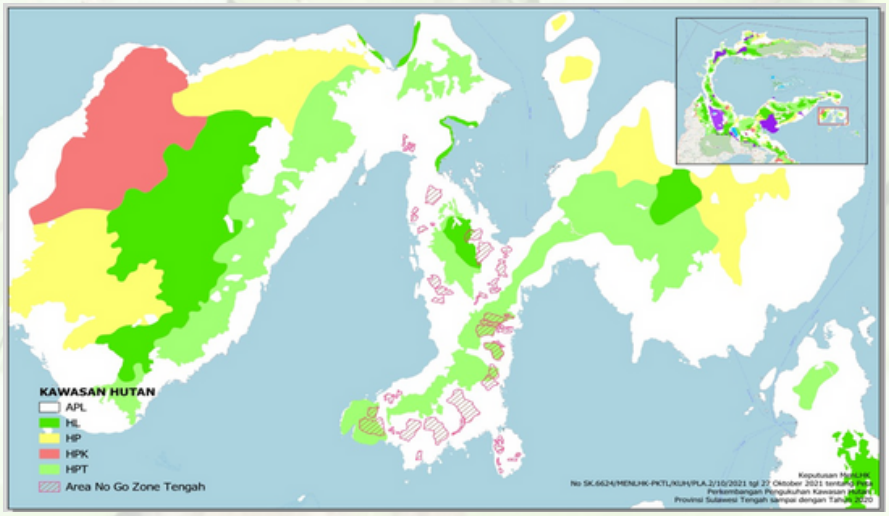


Figure 3.3. Map of No Go Mining Zone Area of the Central Part of Peling Island Banggai Archipelago

Indicative Map of No Go Mining Zone downstream

Indicative Map of No Go Mining Zone downstream, **the area reaches 4,607.82 Ha**, located in the lowlands towards the sea or lake and has a slow river flow so that particles are still able to flow only small particles. The erosion process is greatly reduced, the dominant thing is the process of sedimentation of mud, harlus sand that forms meanders and deltas, the shape of the meandering river, and the shape of a very wide valley. Including coral reef cover which is a coastal ecosystem on this island.

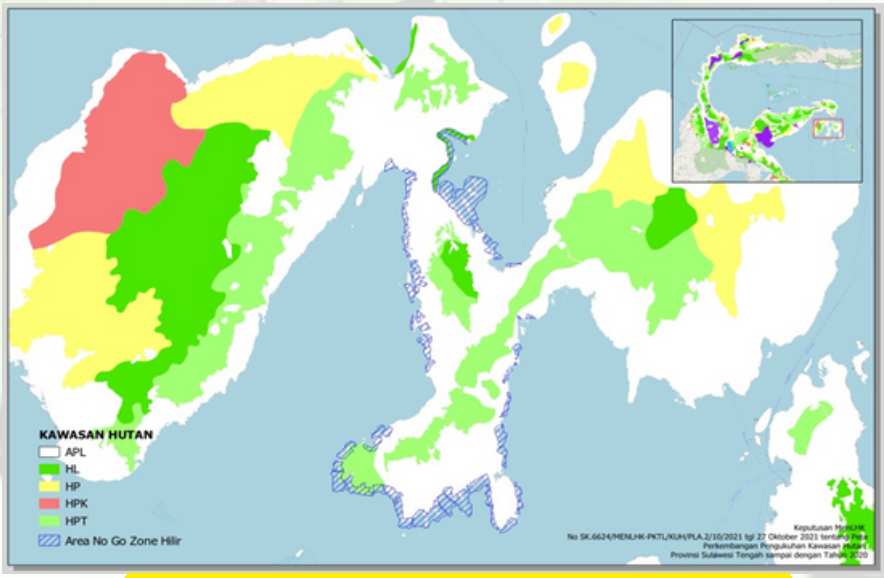


Figure 3.4. Map of No Go Mining Zone Area Downstream of Peling Island Banggai Archipelago

GLOSSARY

- Allen Coral Atlas: an innovative coral reef conservation tool that uses high-resolution satellite imagery and machine learning to map and monitor coral reef habitats around the world
- Air Quality Monitor: a device used to measure and monitor the level of air pollution in an area, both indoor and outdoor
- Iron: a chemical element with the symbol Fe (from Latin ferrum) and atomic number 26. Iron is a metal that belongs to the first transition series and group 8 of the periodic table. In addition, iron is also the most widely used element in the world, especially in construction, manufacturing, and various other applications.
- Limestone: limestone, a sedimentary rock composed mainly of calcium carbonate (CaCO3)
- BMKG : abbreviation of the Meteorology, Climatology and Geophysics Agency. It is a Non-Ministerial Government Institution in Indonesia tasked with carrying out government duties in the fields of meteorology, climatology, and geophysics
- Bromine: a chemical element with the symbol Br and atomic number 35
- Sentinel-1 SAR GRD (Synthetic Aperture Radar Ground Range Detected) satellite imagery: radar data generated from the Sentinel-1 satellite, which has been processed to display data in ground range coordinates
- Degradation: decline (in rank, quality, morale, etc.), deterioration, and degeneration
- Secondary data: data that is already available and collected by other parties, not by the researchers themselves for specific research purposes

- Primary data : the type of data collected directly by researchers from the original source for specific research purposes, not from existing sources or secondary data

- Watershed (DAS) : a land area bounded by topographic dividers (ridges) that functions to accommodate, store, and drain rainwater into rivers and eventually into lakes or the sea

- Delineation : the process of creating a boundary line to mark a certain object or area, either on a map or in the field.

- Endemism: a condition in which a species of organism (plant, animal, or microorganism) is only found naturally in a certain geographical area and nowhere else in the world

- Business license expansion: the process of expanding or developing a business that requires official permission from the authorities to be able to operate legally in the expanded area

- Terrestrial ecosystem : a type of ecosystem found on land

- Kelapa Island Karst Hills Complex Ecoregion : a geographical area with unique characteristics of climate, soil, water, flora, and fauna, as well as patterns of human interaction with nature that describe the unity of natural systems and the environment around the karst hills of Kelapa Island

- Ferronickel: an alloy of iron and nickel that is commonly used as an alloy in steelmaking, especially stainless steel

- Focus Group Discussion (FGD) : a systematic and directed discussion of a group to discuss a particular issue in an informal setting and conducted with the guidance of a moderator

- Forest Concession Rights (HPH) : a license granted to certain parties to manage and utilize production forest areas, including logging, maintenance, processing, and marketing of forest products. HPH used to be a commonly used term, but is now better known as a Business Permit for Utilization of Timber Forest Products in Natural Forests (IUPHHK-HA) according to the Minister of Environment and Forestry Regulation

- Seaweed downstreaming : The process of increasing the added value of seaweed through processing into various derivative products that have a higher selling value

- Diversity index: a quantitative measure used to describe the diversity of species in a community or ecosystem

- Shannon-Wiener diversity index: a measure used to quantify species diversity in a community or ecosystem

- Implementation : the implementation or application of a plan, program, or policy that has been prepared previously

- Inclusive : accepting and involving all people regardless of differences in background, ability, or other characteristics

- IUP OP : stands for Production Operation Mining Business License. This is a license granted by the government to a company or business entity to carry out mining production activities, after previously obtaining an exploration license (IUP Eksplorasi)

- Water hardness : a measure of the mineral content, especially calcium and magnesium, dissolved in water

- Chromium (Cr) : a metallic chemical element that is hard, steel gray, and resistant to corrosion

- Qualitative : a research approach that aims to understand social phenomena in depth using non-numerical data such as text, interviews, observations, or documents

- Quantitative : something that is based on number or amount

- Karst : a landscape formed by the dissolution of rocks such as limestone and dolomite by water

- Chlorine : a chemical element with the symbol Cl and atomic number 17. It is a greenish-yellow gas at room temperature and has a pungent odor. Chlorine is widely used as a disinfectant, sanitizer, and in various industries, including water treatment and bleaching

- Formaldehyde concentration: a measure of how much formaldehyde is contained in a solution or environment. Formaldehyde is a common chemical compound used in a variety of applications, including as a preservative and disinfectant, and in the production of products such as resins, plastics, and textiles

- Calibration: the process of comparing a measuring instrument to a standard of known accuracy, to ensure it gives accurate and consistent results

- Exploration method : various ways or techniques used to search, find, and investigate the existence of an object, phenomenon, or information, both in the context of scientific, research, and other practical activities

- Mangrove : a group of plants that live in coastal areas, especially in the intertidal zone or tidal area

- Indigenous peoples : groups of people who have lived for generations in a particular area, have ancestral origins, cultural identity, customary law, and a strong connection to the land and surrounding environment

- MapBiomas : an open platform that provides detailed and continuous data and maps of land cover and use

- Mercury: also known as mercury, is a chemical element with the symbol Hg and atomic number 80

- No Go Zone : an area that is prohibited from being utilized for various reasons, such as for the sake of preserving biodiversity and its protected functions

- Nickel Pig Iron (NPI) : pig iron that contains less than 15% nickel, and has higher levels of sulfur and phosphorus than ferronickel

- NDWI (Normalized Difference Water Index) : an index used in remote sensing to detect and monitor the presence of water on the earth's surface, such as lakes, rivers, and swamps, as well as water content in vegetation

- Nitrite: a chemical compound containing nitrogen and oxygen, with the chemical formula NO2-. Nitrite is an oxidized form of nitrogen and is an intermediate in the nitrogen cycle, formed from the oxidation of ammonia and can be converted to nitrate

- pH: stands for "potential of hydrogen" and is a measure of the acidity or basicity of a solution

- Carbonate sediments: sedimentary rocks composed mainly of carbonate minerals such as calcite (CaCO3) and dolomite (CaMg(CO3)2)

- Sulfites: a group of chemical compounds containing sulfite anions (SO_3^{2-}) and are often used as food and beverage preservatives to prevent discoloration and spoilage.

- Lead: a chemical element with the symbol Pb and atomic number 82. Lead is a toxic heavy metal that can be found naturally in the environment, and is also used in various industrial and household applications, although its use is increasingly restricted due to its toxicity

- TVOC: stands for Total Volatile Organic Compounds, which means Total Volatile Organic Compounds. It is a term used to measure the total amount of volatile organic compounds (VOCs) in a room or environment

- Vegetation : a collection of various plant species that grow together in one place, forming a plant community with interactions between plant species and the surrounding environment

- WIUP : abbreviation of Mining Business License Area. WIUP is an area or region granted to Mining Business License (IUP) holders to conduct mining business activities. In other words, WIUP is an area where IUP holders can carry out exploration and exploitation of mineral resources or coal

APPENDIX

WATER QUALITY RESULTS

Sample	Image	Description
Balayon Village Spring Point 1		1. Lead (Pb) = No lead detected 2. Copper (Cu) = No detected 3. Iron (Fe) = This result indicates that there is no iron dissolved in the water. 4. Chromium (Cr) = No chromium detected. 5. Sulfite = No detected 6. 6.Free chlorine = Not 7. Bromine =No bromine detected 8. Nitrate (NO3) = No nitrate detected 9. Nitrite (NO2) = No nitrite detected 10. Mercury (Hg): No mercury detected 11. Fluoride (F) = No detected 12. Hardness = A water hardness level of 125 mg/L is considered moderately high (+) or medium. This indicates that this water contains minerals such as calcium and magnesium. While this level is not harmful, it can affect taste and the potential for sediment formation in pipes. 13. pH = 7.2 A pH in this slightly alkaline range (close to neutral) indicates good water quality for most applications. pH 7.2 is considered safe and comfortable for consumption. 14. Total alkalinity = Good total alkalinity at 120 mg/L indicates that the water is able to neutralize acids and maintain pH stability. This is important to prevent extreme pH fluctuations. The results of this analysis indicate that the water is relatively clean and free from various harmful contaminants. However, the absence of disinfectants (chlorine and bromine) is a concern, especially for water consumption. Hardness and pH levels are within acceptable limits, however further monitoring is required to ensure that the water remains fit for use and consumption.

APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Balayon Village Spring Point 2		1. Lead (Pb) = No detectable lead in water 2. Copper (Cu) = Undetectable copper content 3. Iron (Fe) = No iron detected in the water. 4. Chromium (Cr) = Chromium level not detected. 5. Sulfite (SO_3) = No sulfite detected. 6. Free chlorine = Free chlorine level not detected. 7. Bromine (Br) = The amount of bromine is not detected, indicating the absence of bromine-based disinfectants in the water. 8. Nitrate (NO_3) = A detectable nitrate level of 10 mg/L, which is generally still considered safe for drinking water. 9. Nitrite (NO_2) = The nitrite level was recorded as 1 mg/L. This is also considered a low level. 10. Mercury (Hg) = No mercury detected in water. 11. Fluoride (F) = Fluoride level not detected 12. Hardness = The hardness level of water is 125 mg/L, which is categorized as semi-hard. Water with this hardness level may not have much effect on taste, but it can affect the ability of detergents to wash. 13. pH = 7.8: slightly alkaline pH. pH in the range of 6.5 to 8.5 is generally considered safe for drinking water, so this pH is also good and stable. 14. Total alkalinity = 120 mg/L: A total alkalinity of 120 mg/L indicates the capacity of the water to neutralize acids. It reflects good pH stability and the ability of water to cope with chemical changes from acidification or pollution. The results of this analysis indicate that the water is of good quality and safe for consumption in this context. Despite the presence of low levels of nitrate and nitrite, no harmful contaminants were detected, and other parameters, such as pH and alkalinity, indicate that the water is stable and non-acidic. However, it is recommended to monitor the water quality periodically, especially in relation to disinfectants (chlorine and bromine), to ensure safety if the water is used for consumption.

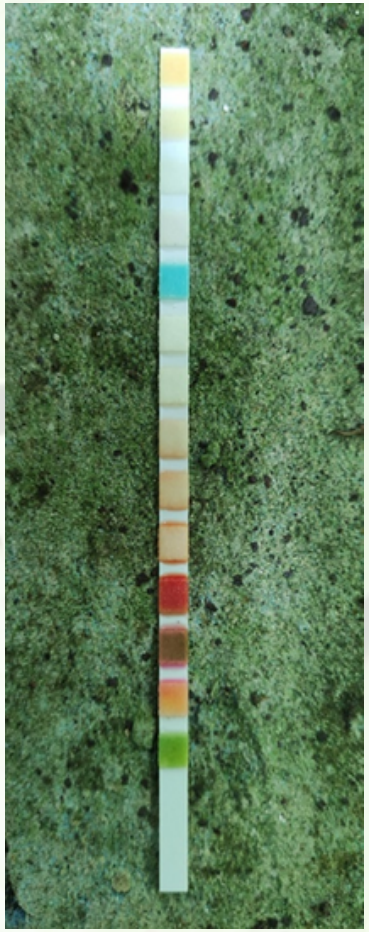
APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Balayon Village Point on Water/drain		1. Lead (Pb) = Absence of lead 2. Copper (Cu) = Without copper in water 3. Iron (Fe) = A result indicating the absence of iron means the water has no iron contaminants. 4. Chromium (Cr) = No detected 5. Sulfite = No presence of sulfite in water indicates that there is no sulfite-related problem 6. Free chlorine = Absence of 7. Bromine = Like chlorine, the absence of bromine indicates that no disinfectant was added. 8. Nitrate (NO3) = No nitrate indicates that the water is free of nitrate contamination 9. Nitrite (NO2) = Similar to nitrate, the absence of nitrite indicates that the water is safe and not contaminated by this harmful substance. 10. Mercury (Hg) = This result indicates no presence of mercury, which is a dangerous toxin to health. 11. Fluoride (F) = Absence of fluoride in water 12. Hardness = A water hardness level of 125 mg/L is considered quite high, which indicates that this water has more calcium and magnesium minerals. This can result in the formation of sediment and may affect the taste, but is not harmful within certain limits. 13. pH = 6.8 The pH is slightly acidic, but still within the acceptable range for most uses. This number shows the water to be near neutral (7), which is ideal for many applications. 14. Total alkalinity = Total alkalinity value 0. Low alkalinity can cause greater pH fluctuations and make water more easily acidic. It can also affect the ability of water to neutralize acids, thus questioning the stability of water quality. Analysis results show that this water is free of many harmful contaminants, which is a positive. The moderately high hardness levels should also be considered, especially if used for water intake or watering. It is recommended to retest and, if necessary, perform additional treatment to ensure the water becomes fit for consumption.

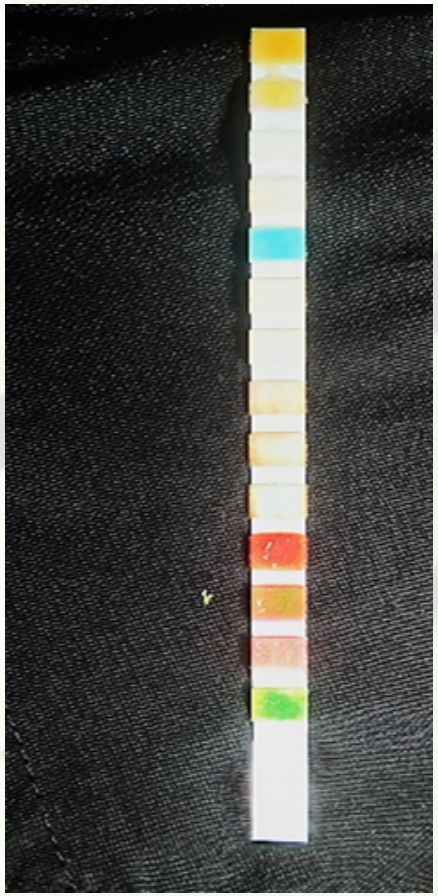
APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Balayon Village Spring Point 3		1. Lead (Pb) = Not detected 2. Copper (Cu) = Not detected 3. Iron (Fe) = Not detected 4. Chromium (Cr) = Not detected 5. Sulfite = Not detected 6. Free chlorine = Not detected 7. Bromine = Not detected 8. Nitrate (NO3) = Not detected 9. Nitrite (NO2) = Not detected 10. Mercury (Hg) = Not detected 11. Fluoride (F) = Not detected 12. Hardness = A water hardness level of 50 on the mg/L scale is considered low, indicating the water is slightly hard. Soft water with this level is more comfortable to use. 13. pH = 6.8: A pH closer to neutral (7) is considered ideal. pH 6.8 indicates this water is slightly acidic, but still within acceptable limits for most uses. 14. Total alkalinity = 80: A good alkalinity balance indicates the ability of water to neutralize acids. A figure of 80 mg/L is considered adequate to maintain water pH stability. The results of this analysis indicate that the water is relatively clean of various harmful contaminants (such as heavy metals and nitrates). However, the absence of disinfectants (chlorine and bromine) can be a concern, especially if the water is used for consumption. Hardness and pH levels are within good ranges for most uses, but care needs to be taken to keep the water safe and clean.

APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Boyomoute Village Pakaut Spring		1. Lead (Pb) = Not detected 2. Copper (Cu) = Not detected 3. Iron (Fe) = Not detected 4. Chromium (Cr) = Not detected 5. Sulfite = Not detected 6. Free chlorine = Not detected 7. Bromine = Not detected 8. Nitrate (NO3) = A nitrate level of 10 mg/L is within the limit that is usually considered safe, but if the level increases, it could indicate pollution from fertilizers or sewage. 9. Nitrite (NO2) = Not detected 10. Mercury (Hg) = Non-detection of mercury indicates that the water is safe from contamination with this heavy metal, which is extremely harmful when accumulated in the body. 11. Fluoride (F) = Not detected 12. Hardness = A water hardness level of 125 mg/L indicates that the water is classified as slightly hard. This means that the water contains minerals such as calcium and magnesium in sufficient proportion. 13. pH = A pH around 7.6 indicates that the water is slightly alkaline, which is generally within the safe range (between 6.5 and 8.5). 14. Total alkalinity = Total alkalinity of 120 mg/L indicates that the water has a good capacity to neutralize acids, which is good for aquatic ecosystem systems and water treatment. The results of this water analysis indicate good quality and relative safety. With the absence of harmful contaminants and other parameters within reasonable limits, this water can be considered suitable. However, it is important to remember to monitor nitrate levels and ensure appropriate treatment, especially in relation to water disinfection, to keep it safe from harmful microorganisms. Meanwhile, hardness and pH levels are within healthy ranges, and high alkalinity adds stability to the water quality.

APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Komba-komba Village Well 1		1. Lead (Pb) = No detectable lead in water. 2. Copper (Cu) = Copper levels were also not detected. 3. Iron (Fe) = No iron detected in the water. 4. Chromium (Cr) = No chromium detected in water. 5. Sulfite (SO_3) = Sulfite level not detected. 6. Free chlorine = Free chlorine level not detected. 7. Bromine (Br) = The amount of bromine was not detected, indicating that no bromine-based disinfectant was used. 8. Nitrate (NO_3) = The nitrate level is detected in an amount of 10 mg/L. This is usually considered safe. 9. Nitrite (NO_2) = 0 mg/L: Nitrite level recorded at safe level 10. Mercury (Hg) = No mercury detected, so the water is free from mercury contamination. Mercury is a heavy metal that is highly toxic and harmful to health. 11. Fluoride (F) = There is no fluoride in the water. 12. Hardness = The recorded water hardness level is 125 mg/L, which falls into the semi-hard category. Water hardness can affect taste and washability, but is not a direct health hazard. 13. pH = 7.8: pH is slightly alkaline, which means the water is in a good range. 14. Total alkalinity = 180: High total alkalinity indicates the capacity of water to neutralize acids. This indicates the stability of the water's pH, which is important for maintaining quality. The results of this analysis indicate that the water quality is good and safe. The absence of harmful contaminants and other parameters are within reasonable limits, making this water suitable for use. However, it is important to remember the importance of water treatment and disinfection, especially to keep it clean of microorganisms, as well as regularly monitoring nitrate levels. Good hardness and pH levels, along with high alkalinity, contribute to the stability of the water quality over time.

APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Komba-Komba Village Well 2		1. Lead (Pb) = No detectable lead in water. 2. Copper (Cu) = Copper levels were also not detected. 3. Iron (Fe) = No iron detected in the water. 4. Chromium (Cr) = No chromium detected in water. 5. Sulfite (SO_3) = Sulfite level not detected. 6. Free chlorine = Free chlorine level not detected. 7. Bromine (Br) = The amount of bromine was not detected, indicating that no bromine-based disinfectant was used. 8. Nitrate (NO_3) = The nitrate level is detected in an amount of 10 mg/L. This is usually considered safe. 9. Nitrite (NO_2) = 0 mg/L: Nitrite level recorded at safe level 10. Mercury (Hg) = No mercury detected, so the water is free from mercury contamination. Mercury is a heavy metal that is highly toxic and harmful to health. 11. Fluoride (F) = There is no fluoride in the water. 12. Hardness = The recorded water hardness level is 125 mg/L, which falls into the semi-hard category. Water hardness can affect taste and washability, but is not a direct health hazard. 13. pH = 7.8: pH is slightly alkaline, which means the water is in a good range. 14. Total alkalinity = 180: High total alkalinity indicates the capacity of water to neutralize acids. This indicates the stability of the water's pH, which is important for maintaining quality.

APPENDIX

WATER QUALITY RESULTS

Sample	Image	Intruduction
Komba-Komba Village Well 3		1. Lead (Pb) = No detectable lead in water. 2. Copper (Cu) = Copper levels were also not detected. 3. Iron (Fe) = No iron detected in the water. 4. Chromium (Cr) = No chromium detected in water. 5. Sulfite (SO_3) = Sulfite level not detected. 6. Free chlorine = Free chlorine level not detected. 7. Bromine (Br) = The amount of bromine was not detected, indicating that no bromine-based disinfectant was used. 8. Nitrate (NO_3) = The nitrate level is detected in an amount of 10 mg/L. This is usually considered safe. 9. Nitrite (NO_2) = Nitrite levels recorded at safe levels 10. Mercury (Hg) = No mercury detected, so the water is free from mercury contamination. Mercury is a heavy metal that is highly toxic and harmful to health. 11. Fluoride (F) = There is no fluoride in the water. 12. Hardness = The recorded water hardness level is 125 mg/L, which falls into the semi-hard category. Water hardness can affect taste and washability, but is not a direct health hazard. 13. pH = 7.8: pH is slightly alkaline, which means the water is in a good range. 14. Total alkalinity = 180: High total alkalinity indicates the capacity of water to neutralize acids. This indicates the stability of the water's pH, which is important for maintaining quality.

APPENDIX

AIR QUALITY MEASUREMENT RESULTS

Village Name	DATA LIST				Description
	Morning	Midday	Afternoon	Night	
Balayon	PM2.5: 4 ug/m3 PM1.0: 2 ug/m3 PM10: 5 ug/m3 HCHO: 0.020 mg/m3 TVOC: 0.111 mg/m3 TEMP: 27 °C HUM: 85 % AQI: Excellent	PM2.5: 4 ug/m3 PM1.0: 2 ug/m3 PM10: 5 ug/m3 HCHO: 0.039 mg/m3 TVOC: 0.217 mg/m3 TEMP: 32 °C HUM: 66 % AQI: Excellent	PM2.5: 5 ug/m3 PM1.0: 2 ug/m3 PM10: 6 ug/m3 HCHO: 0.019 mg/m3 TVOC: 0.106 mg/m3 TEMP: 28 °C HUM: 83 % AQI: Excellent	PM2.5: 6 ug/m3 PM1.0: 3 ug/m3 PM10: 7 ug/m3 HCHO: 0.019 mg/m3 TVOC: 0.108 mg/m3 TEMP: 25 °C HUM: 83 % AQI: Excellent	Overall, this data shows that the air quality throughout the day was in good condition with low concentrations of pollutants. The Air Quality Index (AQI) remained in the "Excellent" category, meaning there are no health risks to the public. This condition potentially supports outdoor activities and general health.
Boyomoute	PM2.5: 8 ug/m3 PM1.0: 5 ug/m3 PM10: 10 ug/m3 HCHO: 0.044 mg/m3 TVOC: 0.246 mg/m3 TEMP: 29 °C HUM: 72 % AQI: Excellent	PM2.5: 4 ug/m3 PM1.0: 2 ug/m3 PM10: 5 ug/m3 HCHO: 0.002 mg/m3 TVOC: 0.016 mg/m3 TEMP: 30 °C HUM: 67 % AQI: Excellent	PM2.5: 5 ug/m3 PM1.0: 3 ug/m3 PM10: 6 ug/m3 HCHO: 0.042 mg/m3 TVOC: 0.236 mg/m3 TEMP: 26 °C HUM: 83 % AQI: Excellent	PM2.5: 11 ug/m3 PM1.0: 6 ug/m3 PM10: 14 ug/m3 HCHO: 0.009 mg/m3 TVOC: 0.050 mg/m3 TEMP: 24 °C HUM: 84 % AQI: Excellent	Air quality was observed to be good with a consistent AQI value of "Excellent". Concentrations of harmful particles and substances are within safe levels for health. However, there are fluctuations among parameters such as PM2.5 and HCHO, which, if not properly regulated, may potentially cause problems if symptoms of increase continue. Generally, these conditions support outdoor activities and overall public health.

APPENDIX

AIR QUALITY MEASUREMENT RESULTS

Village Name	DATA LIST				Description
	Morning	Midday	Afternoon	Night	
Komba-komba	PM2.5: 4 ug/m3 PM1.0: 2 ug/m3 PM10: 5 ug/m3 HCHO: 0.031 mg/m3 TVOC: 0.173 mg/m3 TEMP: 26 °C HUM: 91 % AQI: Excellent	PM2.5: 4 ug/m3 PM1.0: 2 ug/m3 PM10: 5 ug/m3 HCHO: 0.060 mg/m3 TVOC: 0.394 mg/m3 TEMP: 31 °C HUM: 68 % AQI: Excellent	PM2.5: 4 ug/m3 PM1.0: 2 ug/m3 PM10: 5 ug/m3 HCHO: 0.033 mg/m3 TVOC: 0.185 mg/m3 TEMP: 27 °C HUM: 82 % AQI: Excellent	PM2.5: 9 ug/m3 PM1.0: 5 ug/m3 PM10: 12 ug/m3 HCHO: 0.006 mg/m3 TVOC: 0.036 mg/m3 TEMP: 24 °C HUM: 86 % AQI: Excellent	Air quality was observed to be good despite a slight increase in particulate matter at night. The Air Quality Index (AQI) consistently showed "Excellent," meaning that the air in the neighborhood was safe to breathe. Measurements show that while there are fluctuations in parameters such as TVOC and HCHO, all values remain within acceptable ranges, supporting public health and outdoor activities. High humidity in the morning can also provide a comfortable feeling in the environment.

APPENDIX

Birdwatching in the Core of Peling Island, Banggai Archipelago

No	Species Name	Scientific Name	Famili
1	Perling Maluku	*Aplonis mysolensis*	Sturnidae
2	Punai Gading	*Treron vernans*	Columbidae
3	Sikatan-rimba banggai*	*Cyornis pelingensis*	Muscicapidae
4	Baza Jerdon	*Aviceda jerdoni*	Accipitridae
5	Elang Bondol	*Haliastur indus*	Accipitridae
6	Betet Kelapa Punggung Biru	*Tanygnathus sumatranus*	Psittaculidae
7	Brinji Emas Banggai*	*Hypsipetes harterti*	Pycnonotidae
8	Burung Gereja Erasia	*Passer montanus*	Passeridae
9	Cabai Panggul Kelabu*	*Dicaeum celebicum*	Dicaeidae
10	Burung Madu Hitam	*Leptocoma aspasia*	Nectariniidae
11	Burung Madu Kelapa	*Anthreptes malacensis*	Nectariniidae
12	Burung Madu Sriganti	*Cinnyris ornatus*	Nectariniidae
13	Cekakak Merah	*Halcyon coromanda*	Alcedinidae
14	Pekaka Bua-bua*	*Pelargopsis melanorhyncha*	Alcedinidae
15	Cekakak Sungai	*Todiramphus chloris*	Alcedinidae

APPENDIX

Birdwatching in the Core of Peling Island, Banggai Archipelago

No	Species Name	Scientific Name	Famili
16	Cekakak Australia	*Todiramphus sanctus*	Alcedinidae
17	Delimukan Timur	*Chalcophaps stephani*	Columbidae
18	Elang Sayap Coklat	*Butastur liventer*	Accipitridae
19	Elang Ular Sulawesi*	*Spilornis rufipectus*	Accipitridae
20	Gagak Banggai*	*Corvus unicolor*	Corvidae
21	Gagak Hutan	*Corvus enca*	Corvidae
22	Gajahan Pengala	*Numenius phaeopus*	Scolopacidae
23	Kacamata Laut	*Zosterops chloris*	Zosteropidae
24	Kancilan Emas	*Pachycephala pectoralis*	Pachycephalidae
25	Kapasan Sulawesi*	*Lalage leucopygialis*	Campephagidae
26	Kedasi Hitam	*Surniculus lugubris*	Cuculidae
27	Kehicap Pulau	*Monarcha cinerascens*	Monarchidae
28	Kekep Babi	*Artamus leucorynchus*	Artamidae
29	Kekep Sulawesi*	*Artamus monachus*	Artamidae
30	Layang-layang Batu	*Hirundo javanica*	Hirundinidae

APPENDIX

Birdwatching in the Core of Peling Island, Banggai Archipelago

No	Species Name	Scientific Name	Famili
31	Pergam Hijau	*Ducula aenea*	Columbidae
32	Pergam Putih*	*Ducula luctuosa*	Columbidae
33	Punai Penganten	*Treron griseicauda*	Columbidae
34	Raja Udang Erasia	*Alcedo atthis*	Alcedinidae
35	Serindit Sula*	*Loriculus sclateri*	Psittaculidae
36	Tiong Lampu Biasa	*Eurystomus orientalis*	Coraciidae
37	Trinil Kaki Hijau	*Tringa nebularia*	Scolopacidae
38	Uncal Sulawesi*	*Macropygia albicapilla*	Columbidae
39	Walik Banggai*	*Ptilinopus subgularis*	Columbidae
40	Walik Kembang	*Ptilinopus melanospilus*	Columbidae
41	Paok Sula*	*Erythropitta dohertyi*	Pittidae
42	Raja Perling Sula*	*Basilornis galeatus*	Sturnidae
43	Srigunting	*Dicrurus montanus*	Dicruridae
44	Kepudang kuduk hitam	*Oriolus chinensis*	Oriolidae
45	Cangak Merah	*Ardea purpurea*	Ardeidae

APPENDIX

Birdwatching in the Core of Peling Island, Banggai Archipelago

No	Species Name	Scientific Name	Famili
46	Kacamata Dahi Hitam*	*Zosterops atrifrons*	Zosteropidae
47	Sikep Madu Sulawesi*	*Pernis celebensis*	Accipitridae

Description:
*** Endemic to Sulawesi**