



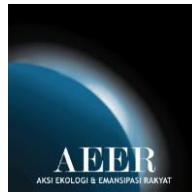
BTIIG Industry and Threats to High Conservation Value Areas in Morowali: A Consistency Test of IBSAP, FOLU Net Sink 2030, and the Kunming-Montreal Global Biodiversity Framework



Research Report

BTIIG Industry and Threats to High Conservation Value Areas in Morowali: A Consistency Test of IBSAP, FOLU Net Sink 2030, and the Kunming-Montreal Global Biodiversity Framework

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Action for Ecology and People's Emancipation (AEER)
Aksi Ekologi dan Emansipasi Rakyat (AEER)

2025

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Global Biodiversity Framework**

Size : 17 x 23,5 cm, Page : x + 70

Category : Research Report

Authors : Hamas Fathani
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Person responsible : Pius Ginting

Layout & Design : Taqi

Published by :

Action for Ecology and People's Emancipation (AEER) /
Perkumpulan Aksi Ekologi dan Emansipasi Rakyat (AEER)
Talavera Office Park, 28th Floor, Jl. T.B. Simatupang, South Jakarta

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About Action for Ecology and People's Emancipation (AEER)

AEER is an Indonesian environmental organization founded in 2017, dedicated to addressing ecological and social justice issues, particularly those exacerbated by unsustainable industrial practices. AEER's mission is to rescue communities impacted by environmental degradation and promote policies that support sustainability. The organization actively campaigns to reduce the country's dependence on fossil fuels, particularly coal, while encouraging a transition to low-carbon energy alternatives. This commitment is reflected in its target to help reduce Indonesia's carbon emissions by 446 million tons of CO2 in the energy sector by 2060.

The organization collaborates with local and international partners, including community groups, government agencies, and other NGOs, to conduct research and advocacy campaigns. AEER's activities are particularly important in the context of Indonesia's growing nickel industry, which, while playing a crucial role in the global transition to electric vehicles, also poses significant environmental and social challenges. By raising awareness, producing detailed research reports, and engaging in policy dialogue, AEER seeks to mitigate the negative impacts of mining and other industrial activities. The organization also emphasizes the importance of biodiversity conservation and the protection of vital ecosystems, working to ensure that economic development does not compromise environmental integrity.

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Photo Source: AEER Documentation

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Photo Source: AEER Documentation



EXECUTIVE SUMMARY

PT Boashuo Taman Industry Investment Group (BTIIG) plans to build and develop industrial parks in West Bungku, Morowali which covers around 7,376 hectares of area. The research shows that 3,945 hectares, or equivalent to 53.47 percent of the total area, are the High Conservation Value (HCV) areas. It means that more than half of the planned industrial park have ecological, social, and cultural functions, essential for sustainability.

The biggest portion of HCV is located in Sigendo Secondary Forest, covering up to 3,080 hectares of area. Sigendo is the main habitat for anoas, babirusas (deer-pigs), maleos, and Sulawesi hornbills. The forest also works to preserve the water systems, prevent erosion, and provide forest products such as honey and resin to society. There is also an Ultrabasic Forest in Folili with an area of 478 hectares. This forest offers a native ecosystem that grows on nickel-rich soil and features distinctive vegetation that is difficult to restore once damaged.

There are 69 hectares of Folili Karst identified in the karst area. Kumapa Cave is also in this area, which functions as a permanent and vital water source for the Wana community. There is also 283 hectares of riparian area that stretches along Ambunu, Monsumbu, and Moburu Rivers, serving the function of maintaining water quality as well as preventing sedimentation. Apart from that, the diverse areas in the Ambunu coastline exist on 31 hectares of territory, consisting of mangroves, swamps, and coastal forests. This mosaic coastline has an important role as the habitat for migratory birds and a natural barrier for the coastline. Another High Conservation Value area is Cultural Site Vavompogaro/Tokandindi Cave, recognized as a cultural heritage and possesses an important value for the identity and history of the local community.

The findings highlight the huge risks of nickel industry development in the area towards the unique ecosystems, endemic and endangered biodiversity, and socio-cultural sustainability. Due to their irreplaceable nature, specifically the ultrabasic and karst ecosystems, the precautionary principle should be applied. Thus, every HCV areas, which covers 3,945 hectares of land should be regarded as a no-go area until credible scientific evidence refutes it.

HCV approach is also in line with the national policy and global agenda, such as Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2025-2045, Kunming-Montreal Global Biodiversity Framework (KM-GBF), and FOLU Net Sink 2030 national target. In conclusion, preserving 3,945 hectares of HCV areas in Morowali is not only an ecological responsibility, but also a part of the sustainable development strategy and Indonesia's tangible contribution to the global conservation agenda.



Photo Source: AEER Documentation

1.1 Background

1.1.1 Sulawesi's Biodiversity and Its Utilization by the Local Community

Sulawesi is an island located in the Wallacea with a high level of biodiversity and species endemism. Many endemic faunas and floras exist in Sulawesi. The island is home to ebony family (*Diospyros spp.*), sawo family (*Sapotaceae*), nutmeg family (*Myristicaceae*), kenari family (*Burseraceae*), mango family (*Anacardiaceae*), and guava family (*Myrtaceae*). It is also home for endemic faunas like anoas (*Bubalus depressicornis*), maleos (*Macroncephalon maleo*), and hornbills (*Rhyticeros cassidix*). Avibase and iNaturalist reported that there are at least 555 bird species in Sulawesi, of which 105 are endemic^{1,2}. Island Endemism causes Sulawesi and other islands in Eastern Indonesia to be prone to environmental damage. The integrity of forests in Sulawesi should be preserved and protected due to the fact that most vulnerable endemic species can only be found in forests with healthy ecosystems. However, the ecosystems in Sulawesi forests also exhibit high resilience to logging disturbance³, meaning moderate logging activities are still tolerable for these ecosystems.

¹ Gill F, D Donsker & P Rasmussen (Eds). 2023. IOC World Bird List (v13.1). doi : 10.14344/IOC.ML.13.1.

² Lepage, D. Bird Checklist of the World - Sulawesi Tengah. Avibase (2024).

³ Waltert, M., Mardiastuti, A. & Mühlenberg, M. Effects of deforestation and forest modification on understorey birds in Central Sulawesi, Indonesia. *Bird Conserv. Int.* 15, 257–273 (2005).

Biodiversity also supports the livelihood of Sulawesi's local community. According to Statistics Indonesia (BPS), 28.64% of Indonesians rely on agriculture for their livelihood. Statistics Indonesia of Central Sulawesi Province also recorded that as many as 50% of the population make a living in the agricultural, forestry, and fisheries sectors⁴. Biodiversity functions as the germ plasm for the community that depends on agriculture, forest products, and marine products as livelihood. Based on the research conducted in various locations in Central Sulawesi, there were 113 species of flora out of 56 families that were utilized by the local community. Most of them were understory plants^{5,6,7,8} used as medicines.

The existence of biodiversity shows a strong connection between the forests in Sulawesi and the local community. The forests produce food sources, medicines, timbers, and water. On the other hand, a wise utilization by society contributes to ecosystem preservation. Due to the aforementioned situation, society is at risk of massive landscape changes caused by the expansion of extractive industries. In other words, the loss of forest ecosystems will not only extinct the endemic species but also threaten society.

Amid the importance of biodiversity and society's dependence on forests, the construction and development of the nickel industrial park by PT Boashuo Taman Industry Investment Group (BTIIG) at the West Bungku Sub-district of Morowali presents a significant challenge.

⁴ Statistics Indonesia of Central Sulawesi Province. Working Population Aged 15 and Over by Main Employment Sector of 2013-2015. *Statistic Table* <https://sulteng.bps.go.id/statictable/2016/03/20/537/penduduk-usia-15-tahun-keatas-yang-bekerjamenurut-lapangan-pekerjaan-utama-tahun-2013-2015-.html>.

⁵ Hapid, A. et al. Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia. *Pharmacogn. J.* **15**, 535–540 (2023).

⁶ Haruna, M. F., Kenta, A. M. & Herawati, H. Medicinal plants used by the community of Lipulalongo Village, Banggai Laut District, Central Sulawesi, Indonesia. *Asian J. Ethnobiol.* **5**, (2022).

⁷ Pitopang, R. et al. Plant diversity in agroforestry system and its traditional use by three different ethnics in Central Sulawesi Indonesia. *IOP Conf. Ser. Earth Environ. Sci.* **886**, 012058 (2021).

⁸ Rahmawati, N., Mustofa, F. I. & Haryanti, S. Diversity of medicinal plants utilized by To Manui ethnic of Central Sulawesi, Indonesia. *Biodiversitas J. Biol. Divers.* **21**, (2020).

1.1.2 PT Baoshuo Taman Industry Investment Group (BTIIG) Industrial Park

PT Baoshuo Taman Industry Investment Group (BTIIG) is a Foreign Direct Investment (FDI) company focusing on the development of industrial parks in Morowali District, Central Sulawesi. The developed industrial park is commonly known as Indonesia Huabao Industrial Park (IHIP), although the name is not registered as a company on the official website of the Directorate General of Legal Administrative Affairs of the Ministry of Law and Human Rights of the Republic of Indonesia. Thus, IHIP is the public name of BTIIG. It is also pointed out by many authorization processes that use PT BTIIG as the name.

The development of BTIIG industrial park is planned up to 20,000 hectares of area, carried out in phases. Until September 2024, the company is still developing the park on 5,761 hectares of land.⁹ The project has consumed USD260.14 million of investment since 2022. This industrial park development is located in villages such as Ambunu Village, Tondo Village, and Topogaro Village in West Bungku Sub-district, Morowali District. The main focus of this project is on the processing and refining of nickel ore, as well as the development of supporting infrastructures, such as smelters, PLTU captives, and dedicated terminals.

Currently, there's a smelter company operating in BTIIG industrial park, that is PT Shuoshi Indonesia Investment (SII). PT SII is a nickel processing company, producing ferronickel using the Rotary Kiln Electric Furnace (RKEF) technology. PT SII is planned to produce 1,200,000 tons of ferronickel per year. On May 23, 2024, PTSII exported 16,311.26 tons to Zhapu, China. This initial export reached a value of USD18 million.¹⁰

Ferronickels produced in BTIIG industrial park by PT SII's smelters are sold to Zhenshi Holding Group, directly or indirectly, through their subsidiary, Tongxiang Maoshi Trading Co., Ltd.

Similar to other nickel industrial parks, the energy resources in BTIIG industrial park also come from coal energy, using 3x250 MW Captive PLTU (Coal-Fired Power Plant). Captive PLTU in BTIIG industrial park belongs to Beishi Indonesia Investment.

⁹ Ministry of Agrarian Affairs and Spatial Planning/National Land Agency. (2024). Recommendation of Land Use Activity Compliance for National Strategic Projects Number PF.01/882a -200/III/2024. The Government of the Republic of Indonesia.

¹⁰ JPNN.com. (2024, May 29). PT Shuoshi Indonesia Investment Sukses Eksport Perdana Komoditas Feronikel ke China. Accessed from <https://m.jpnn.com/news/pt-shuoshi-indonesia-investment-sukses-eksport-perdana-komoditas-feronikel-ke-china>

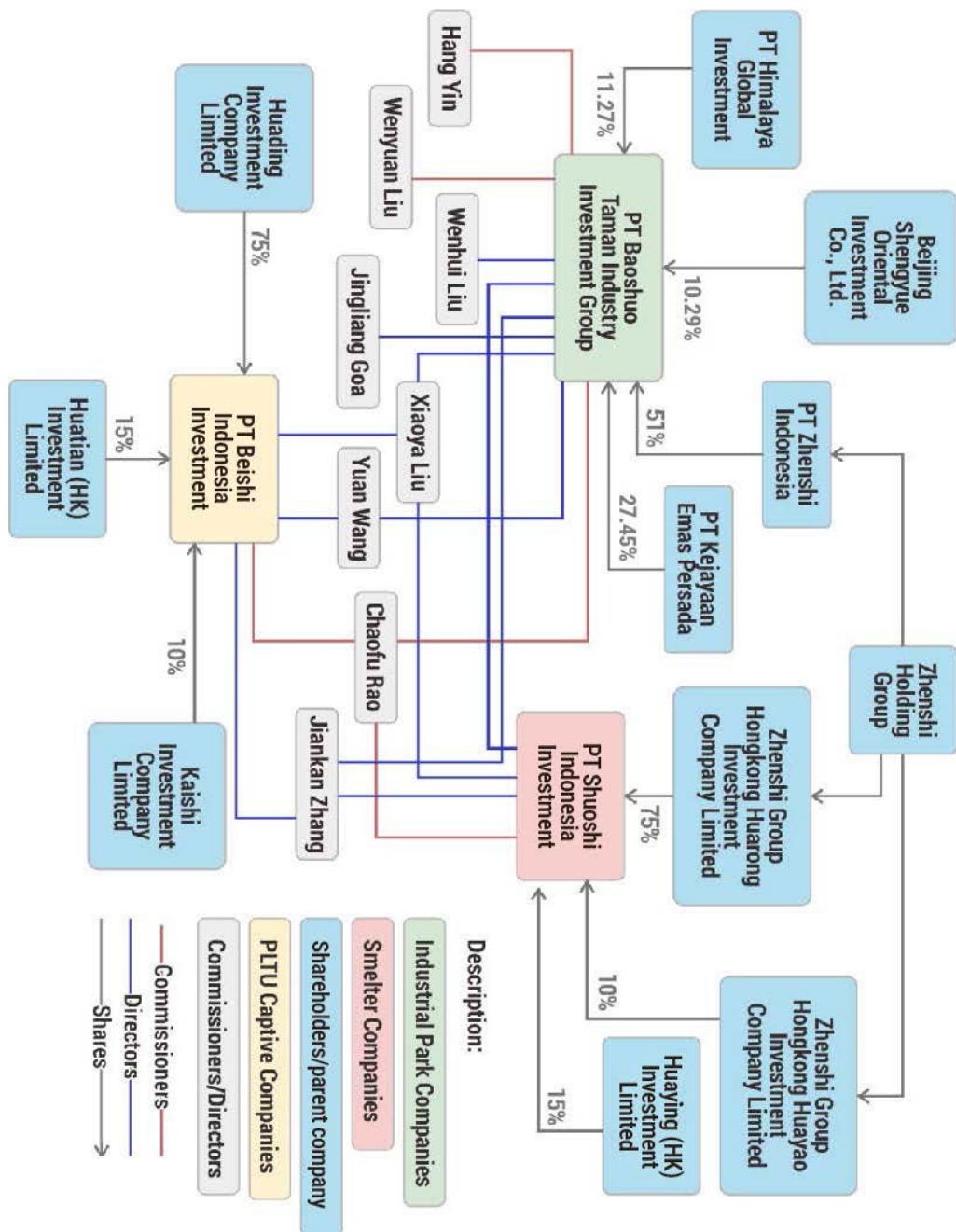


Figure 1. Ownership Chart of PT BTIIG and its Surrounding Subsidiaries

PT Baoshuo Taman Industry Investment Group (BTIIG) is part of a large-scale project managed by Zhenshi Holding Group, a leading Chinese conglomerate. According to BTIIG's ownership chart, Zhenshi Holding Group holds the majority control through its subsidiary, PT Zhenshi Indonesia by owning 51% of the shares. With this majority share, Zhenshi Holding Group has full control over BTIIG's strategic policy direction. BTIIG's minority shares are owned by other entities, such as PT Kejayaan Emas Persada (27.45%), PT Himalaya Global Investment (11.27%), and Beijing Shengyue Oriental Investment Co., Ltd. (10.29%).

PT Shuoshi Indonesia Investment is also under Zhenshi Holding Group through Zhenshi Group Hongkong Huarong Investment Company Limited which owns 75% of the shares and Zhenshi Group Hongkong Huayao Investment Company Limited which owns 10% of the shares. This majority ownership strengthens Zhenshi's control over PT SII's smelter operation. Apart from Zhenshi Holding Group, 15% of PT SII's shares are owned by Huaying (HK) Investment Limited.

Zhenshi Holding Group strengthens its position as the main manager of this industrial park Development by holding the majority shares of BTIIG and SII.

A captive PLTU company in BTIIG, PT Beishi Indonesia Investment, is under Huading Investment Company Limited which holds 75% of the shares. Other entities that own shares in PT BII are Huatian (HK) Investment Limited, with 15% of the shares and Kaishi Investment Company Limited, which owns 10%.

Taking a look at these three companies' boards of directors and commissioners, there are four individuals holding strategic positions within these organizations. They are Chaofu Rao, Jiankan Zhang, Yuan Wang, and Xiaoya Lu. These four people will ensure the synergy of these three companies.

Besides, Zhenshi Holding Group also cooperates with Hanrui Cobalt Nickel to develop smelters to produce nickel matte with the capacity of 20,000 tons/year. Under the joint venture agreement, Zhenshi Holding Group through Huaxin Investment Co., Ltd., shall invest as much as USD72.96 million or around 30% of the total investment. On the other hand, Hanrui Cobalt Nickel invests USD170.24 million through Hanrui Cobalt Industry (Hong Kong) Investment Co., Ltd. The project is planned to finish within 15 months.

1.2 Problem Statement

PT BTIIG industrial park is planned to cover a vast area of approximately 7,376 hectares in West Bungku Sub-district, Morowali District. This vast development area raises fundamental questions that should be answered through research.

First, what is the condition of the fauna community and vegetation in this large area? Also, how far will these rich species be able to survive in this industrial expansion? Second, what kind of flora and fauna species hold significant ecological and social values, particularly in relation to the local community's dependence on forests, seas, and other ecosystems surrounding the industrial park?

The next question relates to space and area. Which part of the BTIIG industrial park development plan can be categorized as High Conservation Value (HCV) areas? How is the position of these areas in relation to the historical and cultural values, such as the presence of an ancient cave that holds special significance in archeology and the spiritual beliefs of the indigenous people? Lastly, the research also aims to answer the questions regarding actual threats arising from the development of PT BTIIG industrial park to the existence of HCV areas, and their implications for both the ecosystem and the local community.

Photo Source: AEER Documentation



1.3 Objectives

1. Identifying and analyzing the diversity of vegetation and the fauna community found at West Bungku Sub-district, Morowali, in order to learn the fundamental condition of the ecosystem.
2. Identifying ecologically, economically, and socio-culturally high-valued flora and fauna species in PT BTIIG industrial park and its surrounding areas.
3. Determining areas with High Conservation Value (HCV) ecosystems, as well as historical and cultural values that are important for biodiversity, ecosystem services, and the sustainability of local communities.
4. Analyzing potential threats to the High Conservation Value areas from the industrial development of PT BTIIG and suggesting the protective measures and sustainable management practices.

Photo Source: AEER Documentation



1.4 Research Methods

This research was done using the High Conservation Values (HCV) approach. HCV refers to an approach or conservation tool focused on ecological, biological, cultural, or social values that hold remarkable significance. HCV approach consists of six categories as follows:

1. HCV 1 - Species diversity: biodiversity that includes endemic, rare, and endangered species that hold significant values.
2. HCV 2 - Landscape-level ecosystem: A vast and intact landscape-level ecosystem, including the entire forest landscape, serving as the habitat for indigenous species in distribution patterns and natural abundance.
3. HCV 3 - Ecosystem and habitat: An area functioned as a rare or endangered ecosystem and natural habitat.
4. HCV 4 - Ecosystem services: An area providing vital ecosystem services.
5. HCV 5 - Community essentials: Essential sites, areas, or resources to fulfill the basic needs of the local or indigenous community.
6. HCV 6 - Cultural value: Sites, resources, or landscapes with significant historical values, and/or carrying essential cultural, ecological, economic, or religious value for the traditional culture of local or indigenous communities.

This approach is applicable at both local and global levels. The objectives of HCV management are not only to conserve the ecosystem and biodiversity, but also to maintain livelihood sustainability, community welfare, and the preservation of local identity and cultural heritage.

The HCV method was chosen because this approach can identify areas, ecosystems, or landscapes that need to be preserved based on the essential values of an ecosystem. All six HCV categories can serve as guidance for preserving nature across all extractive industrial sectors, including mining. HCV values identification was done during the desk duty. Then, the verification and specification were done after the field data were collected. The selection of HCV areas was helped by the HCV-HCSA Assessment Manual¹¹ and HCV Toolkit Indonesia¹².

¹¹ Soetjiadi, A. et al. HCV-HCSA Assessment Manual. (2023).

¹² Consortium for the Revision of the HCV Toolkit in Indonesia. Guidelines for the identification of High Conservation Values in Indonesia (HCV Toolkit Indonesia). (2009).

1.4.1 Time and Place

The research was conducted at PT BTIIG areas, sourced from the document of wastewater utilization technical standard of PT BTIIG. PT BTIIG areas are located in West Bungku Sub-district, Morowali. The research took place for 2 weeks, from 19 to 31 August 2024. The timing was also chosen to align with the early bird migration season from the Asia mainland. This allowed the migratory birds to be monitored for the identification of HCV 1 and 3 areas.

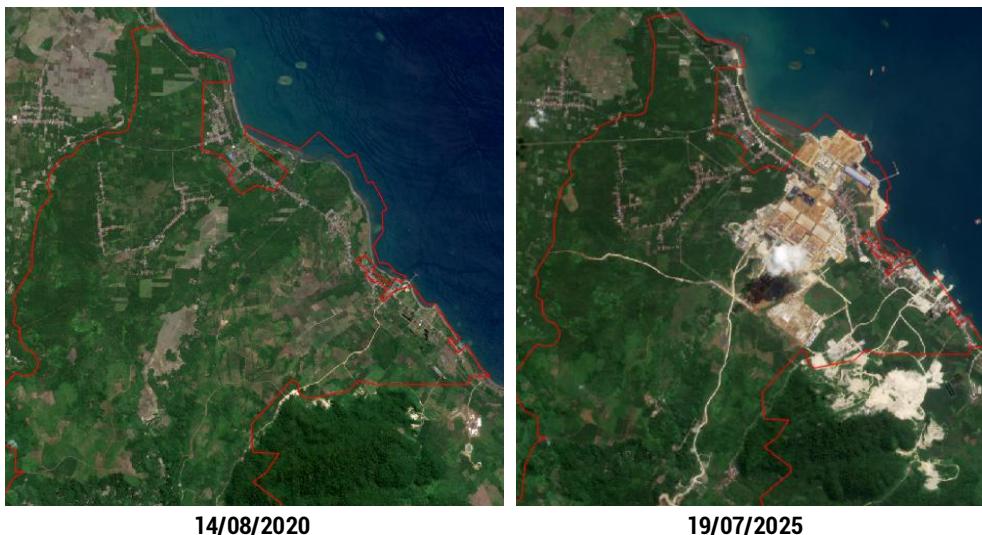


Figure 2. Maps of PT BTIIG's Developed Locations and The Surrounding Villages
(Source: Citra Sentinel-2)



Photo Source: AEER Documentation

1.4.2 Data Collection and Analysis

1.4.2.1 Document and map studies

Every publication related to PT BTIIG, such as PT BTIIG and its surrounding area maps, documents, reports, as well as news reports on PT BTIIG from mass media, NGOs, and CSOs, was compiled and studied to obtain a broader view. Document study was conducted to collect the field condition data and update the collected data in this study plan. The map study aimed to determine potential HCV areas, which would later be assessed directly on location. Document study was done without any time constraint. Document study could be done concurrently with other data collection.

HCV analysis was also carried out alongside the map study of PT BTIIG area. Map study particularly involved overlay analysis on regional maps using vector and raster maps to assess crucial areas for preservation. HCV criteria identification procedure also required in-depth map analysis. Map details analyzed in the desk study are described in Table 1 below.

Photo Source: AEER Documentation



Table 1. Data Required for Desk Study Method

Aspects	Collected Data
Biodiversity	<ol style="list-style-type: none"> 1) Forest map of the Ministry of Environment and Forestry (KLHK)¹³ 2) KBA (Key Biodiversity Area) Map¹⁴ 3) IBA-EBA Map¹⁵ 4) Sentinel Imagery¹⁶ 5) RBI Map¹⁷ 6) Home range of encountered wildlife
Natural Landscape and Ecosystem	<ol style="list-style-type: none"> 1) RePPProT Map¹⁸ 2) RBI Map 3) KLHK's Indicative Map of New License Issuance Moratorium (PIPPIB)³¹ 4) Erosion vulnerability map³¹ 5) Map of the Directorate General of Mineral and Coal of the Ministry of Energy and Mineral Resources¹⁷ 6) Map of the National Digital Elevation Model of the Geospatial Information Agency¹⁹ 7) Land Cover Map 8) Sentinel Imagery
Environmental Services	<ol style="list-style-type: none"> 1) Map of the National Digital Elevation Model of the Geospatial Information Agency 2) RBI Map 3) Map of Disaster Risk Index (National Disaster Management Agency/BNPB) 4) Land Cover 5) Sentinel Imagery

¹³ Ministry of Environment and Forestry. Geospatial Information System. *SIGAP KLHK* <https://sigap.menlhk.go.id/> (2024).

¹⁴ Key Biodiversity Areas. KBA - Map Search. *Key Biodiversity Areas* <https://www.keybiodiversityareas.org/sites/search> (2024).

¹⁵ BirdLife International. BirdLife Data Zone. *BirdLife Data Zone* <https://datazone.birdlife.org/site/mapsearch> (2024).

¹⁶ Copernicus Data Space Ecosystem. Sentinel-2. *Copernicus Data Space Ecosystem* <https://dataspace.copernicus.eu/explore-data/data-collections/sentinel-data/sentinel-2> (2024).

¹⁷ Geospatial Information Agency. Rupa Bumi Indonesia (RBI) Map. (2021).

¹⁸ Saxon, E. & Sheppard, S. Land Systems of Indonesia and New Guinea. (2010).

¹⁹ Geospatial Information Agency. National DEM - Geospatial Information Agency. *DEMnas BIG* <https://tanahair.indonesia.go.id/demnas/#/> (2024).

Basic Needs of the Indigenous Community	<ol style="list-style-type: none"> 1) KLHK's Indicative Map of Social Forestry Area³¹ 2) Map of village forest area³¹ 3) RBI Map 4) Land Cover Map 5) Sentinel Imagery
Historical Value	Data on Cultural Heritage and historical sites around the location

1.4.2.2 Landscape Mapping and Documentation

Landscape was observed based on its land cover. Every existing landscape was observed and documented by cameras and drones. Every geographic feature name (mountain, hill, river, shore) was recorded to identify the potential HCV 4 areas. Historical places were also recorded and documented to identify the potential HCV 6 areas. Ground truthing was cross-checked with the land cover and land use analysis results shown on the existing maps. Ground truthing was also done to match the observation point on Figure 2 with the on-site condition.

1.4.2.3 Vegetation Analysis

Vegetation data was collected in every type of habitat found. This observation was done to identify potential HCV 2 and/or HCV 3 areas. There were 7 relevant habitats based on imagery and map study (Figure 2), namely plantation, forest edge, coast, riverbank, rice field, mine perimeter, and lakefront. Vegetation analysis could be conducted in the morning, midday, or in the afternoon. Rice fields and plantation habitats were not observed for the vegetation analysis since both of them had homogeneous land cover. The recorded data were the species name and its local name. The vegetation data were also uploaded to iNaturalist to enrich the database of plant distribution in Sulawesi.

1.4.2.4 Wildlife Observation

The wildlife listing was aimed to identify HCV 1 existence in this landscape. Wildlife observation focused on 4 taxa, namely mammals, birds, amphibians, and reptiles. Taxa of fish, mollusks, and arthropods were also observed and recorded, but are not deeply analyzed. Those four wildlife taxa are recorded based on the total number of species, total number of individuals, and the substrate where they are found. Every taxon encountered is mapped with the GPS receiver to record the encounter location. All encounters were uploaded to iNaturalist²⁰ to enrich the database of wildlife biodiversity in Sulawesi, as well as to facilitate other biodiversity research. The wildlife observation method was compiled in Table 2. Wildlife calculation analysis was done by using Past²¹ software.

Mammals at the location were observed without any special method. The observer walked and observed mammals or any signs of mammals being found. Thus, mammal observation could be conducted alongside the observation of other taxa. Every encounter with mammals (any footprints, feces, or direct encounters) was recorded and documented. Currently, mammal species were identified based on available research journals and the book entitled the *Ecology of Sulawesi*²². This was because there wasn't any field manual for mammals in Sulawesi.

Birds at the location were studied using MacKinnon list method²³. Bird observation point was observed in every habitat based on the results of landscape and vegetation observation. Bird sounds that were heard during the observation were recorded by the voice recorder to help with the identification. The MacKinnon method was done by filling in tables. Every table consists of the first 10 birds found in the field, provided that the same bird was not recorded twice at the same table. Bird species was identified with the help of the book entitled *Birds of Indonesian Archipelago*²⁴. Bird sound identification was done using the sound database at xeno-canto.org²⁵.

²⁰ Ueda, K.-I. About · iNaturalist. *iNaturalist* <https://www.inaturalist.org/pages/about> (2024).

²¹ Hammer, Ø., Harper, D. A. T. & Ryan, P. D. PAST: paleontological statistics software package for education and data analysis. *Palaeontol. Electron.* **4**, 1–9 (2001).

²² Whitten, T., Henderson, G. S. & Mustafa, M. *Ecology of Sulawesi*. (Tuttle, New York, 2012).

²³ MacKinnon, J. R., Phillipps, K. & van Balen, B. *Burung-burung di Sumatera, Jawa, Bali dan Kalimantan: termasuk Sabah, Sarawak dan Brunei Darussalam*. (Burung Indonesia, Bogor, 2010).

²⁴ Eaton, J. A., Balen, S. van, Brickle, N. W. & Rheindt, F. E. *Birds of the Indonesian Archipelago: Greater Sundas and Wallacea*. (Lynx, Barcelona, 2016).

²⁵ Xeno-Canto Foundation. *xeno-canto :: Sharing wildlife sounds from around the world*. <https://xeno-canto.org/> (2024).

Herpetofauna was observed using VES^{26,27} method. Herpetofauna surveys were conducted in the evening (at 6-10 p.m.) and at dawn (at 4-6 a.m.). The observers walked along the observation area for 1 hour at every observation plot. Every reptile was captured and placed in a plastic bag (a sack for the big ones) for identification. Reptiles and amphibians identification referred to the list of types by Koch^{28,29}.

Aquatic organism surveys were conducted using the market survey and river tracing methods. Observers came to the markets and fish auction markets around PT BTIIG to document all types of fish, aquatic arthropods, and aquatic mollusks that were found. Observers, together with the fishermen, recorded all the aquatic organisms caught during fishing. Observers also interviewed the traders in the market and fish auction markets to determine the origin of the caught organisms.

Photo Source: AEER Documentation



²⁶ Campbell, H. W. & Christman, S. P. *Field Techniques for Herpetofaunal Community Analysis*. <https://nwrc.contentdm.oclc.org/digital/collection/NWRCPubs1/id/16670> (1982).

²⁷ Corn, P. S. & Bury, R. B. Sampling methods for terrestrial amphibians and reptiles. Gen Tech Rep PNW-GTR-256 Portland US Dep. Agric. For. Serv. Pac. Northwest Res. Stn. 34 P 256, (1990).

²⁸ Koch, A. The Amphibians and Reptiles of Sulawesi: Underestimated Diversity in a Dynamic Environment. in *Biodiversity Hotspots* (eds. Zachos, F. E. & Habel, J. C.) 383–404 (Springer, Berlin, 2011). doi:10.1007/978-3-642-20992-5_20.

²⁹ Iskandar, D. T. & Tjan, K. N. The amphibians and reptiles of Sulawesi, with notes on the distribution and chromosomal number of frogs. *Proc. First Int. Conf. East. Indones.-Aust. Vertebr. Fauna Manado* 39–46 (1996).

Table 2. Summary of Activities Done for Wildlife Observation

Activities	Collected Data	Instrument Used
Mammals Observation	1) Σ mammal individuals 2) Σ mammal species	1) Binoculars 2) Camera 3) Notebook 4) Pencil
Avifauna Observation	1) Σ bird individuals 2) Σ bird species	1) Binoculars 2) Camera 3) Notebook 4) Pencil
Herpetofauna Observation	1) Σ reptile individuals 2) Σ reptile species 3) Σ amphibian individuals 4) Σ amphibian species	1) Notebook 2) Pencil 3) Snake stick 4) Plastic bag 5) Sack (optional) 6) Flashlight 7) Camera 8) Batteries
Local and indigenous community interviews	1) Community perception 2) Local knowledge about the wildlife and its benefit	Presentation slides, including the wildlife pictures

1.4.2.5 Local Community Interviews

Interviewing the local community functioned as information collection regarding the biodiversity found around PT BTIIG. All information obtained from the residents was used to identify HCV 4 area (essential area for environmental services preservation), HCV 5 area (local community livelihood area), and HCV 6 area (historically valued area). Interviewees were the local residents around PT BTIIG who often carried out activities and earned their livelihood in the forest. Data collection was done using snowball sampling and/or focus group discussion methods. Every flora and fauna species encountered by the residents was directly verified by showing the picture of the flora/fauna being described. Therefore, the residents would be able to directly understand the said species.

Photo Source: AEER Documentation



PART II

2.1 Landscapes

BTIIG industrial park development area is planned to be located at four river basins (DAS/daerah aliran sungai), namely DAS Ambunu, DAS Monsombo, DAS Moburu, and DAS Uedago. Mostly, it is located at DAS Ambunu and Uedago.



Photo Source: AEER Documentation

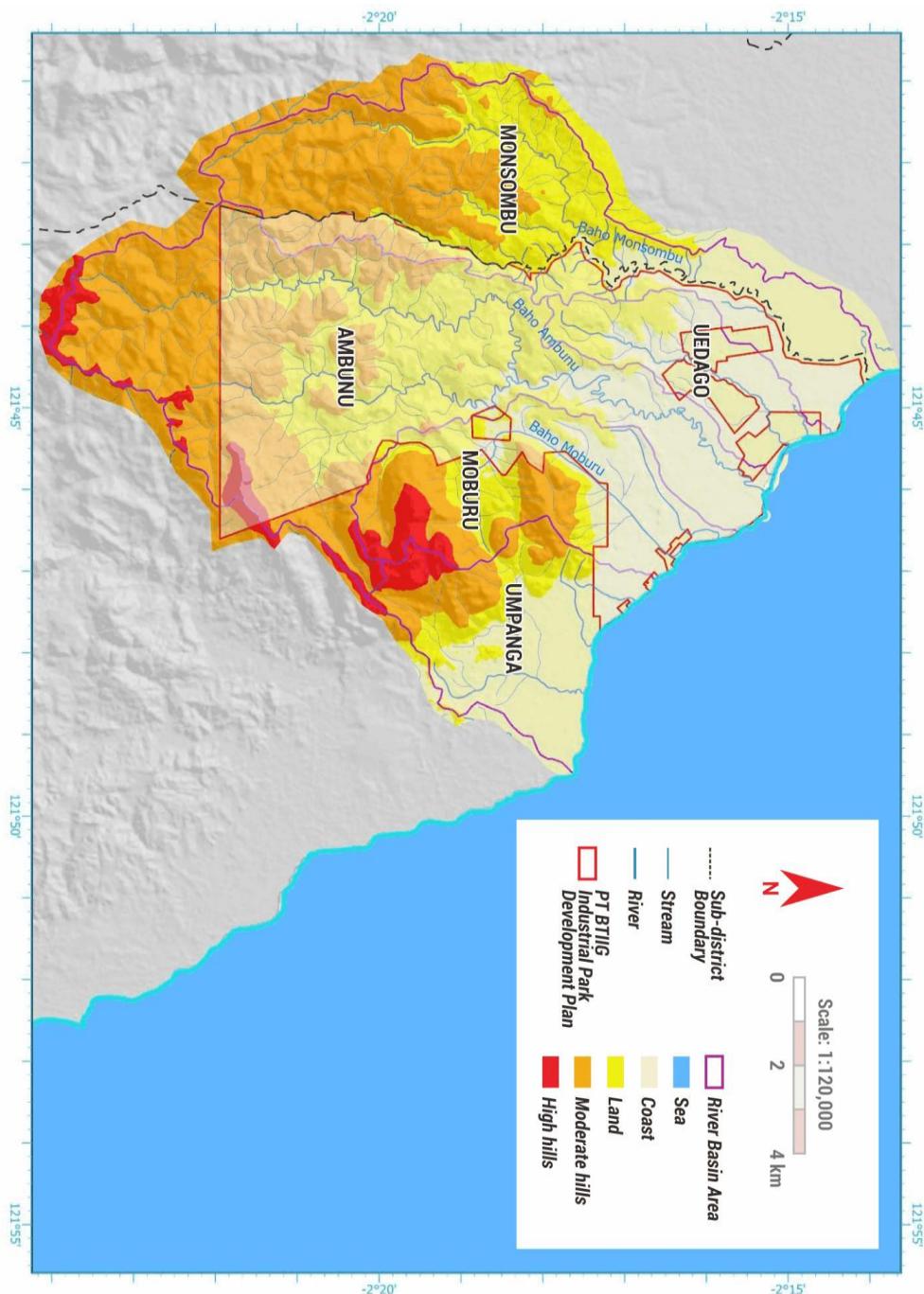


Figure 3. Map of River Basin in the BTIIG Industrial Park Development Plan

The landscapes described below are those endangered by the development of PT BTIIG industrial park, resulting in quite a significant implication. PT BTIIG industrial park is located in a mixture of landscapes, where the coastline meets the soil and limestone hills. In general, the existing area of PT BTIIG is a mixture of limestone and soil hills as well as lowland areas. The area is already managed by the community, so there are many oil palm plantations, fields, and rice paddies. Based on the satellite imagery and local residents' information, the smelter and PLTU areas used to be oil palm plantations, community fields, and mangroves.

There are at least two main rivers in PT BTIIG area, which are Bahu (River) Ambunu and Bahu Moburu. Also, Bahu Monsombu is located at the western border of PT BTIIG. These three rivers are still utilized by the local residents to fulfill their daily water needs. Water in these three rivers is clear, odorless, tasteless, and colorless. According to RBI Map tracing, there are at least 124 streams located inside PT BTIIG area. These streams help channel excess water upstream and become the local residents' source of water.



Figure 4. Ambunu Stream, A hill on the right side was seen being cut and leveled by PT BTIIG subsidiary to be used as an access road.



Figure 5. Baho Moburu is Dammed for Local Residents' Water Needs



Figure 6. Baho Monsombu is Utilized to Wash Local Residents' Vehicles

Hilly landscape in the southeastern, southern, and southwestern parts of PT BTIIG is dominated by the karst. The karst's highest peak is at 733 masl in the southeast of PT BTIIG. This hilly area still remains as forests, so it has a good water cycle and evapotranspiration process, marked by the appearance of fog in the morning and after rains. This karst is also covered by many kinds of forest trees.

PT BTIIG development area and its surroundings are covered by 2 main vegetations, one in a natural area with very little human disturbance and the other in disturbed areas. Both areas can be clearly seen in the satellite imagery. A part of this disturbed area is used as a plantation and residential areas by the local community. According to GBIF, at least 206 kinds of woody plants can be found in Morowali. A list of the plants that can be found during the observation is detailed in Table 3.

The satellite imagery observation result shows that most forest areas are still in good condition. There are several open areas, whether inside the healthy forest or at the logged forest area. A healthy forest area is indicated by a high NDVI, while the open area and empty land are indicated by a low NDVI.³⁰ These areas can be found on the southern part of the map.

Photo Source: AEER Documentation



³⁰ NDVI (*normalized difference vegetation index*) is a measurement used to analyze and monitor vegetation's health and density on the earth's surface based on the different characteristics of light reflectance between healthy and unhealthy vegetation components.

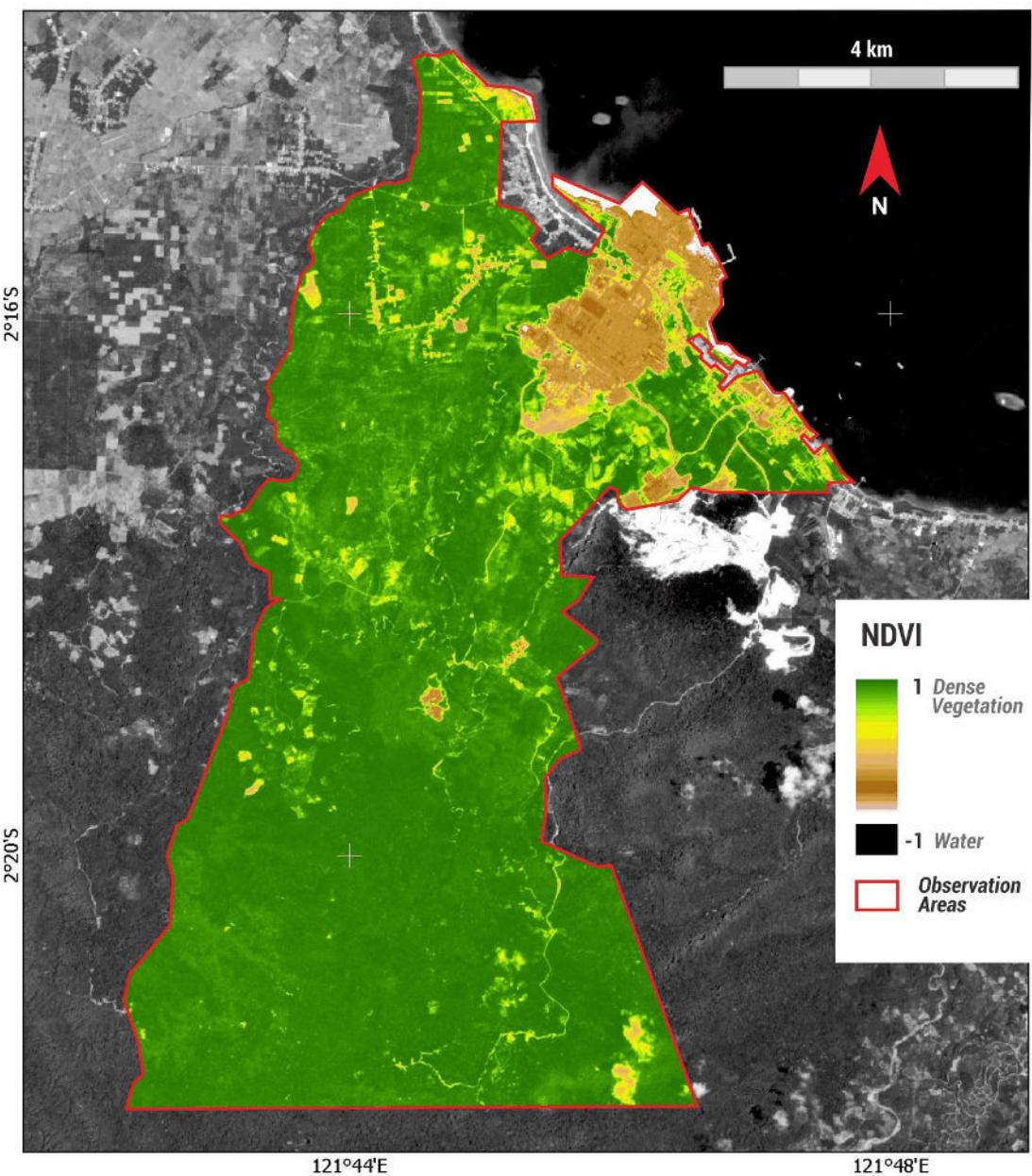


Figure 7. NDVI Map of BTIIG Industrial Park

2.1.1 Forest



Figure 8. Trees on the Hill in the Southern Part of BTIIG Industrial Park after the Rain



Figure 9. Forest Clearing in the Southeastern Part of BTIIG Industrial Park

The forests located at BTIIG industrial park development area are lowland forest and highland forest that are covered by natural vegetation with limited and difficult access, thus the existing vegetation are the undisturbed ones. Based on the field observation, vegetation at the highlands are a mixture of secondary forest and primary forest resulting from the logging done by HPH company in the '80s and '90s.³¹ The forest is vegetated with typical forest trees from Sulawesi, such as sempur and the guava family (*Dillenia* genus and *Myrtaceae* family, Table 3). There are also limestone hills covered with typical karst vegetation. Some clearings can be seen from the satellite imagery. Part of the land was cleared by the Wana community for their shifting cultivation.

Photo Source: AEER Documentation



³¹ Community interview

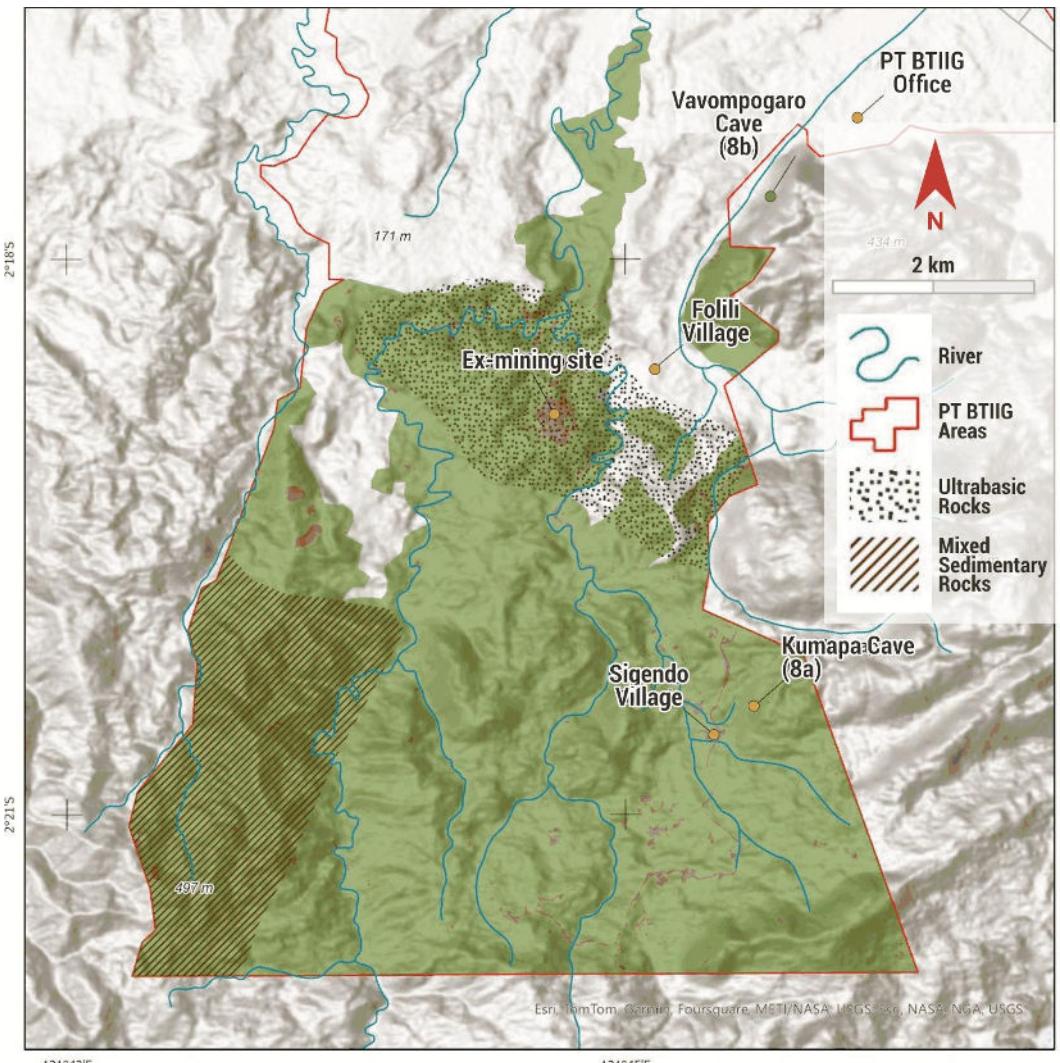


Figure 10. Forest Coverage (green) at PT BTIIG Area.

The dotted area is the ultrabasic forest, while the shaded area is the lowland secondary forest.

The remaining 3,784 hectares of forest are mainly located in the hilly area, at least 4 km away from PT BTIIG's smelters. They mainly consist of mixed forest growing on limestone hills. As wide as 478 hectares of them are ultrabasic forest ecosystems, while the other 619 hectares are secondary forest on sedimentary rocks.

Ultrabasic forest is the forest growing on nickel-rich ultramafic rocks. The ultrabasic forest can only be found on nutrient-poor ultrabasic soil, resulting in a long period of succession⁵³. Due to its long period of succession, the ultrabasic forest becomes an essential ecosystem which consists of many kinds of trees adapted to the area, such as *kayu embuh* (*Kjellbergiodendron celebicum*), *kayu lara/nani* (*Metrosideros* spp. and *Xanthostemon confertiflorus*), *calophyllum soulatii* (*Calophyllum* spp.), *knema* (*Knema* spp.), *vatica* (*Vatica* spp.), and several kinds of *canarium* (Burseraceae family) and *sapotaceae* (Sapotaceae family)³². The conservation of the ultrabasic forest ecosystem is essential because this ecosystem is now very hard to find³³. Other than that, due to its high metal content, an ultrabasic forest also needs a long period of time to restore once it is destroyed.

Alongside ultrabasic forest, the lowland forest ecosystem also grows on top of sedimentary rocks. The lowland forests are in a more disturbed condition due to their proximity to PT BTIIG and the local residential areas. This condition is characterized by the existence of invasive plant species, such as *mantangan* (*Decalobanthus peltata*) and *macaranga* (*Macaranga* spp.). Ultrabasic and lowland forests are the habitat for at least six key Sulawesi faunas: lowland anoas (*Bubalus depressicornis*), Sulawesi babirusas (*Babirousa celebensis*), Sulawesi warty pig (*Sus celebensis*), maleos (*Macrocephalon maleo*), knobbed hornbills (*Rhyticeros cassidix*), and Sulawesi hornbills (*Rhabdotorrhinus exarhatus*).

2.1.2 Non-forest area

Non-forest vegetation mainly consists of pioneer species and introduced plants from outside the ecoregion, like Jamaican cherry (*Muntingia calabura*), *terap* (*Artocarpus elasticus*), and *macaranga* (*Macaranga* spp.). Vegetation in this area is dominated by understory plants and shrubs with only a few scattered large trees. The local community also utilized non-forest areas and planted them with plantation crops, such as oil palm (*Elaeis guineensis*), cacao (*Theobroma cacao*), and coconut (*Cocos nucifera*).

³² Meijer, W. Botanical explorations in Celebes and Bali. *Natl. Geogr. Soc. Rep.* **1976**, 588–605 (1984).

³³ Proctor, J. The vegetation over ultramafic rocks in the tropical far east. in *The Ecology of Areas with Serpentinized Rocks: A World View* (eds. Roberts, B. A. & Proctor, J.) 249–270 (Springer Netherlands, Dordrecht, 1992). doi:10.1007/978-94-011-3722-5_10.



Figure 11. Jamaican Cherry Trees Grow Well in the Disturbed Area



Figure 12. The Grassland Area that has been Cleared Up for Rice Fields, and the Northern Part of Mined Limestone Hill

A disturbed area can be characterized by the high intensity of industrial and human activity around it. Succession in the forest is often difficult to achieve in this disturbed area, so that the vegetation found is mostly fast-growing and herbaceous plants.

2.1.3 Coastal Area

The coastal ecosystem found around PT BTIIG area mostly consists of shores, coastal backswamps, and mangroves. The mangroves around PT BTIIG are dominated by large trees. All mangroves found around PT BTIIG areas are a mixture of back mangroves (mangroves located behind the shoreline) and coastal forests. Those mangroves grow on top of the mixture of clay and sand. Back mangroves behind the shoreline are not commonly found. Those kinds of mangroves are not heavily affected by the tidal fluctuations, resulting in slower growth. The floras at the West Bungku coastal area are dominated by some common plants in Indonesian mangrove habitat, such as mangrove apples (*Sonneratia caseolaris*), mangroves (*Rhizophora mucronata* and *Rhizophora stylosa*), and black mangroves (*Avicennia* spp.). Beyond that, there are other mangrove species like *teruntum*/black mangroves (*Aegiceras corniculatum*), nipa palms (*Nypa fruticans*), and pandans (*Pandanus odorifer*). Typical coastal forest species can also be found in this area, like macarangas (*Macaranga* spp.) and *keben*/sea poison tree(*Barringtonia* spp.). The coastal ecosystem is also home to two key Sulawesi species, namely *maleos* (*Macrocephalon maleo*) and booted macaque (*Macaca ochreata*).



Figure 13. Mangrove Root System (*Rhizophora mucronata*)
in Wosu Mangrove, West Bungku

Mangroves are such a rare ecosystem in Sulawesi. This is because of Sulawesi's steep coastal contours and high waves, which hinder the mangroves' growth. WWF and IUCN reports in 1984 stated that intact mangrove ecosystems were only found at the southern coasts of East Luwu and North Luwu; the eastern coasts of Wajo; Parepare Bay; some parts of the eastern coasts of Bone; southern coasts of South Konawe; northern part of Mula Island; southern coasts of Moutong, Pohuwato, and Boalemo; northern coasts of Gorontalo, and western coasts of South Minahasa³⁴.

Photo Source: AEER Documentation



³⁴ Halim, M. & Salm, R. V. Marine Conservation Data Atlas: Planning for the Survival of Indonesia's Seas and Coasts. (1984).

2.1.4 Limestone Hills

The southern part of PT BTIIG is mostly located on limestone hills. These limestone hills are mined to supply nickel smelter industrial needs. Limestones are essential for the nickel industry, especially as the purifying agent (flux) during the nickel ore processing. Based on AEER observation on the Minerba One Map website by the Ministry of Energy and Mineral Resources, there are at least 25 limestone Mining Business Permit Areas (WIUP) located around PT BTIIG, four of them have started the production and exploration operation on the limestone hill in the eastern part of PT BTIIG. The mining area can be clearly seen on the map as the white area (the southern area of PT BTIIG office in 2025 in Figure 2).



Figure 14. Limestone Hill Mined by PT BTIIG

Based on the world aquifer map, a vast karst area is found in the southern part of PT BTIIG. Within this limestone hills area, there are Vavompogaro and Tokandindi Caves. If it is left unprotected, the expansion of PT BTIIG and the mining of 25 surrounding companies will destroy the essential cultural heritage sites.

AEER also found that there is a complex cave network within the hills, based on the statements from the Wana people (Tau Taa). Wana people call this cave network as *kumapa*. The cave is not yet extensively explored by the locals. Some parts of its entrance and network have been explored and utilized by the Wana people living near the cave. There are at least 3 entrances found and explored by them, one of which has a perennial karst spring. The discovered cave is an active cave hosting a range of fauna inside it



Figure 15. One of the Corridors of Kumapa Cave that the Wana People Have Explored



Figure 16. The Entrance to Kumapa Cave, Facing Northwest

Tabel 3. Tumbuhan yang berhasil diidentifikasi di Area PT BTIIG

No	Species Name	APG Code	Family	Habitat		
				F	N	M
Understory Plants						
1	<i>Selaginella</i> spp.		Selaginellaceae	●	●	
2	<i>Acrostichum aureum</i>		Pteridaceae			●
3	<i>Piper</i> cf. <i>aduncum</i>	0502	Piperaceae	●		
4	<i>Mimosa pudica</i>	3002	Fabaceae		●	
5	<i>Portulaca</i> sp.	4736	Portulacaceae			●
Shrubs and bushes						
1	Aroideae 1	1001	Araceae			●
2	<i>Calamus</i> spp.	1602	Arecaceae	●		
3	<i>Musa</i> spp.	1804	Musaceae	●	●	
4	<i>Zingiber</i> spp.	1808	Zingiberaceae	●		
5	Bambusinae 1	1914	Poaceae	●	●	
6	Bambusinae 2	1914	Poaceae	●		
7	Rubiaceae 1	5301	Rubiaceae	●		
8	<i>Decalobanthus peltatus</i>	5601	Convolvulaceae	●	●	
Trees						
1	<i>Agathis alba</i>		Araucariaceae	●		
2	<i>Magnolia</i> sp. 1	0602	Magnoliaceae	●		
3	<i>Magnolia vrieseana</i>	0602	Magnoliaceae	●		
4	<i>Pandanus</i> cf. <i>odorifer</i>	1305	Pandanaceae			●
5	<i>Caryota</i> sp.	1602	Arecaceae	●		
6	<i>Cocos nucifera</i>	1602	Arecaceae		●	
7	<i>Metroxylon sagu</i>	1602	Arecaceae		●	●
8	<i>Nypa fruticans</i>	1602	Arecaceae			●
9	<i>Dillenia</i> sp.	2601	Dilleniaceae	●		
10	<i>Flemingia strobilifera</i>	3002	Fabaceae	●		
11	<i>Intsia bijuga</i>	3002	Fabaceae	●		
12	<i>Saraca</i> cf. <i>cauliflora</i>	3002	Fabaceae	●	●	
13	<i>Artocarpus elasticus</i>	3108	Moraceae		●	
14	<i>Ficus benjamina</i>	3108	Moraceae	●	●	
15	<i>Ficus septica</i>	3108	Moraceae	●		
16	<i>Ficus</i> sp. 1	3108	Moraceae	●	●	
17	<i>Ficus</i> sp. strangler	3108	Moraceae	●		

18	<i>Cecropia peltata</i>	3109	Urticaceae	•	
19	<i>Averrhoa</i> sp.	3503	Oxalidaceae	•	
20	<i>Averrhoa bilimbi</i>	3503	Oxalidaceae	•	
21	<i>Rhizophora mucronata</i>	3604	Rhizophoraceae		•
22	<i>Macaranga gigantea</i>	3632	Euphorbiaceae		•
23	<i>Macaranga</i> sp.	3632	Euphorbiaceae	•	
24	<i>Mallotus</i> sp. 1	3632	Euphorbiaceae	•	
25	<i>Terminalia catappa</i>	3801	Combretaceae	•	•
26	<i>Sonneratia caseolaris</i>	3802	Lythraceae		•
27	<i>Xanthostemon confertiflorus</i>	3805	Myrtaceae	•	
28	Anacardiaceae 1	4205	Anacardiaceae	•	
29	<i>Pometia pinnata</i>	4206	Sapindaceae	•	
30	<i>Muntingia calabura</i>	4302	Muntingiaceae	•	
31	Malvaceae 1	4304	Malvaceae	•	
32	<i>Santalum</i> cf. <i>album</i>	4604	Santalaceae	•	
33	<i>Barringtonia asiatica</i>	4609	Lecythidaceae		•
34	<i>Abelmoschus fasciculata</i>	4909	Sapotaceae	•	
35	<i>Manilkara</i> cf. <i>celebica</i>	4909	Sapotaceae	•	
36	<i>Palaquium</i> sp. 1	4909	Sapotaceae	•	
37	<i>Diospyros</i> sp.	4910	Ebenaceae	•	
38	<i>Aegiceras corniculatum</i>	4911	Primulaceae		•
39	<i>Neolamarckia cadamba</i>	5301	Rubiaceae	•	
40	<i>Alstonia</i> sp. 1	5305	Apocynaceae	•	
41	<i>Avicennia</i> spp.	5714	Acanthaceae		•
42	Lamiaceae 1	5720	Lamiaceae	•	
43	<i>Gmelina arborea</i>	5720	Lamiaceae	•	
44	<i>Tectona grandis</i>	5720	Lamiaceae	•	
45	<i>Vitex</i> cf. <i>cofassus</i>	5720	Lamiaceae	•	
<p>Description:</p> <p>N : non-forest habitat</p> <p>F : forest habitat</p> <p>M : mangrove habitat</p>					



Soka tree (*Saraca cf. cauliflora*)



Dillenia (*Dillenia sp.*)



Pedada (*Sonneratia caseolaris*)



Sea almond (*Terminalia catappa*)



Flemingia strobilifera



Awar-awar (*Ficus septica*)

Figure 17. Plants Found around PT BTIIG

2.2 Fauna

2.2.1 Avifauna

The bird communities found in this area could be analyzed by their level of disruptions. In general, there are two types of bird community, i.e. those unaffected (tolerant) by human disturbance and those sensitive to human disturbance (intolerant). The two communities could be identified by the locations they were found. Birds more tolerant of human disturbance are capable of adapting and living in disrupted landscapes, meanwhile timid, intolerant birds tend to avoid interaction with humans and are harder to find.

Table 4. Bird Communities Statistics at BTIIG and its Surroundings

Variables	Non-forest	Forest	Overall
Number of Species	29	16	36
Number of Individuals	116	67	183
Endemic to Sulawesi (species)	7	8	11
Endangered Status	2	4	4
Diversity (H')	2.875	2.478	3.146
Evenness (J)	0.850	0.890	0.880
Estimated iChao1	53	19	82

Table 5. Results of Hutcheson t-test on the Two Habitats

Non-forest		Forest	
H'	2.875	H'	2.478
s^2	0.0096	s^2	0.0092
t			28.95
df			171.65
$p_{(same)}$	0.0043 (0.43%)		

According to the observation results, there were fewer birds found in the forests compared to those found in farms. It is indicated by more birds found in the farm area and the higher diversity index. Nevertheless, the t-test showed that the two communities found have a *p* value of less than 5% (Table 5). That implies that the bird communities in forest and non-forest areas are extremely different. In addition, the forest habitat was also inhabited by vulnerable bird species, i.e. endemic birds and birds with endangered conservation status (Table 4).

Such a difference is of importance because the bird communities are highly sensitive to deforestation. Human disturbances, particularly those involving modification to land cover and land use, have detrimental impacts on the functional diversity of birds³⁵. In case of deforestation, the bird communities in the forests would be the most affected.

There were at least 3 types of bird that become the key species, i.e. maleos, knobbed hornbills, and Sulawesi hornbills³⁶. Maleo is also one of the umbrella species. Knobbed hornbills, Sulawesi hornbills, and maleos are considered key species due to their crucial existence for the forest ecosystem.

Knobbed hornbills and Sulawesi hornbills are frugivorous birds with high exploratory range, allowing them to disperse seeds of the fruits they eat. Knobbed hornbills, in any habitat with minimal disturbance, have an average density of 0.07 individual per ha, meanwhile the average density of Sulawesi hornbills is 0.04 individual per ha³⁷. As shown in the map on Figure 10, there are still a forest area of 3,761 ha with minimal disturbances, allowing this forest to accommodate up to 263 knobbed hornbills and 150 Sulawesi hornbills based on their occurrence rates.

³⁵ Matuoka, M. A., Benchimol, M., Almeida-Rocha, J. M. de & Morante-Filho, J. C. Effects of anthropogenic disturbances on bird functional diversity: A global meta-analysis. *Ecol. Indic.* **116**, 106471 (2020).

³⁶ Mustari, A. *Manual Identifikasi Dan Bio-Ekologi Spesies Kunci Di Sulawesi (Bio-Ecology of the Key Species in Sulawesi)*. (2020).

³⁷ Winarni, N. L. & Jones, M. Effect of anthropogenic disturbance on the abundance and habitat occupancy of two endemic hornbill species in Buton island, Sulawesi. *Bird Conserv. Int.* **22**, 222–233 (2012).

Table 6. Bird Species Found around PT BTIIG

No	Type Name	N	F	Σ	Information
13	<i>Macrocephalon maleo</i>				Observations by locals; community analyses are not included due to the unknown number of individuals. IUCN Status EN ; endemic to Sulawesi; protected by P.106/2018
29	<i>Macropygia albicapilla</i>	1	1	2	Unassessed by IUCN; endemic of Sulawesi
32	<i>Chalcophaps indica</i>	1	1	2	
51	<i>Ducula aenea</i>	5	12	17	IUCN Status NT
61	<i>Centropus bengalensis</i>	4	2	6	
72	<i>Cacomantis virescens</i>		1	1	endemic to Sulawesi
101	<i>Hemiprocne longipennis</i>		1	1	
106	<i>Gallirallus philippensis</i>	1		1	
172	<i>Calidris alba</i>	1		1	
247	<i>Ardea purpurea</i>	1		1	
252	<i>Elanus caeruleus</i>	1		1	Protected by P.106/2018
256	<i>Aviceda jerdoni</i>		5	5	Protected by P.106/2018
262	<i>Ictinaetus malaiensis</i>	1	1	2	Protected by P.106/2018
299	<i>Rhyticeros cassidix</i>		6	6	IUCN Status VU ; endemic to Sulawesi; protected by P.106/2018
300	<i>Rhabdotorrhinus exarhatus</i>		4	4	IUCN Status VU ; endemic to Sulawesi; protected by P.106/2018
316	<i>Todiramphus chloris</i>	3	2	5	
323	<i>Merops ornatus</i>	1		1	
325	<i>Eurystomus orientalis</i>	1		1	
339	<i>Prioniturus platurus</i>				Observations by locals; community analyses are not included due to the unknown number of individuals. Endemic to Sulawesi; protected by P.106/2018
344	<i>Tanygnathus sumatranus</i>				Observations by locals; community analyses are not included due to the unknown number of individuals. Protected by P.106/2018
354	<i>Loriculus stigmatus</i>	1	1	2	endemic to Sulawesi; protected by P.106/2018

376	<i>Gerygone sulphurea</i>	5		5	
378	<i>Coracina bicolor</i>	2	11	13	IUCN Status NT ; endemic to Sulawesi
382	<i>Coracina</i> sp.			0	
384	<i>Lalage sueurii</i>	1		1	
401	<i>Oriolus chinensis</i>		3	3	
403	<i>Artamus leucorhynchus</i>	25		25	
410	<i>Dicrurus leucops</i>	3	8	11	endemic to Sulawesi
424	<i>Corvus celebensis</i>	4	4	8	endemic to Sulawesi
444	<i>Hirundo tahitica</i>	15		15	
448	<i>Hypothymis puella</i>	3	1	4	endemic to Sulawesi
452	<i>Pycnonotus aurigaster</i>	3	4	7	
474	<i>Pellorneum celebense</i>		1	1	endemic to Sulawesi
525	<i>Dicaeum celebicum</i>	3	1	4	endemic to Sulawesi
527	<i>Anthreptes malaccensis</i>	5		5	
528	<i>Leptocoma aspasia</i>	2	1	3	
531	<i>Cinnyris frenatus</i>	6		6	
534	<i>Aethopyga siparaja</i>	2	2	4	
540	<i>Lonchura atricapilla</i>	8		8	
546	<i>Passer montanus</i>	7		7	
Total		116	73	189	

Description:

N : non-forest habitat

F : forest habitat

Σ : total frequency of encounters or occurrences at observation spots



Black eagle (*Ictinaetus malayensis*)



Black-winged kite (*Elanus caeruleus*)



Common emerald dove
(*Chalcophaps indica*)



Sulawesi cuckoo-dove
(*Macropygia albicapilla*)



Male knobbed hornbill
(*Rhyticeros cassidix*)



Male Sulawesi hanging parrot
(*Loriculus stigmatus*)



Oriental dollarbird
(*Eurystomus orientalis*)



Male pale-blue monarch
(*Hypothymis puella*)



Sanderling (*Calidris alba*)
with transitional plumage from
non-breeding to breeding phase



A pair of pied cuckooshrikes
(*Coracina bicolor*)

Figure 18. Types of Birds Found around PT BTIIG

2.2.2 Cave Animals

The area of PT BTIIG also covers karst hills with a cave network inside. This cave network has been explored by the people of Wana that inhabit the surrounding area. This cave is also a habitat of various cave and troglobitic animals. According to AEER's observation, there were at least 4 types of cave animal discovered only 50 m away from 1 cave entrance. The four faunas were cave crickets (Rhaphidophoridae), cave cockroaches, bat bugs, and various types of bats. These four animals must be further identified to determine their types. Further observation is also required for mapping and observing the cave fauna inhabiting the area.



Cave crickets
(family of Rhaphidophoridae)



Cave cockroaches
(family of Blattidae)

Figure 19. Types of Cave Insects Found in Kumapa Cave

2.2.3 Other Discovered Animals

Aside from the avifauna, there were animals of other taxa found in the area of PT BTIIG. The following data incorporate direct observations, information and documentations by the locals, as well as GBIF's database. Other animals found here were unable to be analyzed quantitatively due to their lack of individual abundance data.

Table 7. Other Faunas Found in PT BTIIG Areas

Nº	Taxon	Data source	Information
Reptilia			
1	<i>Hydrosaurus celebensis</i>	Observations by locals	
2	<i>Crocodylus porosus</i>	Documentations by locals	Protected by P.106/2018
3	<i>Emoia caeruleoocauda</i>	Direct observations	
4	<i>Malayopython reticulatus</i>	Observations by locals	
5	<i>Gekko gecko</i>	GBIF	
6	<i>Draco beccarii</i>	GBIF	
7	<i>Cyrtodactylus jellesmae</i>	GBIF	
8	<i>Dendrelaphis pictus</i>	Direct observations	
9	<i>Emoia atrocostata</i>	GBIF	
Amphibia			
1	<i>Ingerophrynus celebensis</i>	GBIF	
2	<i>Chalcorana mocquardii</i>	GBIF	
3	<i>Limnonectes</i> sp.	GBIF	
4	<i>Fejervarya</i> cf. <i>cancrivora</i>	Direct observations	
5	<i>Duttaphrynus melanostictus</i>	Direct observations	
Actinopterygii			
1	<i>Nomorhamphus kolonodalensis</i>	GBIF/iNaturalist	Status NT
2	<i>Aplocheilus armatus</i>	GBIF	
3	<i>Channa striata</i>	GBIF	
4	<i>Awaous</i> sp.	Direct observations	
5	<i>Anguilla</i> cf. <i>marmorata</i>	Direct observations	
Mammalia			
1	<i>Macaca ochreata</i>	Direct observations	Status VU ; Protected by P.106/2018
2	<i>Babyrousa celebensis</i>	Observations by locals	Status VU
3	<i>Sus celebensis</i>	Observations by locals	
4	<i>Bubalus depressicornis</i>	Observations by locals	Status EN ; Protected by P.106/2018
5	<i>Tarsius</i> sp.	Statements of locals	Status is at least VU ; Protected by P.106; Considered questionable due to being outside their natural distribution



Crab-eating frog
(*Fejervarya cancrivora*)



Pacific bluetail skink
(*Emoia caeruleocauda*)



Giant mottled eel (*Anguila cf. marmorata*)



Nike fish (*Awaous* sp.)



Booted macaque (*Macaca ochreata*)



Malay cruiser (*Vindula dejone*)

Figure 20. Other Wildlife Found in PT BTIIG

2.3 Communities around the Forests

The people in West Bungku and Bumi Raya Districts were mostly farmers, plantation workers, and fishermen prior to the construction of PT BTIIG industrial park. The agricultural commodities for the community in West Bungku District were dominated by upland rice, upland cassavas, and groundnuts³⁸. Locals also planted a wide range of fruits, such as mangoes and cashew fruits. Various types of land use, such as teak forests, coconut plantations, oil palm plantations, were also found in the area. Some other locals even worked at oil palm plantations. This is evident from the numerous oil palm plantations around the area of PT BTIIG, and the palm oil mills in Umpanga Village. Transmigrated residents worked as rice, sugar palm, and sago farmers prior to PT BTIIG.

Some also worked as limestone miners. However, how the locals sold the mined limestones and the location of the target markets are still unknown.



Figure 21. A Mixed Plantation of Oil Palm and Mango in Umpanga Village

³⁸ Syam AS, N. Potensi Sumber Daya Wilayah Dalam Mendukung Perwujudan Kawasan Agropolitan di Kabupaten Morowali. *Teknosains Media Inf. Sains Dan Teknol.* 5, (2011).

On the other hand, some locals scavenged forest products and stones from the nearby southern forest. The scavengers of forest products mostly lived in Tondo Village, Topogaro Village, and Umpanga Village. This community comes from diverse ethnic backgrounds, such as Javanese, Bugis, Bungku, Pamona, and Wana.

The forest products they scavenged were a wide range of timber, forest honey, resin, bark, and rattan. The local communities also frequently collected a variety of forest honey for consumption and trade. According to our interviews and direct observations, the locals collected at least 8 types of timber for different purposes. The collected timbers are, among others, 1) *bitti/gupasa* (*Vitex cf. cofassus*), 2) *nyatoh* (*Palaquium spp.*), sandalwood (*Santalum cf. album*), 4) dammar pine (*Agathis cf. alba*), 5) *jabon* (*Neolamarckia cadamba*), 6) *kononeo*, 7) *kumea* (*Manilkara cf. celebica*), and 8) *jopaka* (*Magnolia vrieseana*).



Figure 22. Local Residents Transporting Sawn Timbers by the River

2.3.1 The Wana People

The people of Wana are indigenous to the area and inhabit forests in Morowali and North Morowali. They are still considered indigenous as they still implement shifting cultivation systems to farm everyday ingredients. They call themselves Tau Taa.

From an interview by AEER, there are at least 12 families that still live inside the forests in the BTIIG area. The 12 families are scattered around in 8 open fields, each plants different types of commodities. One family consists of 3 to 5 members.

The Wana people have been registered as residents by local authorities. According to Topogaro villagers, the people of Wana have been granted one area by the local government so they could have an address to be put on their ID cards. This area later became a separate village named Tondo Village.



Figure 23. Shifting Cultivation of Wana People

PART III

3.1 Identification of HCVs in the Area of PT BTIIG

HCV areas are significant for natural conservation. They are aimed to help the preservation of biodiversity, ecosystems, and environmental services outside the conservation areas. According to HCV Toolkit, the identification of HCV areas is carried out with secondary data, which are maps, and primary data, which are interviews and field observations. This research only contains a partial HCV identification due to the limited secondary data and observation time.

Based on the observation results, there were four main aspects of HCV found in this location. As a note, there is one HCV area that is adjacent to PT BTIIG, but it is not included as a part of PT BTIIG area, namely Vavompogaro Cave. Nevertheless, this cave is covered in this report due to its important cultural values.

Descriptions and information of the discovered HCVs are presented in Table 8.

Photo Source: AEER Documentation



Table 8. High Conservation Values Found in This Research

HCV	Description	Information
1.3	Habitat for Endangered, Restricted-Range, or Protected Species	There is a forest area inhabited by rare and/or protected birds and mammals (see Table 6 and Table 7).
1.4	Refugia/Corridor Habitat for Wildlife	There is a coastal area used as a temporary stop (refugia) for migratory birds. There is also a forest area used as a wildlife corridor for anoas, according to the locals.
3	Area with Rare or Endangered Ecosystems.	There is a natural karst area with cave systems used as a temporary shelter (refugia) for bats and flying foxes.
4.1	Essential Area or Ecosystem for Water Supply and Flood Control.	There is a karst area and a river basin vital for nearby communities.
4.2	Essential Area for Erosion and Sedimentation Control	There is a hill forest area that helps reduce erosion and sedimentation rates.
5	Essential Natural Area for Fulfilling Basic Local Needs.	There is a forest area with rights of use for the people of Wana.

There is at least an area of 3,945 ha with high conservation values. It covers half (53.47%) of PT BTIIG area. The majority of HCV areas found are forests with different conditions and diverse vegetation. The widest HCV area is a lowland secondary forest ecosystem in the southern hill area. There are also coastal and backswamp ecosystems whose existence is threatened by the construction of jetties and terminals for own-interest (TUKS, *Terminal Untuk Kepentingan Sendiri*) by many companies. Moreover, there is a cave known by its network and its function as a water source for the people of Taa in Sigendo village. The map of identified HCV areas is presented on Figure 24.

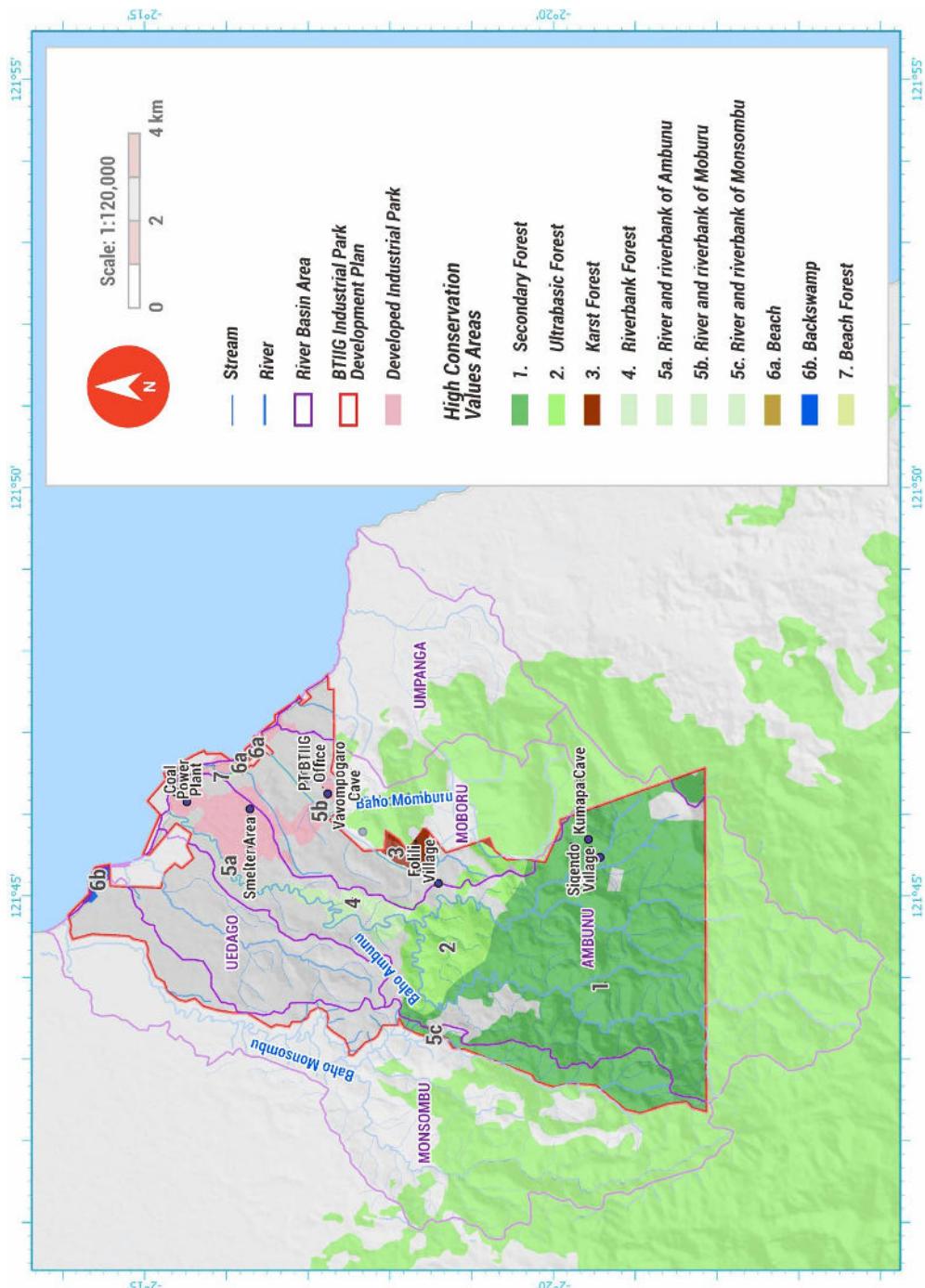


Figure 24. HCV Areas of PT BTIIG

Table 9. Summary of Areas with High Conservation Values

No	Area Name	Covered HCV	Area (ha)	Information
1	Sigendo Secondary Forest	1.3 1.4 3 4.1 4.2 5	3,080	It is dominated by forest area that grows on limestone rocks and soils. 519 ha (17%) of this forest sloped by >20°, which helps reduce the erosion and sedimentation rates. This secondary forest becomes a habitat for many animals and plants listed in Table 6 and Table 7. This forest also serves the Taa Community as a source of food and livelihood.
2	Folili Ultrabasic Forest	1.3 3	478	It is a forest ecosystem rich in unique nickels (Whitten), potentially becoming HCV 3 in the future if the number of nickel mining increases. There is a 10 ha (2%) of hillside in the eastern area with a land slope of >20° that helps reduce the erosion and sedimentation rates.
3	Folili Limestone Hill	1.3 4.1 4.2	69	It is a karst hill area with a still-intact ecosystem to the east of PT BTIIG area. This area is covered by well-preserved karst forest at the slopes. There are limestone mining activities by companies and locals to the north of the hill (Figure 27). In this karst hill area, there are also endangered and protected birds, such as knobbed hornbills, Sulawesi hornbills, and Sulawesi hanging parrots.
4	Ambunu Riparian Forest	1.3 4.1	157	There is a hill forest area that helps reduce erosion and sedimentation rates.
5a	Ambunu River and Riverbank Buffer Zone	1.3 4.1 4.2	86	Ambunu River and its buffer zone are outside the forest area (1), (2), and (4); utilized as flood controller and source of water and food by the locals. The riparian forest is still intact and well-preserved, but has been planted with oil palm at several spots. The width of the buffer zone is 50 m as per Regulations of Minister of Public Works and Public Housing No. 28/PRT/M/2015 of 2015.
5b	Moburu River and Riverbank Buffer Zone	4.1	39	Moburu River and its riverbanks are outside the forest area (3); utilized as flood controllers. There are changes to the flow of the river downstream, each side of the riverbanks has also been used for oil palm plantation by the locals. The width of the buffer zone is 50 m as per Regulations of Minister of Public Works and Public Housing No. 28/PRT/M/2015 of 2015.

5c	Monsombo River and Riverbank Buffer Zone	1.3 4.1	1	Monsombo River and its riverbanks are outside forest area (1); serving as flood, erosion, and sedimentation controller. The riparian forest within PT BTIIG is still untouched and well-preserved. The width of the buffer zone is 50 m as per Regulations of Minister of Public Works and Public Housing No. 28/PRT/M/2015 of 2015.
6a	Ambunu Beach	1.4	27	It is a shoreline with a narrow backswamp ecosystem that is still natural and with minimal disturbances. This ecosystem has migratory birds, an evidence that its beach and backswamp are significant as a stopover for migratory birds.
6b	Ambunu Coastal Backswamp	1.4 3	4	It is a distinct backswamp ecosystem hardly encountered in Sulawesi, formed as a result of tidal activities.
7	Beach Forest	1.3 1.4	4	It is a beach forest heavily fragmented and degraded due to the construction of TUKS and jetties by PT BTIIG. A group of <i>digo</i> monkeys were found in this forest, eating and resting, making this beach forest included in an HCV area.
8a	Kumapa Cave	1.4 3 4.1 5	<1	This is one of the entrances of the unmapped cave network near Sigendo. It has been explored and utilized as a water source by the people of Taa. The total area of the cave network is still unknown.
Total Area		3,945		
HCV Near PT BTIIG				
8b	Vavompogaro and Tokandindi Caves	6	<1	It is outside PT BTIIG area, but only 300 meters away from the border of PT BTIIG. This cave has been recognized as a cultural heritage site by Law No. 11 of 2010 and Regulation of Morowali District Head No. 188.4.45/KEP/0211/Disdikda/2019.

3.1.1 HCV 1 - Species Diversity

The industrial park of PT BTIIG in West Bungku, Morowali, is located in a natural landscape that reserves the native biodiversity of Sulawesi. Sulawesi itself is known as one of the hearths of Wallacea endemism, reflected by the observation results around the research area. In this area, there are still some varieties of species with critical conservation status, either due to their endemism and endangerment levels, or their vital ecological roles. The existence of these species allows the landscape around PT BTIIG to qualify as HCV 1, particularly subcategory 1.3 (habitat for endangered, restricted-range, or protected species) and 1.4 (refugia habitat/wildlife corridor).

One of the most outstanding areas is Sigendo Forest. It is a part of the lowland ecosystem of Sulawesi that grows on limestones, with distinct vegetation that mixes the characteristics of lowland forest and karst forest. According to the locals, this forest has been inhabited for a long time by key animals of Sulawesi, including babirusas (*Babyrousa celebensis*), anoas (*Bubalus depressicornis*), and maleo birds (*Macrocephalon maleo*). The three animals are protected species with highly endangered status according to IUCN. Their existence indicates that this forest still serves important ecological functions despite being under the pressure of industrial activities.

Threats to biodiversity of Sigendo Forest have become more apparent after the expansion of PT BTIIG started. Some parts of the forest area are planned to be transformed into a tailing disposal site. Once it's realized, the heavy metal content in soil and groundwater is expected to rise, decreasing the quality of flora and fauna habitat. Not only locally damaging the species, this impact will also threaten the existence of Sulawesi's unique germ plasm.

Maleo birds are the most apparent case to showcase the vulnerability of HCV 1 in this area. Maleo is a bird endemic to Sulawesi that can only reproduce in specific ecological conditions by making nests out of a hole on the ground to lay eggs. However, land clearing and haul road construction by PT BTIIG made the locations for the nests more open. This condition increases the chance of predation by monitor lizards (*Varanus salvator*) or pythons (*Malayopython reticulatus*), reducing the success rate of maleo reproduction. A documentation by a local even showed maleo eggs being preyed by a predator due to increasingly disrupted habitat.



**Figure 25. Maleo Egg Eaten by Monitor Lizard
due to Land Clearing by PT BTIIG**
(Source: documentation by a Topogaro resident)

Aside from maleo, the field observation also recorded the existence of knobbed hornbills (*Rhyticeros cassidix*). These birds, along with Sulawesi hornbills (*Rhabdotorrhinus exarhatus*), are the key seed dispersers in Sulawesi forest ecosystems. They play a very significant ecological role due to their ability to disperse tree seeds to vast distances, preserving the dynamic of forest regeneration. However, a report by Komiu demonstrated that hornbills around PT BTIIG acted abnormally by plucking their own feathers. It is presumably acted out of stress due to the noises and activities of the industry. This behavior indicates that human disturbances, aside from reducing their population, might as well directly alter the behavior of animals.

This phenomenon also applies to anoas and babirusas. Locals stated that the two animals are barely seen again after the start of industrial park construction. Their presence would have signified that the secondary forest is capable of providing sufficient space for large mammals to explore. The lack of wildlife in the landscape means that an important part of the ecosystem functions is missing, considering the two species played a role in maintaining the vegetation balance by foraging for food and actively moving around inside the forest.

Not only for large mammals and key birds, the secondary forest and the ultrabasic forest are also capable of sustaining a significant number of endemic bird communities. The analysis results showed that the forest bird community is completely different from the non-forest one. Inside the forest, the proportion of endemic and endangered birds are higher, highlighting the importance of preserving the natural forest habitat. There are at least three species of key birds found, namely maleo, knobbed hornbills, and Sulawesi hornbills. These three are not just a symbol for conservation, but also an umbrella species whose existence guarantees how well-preserved the other animals are in the ecosystem.

Therefore, the landscape around PT BTIIG obviously meets the criteria of HCV 1. This area offers a natural habitat for endemic and endangered species, becomes an important corridor in animals' home range, and serves as a stopover for migratory birds in its coastal area. This area is not only significant for local conservation, but it also contributes directly to the global biodiversity conservation efforts. Uncontrolled development of the industrial park may swiftly transform the high-value area into a fragmented landscape and inhabitable for those key species. Hence, protecting this area becomes undeniably crucial to ensure the sustainability of the species native to Sulawesi.

Photo Source: AEER Documentation



3.1.2 HCV 2 - Landscape-Level Ecosystems

While no extensive forest is found in the area of BTIIG industrial park development plan, it may not be deemed separate from a larger forest landscape. The forest ecosystem is part of a belt around the limestone forest and the ultrabasic forest, stretching to Luwu, South Sulawesi.

HCV 2 is not merely measured by the forest integrity within the concession administrative borders. Thus, despite no forest landscape fully qualifying for HCV 2 in the area of BTIIG industrial park development plan, this area may still be categorized as an integral part of HCV 2 on the scale of Morowali-Luwu landscape. Protecting the remaining forest is vital to ensure the ecological connectivity and the integrity of the broader Wallacea forest ecosystem.

3.1.3 HCV 3 - Rare or Endangered Ecosystems and Habitat

The high conservation value category of HCV 3 refers to the presence of an ecosystem or habitat classified as rare, endangered, or restricted-range, and losing only some part of it may cause great impact to biodiversity preservation. In the area of BTIIG industrial park development plan and its surroundings, there are two types of ecosystems that obviously qualify for this criteria, namely ultrabasic forest and karst ecosystem with active cave networks. They are not only ecologically unique, but also very vulnerable to any disturbances from extractive industrial activities, especially nickel and limestone mining.

Folili ultrabasic forest is the key instance of a rare ecosystem that still remains in West Bungku landscape. It grows on soil formed from the weathering of ultramafic rock that is rich in heavy metal, poor in nutrients, and toxic for many types of plants. This extreme condition allows only certain species to adapt and survive, such as thick-leaved dwarf trees of the genus *Metrosideros*, *Xanthostemon*, and members of *Sapotaceae* and *Burseraceae*. In Sulawesi, the ultrabasic forest only covers 0.55% of the island, making its existence extremely rare. By damaging this ecosystem, the natural recovery process would take hundreds of years, given that the vegetative regeneration on ultrabasic soil runs very slowly.

Moreover, the ultrabasic forest is significantly valuable in terms of biogeography and global biodiversity. Some of its plants could potentially become metal hyperaccumulators that may absorb and reserve nickels inside their body cells. In addition to its significance to science, this unique adaptation opens the opportunity for further research on phytoremediation or metallophyte farming. Unfortunately, the pressure against the Folili ultrabasic forest has gotten greater due to the increasing nickel mining activities in Morowali. Failure in protecting it could lead to the loss of this ecosystem and an unrecoverable barren land.



Figure 26. Forest Grows on Rocky Terrain in Folili

In addition to the ultrabasic forest, the karst ecosystem in Folili is also a crucial representation of HCV 3. This limestone hill forms a complex karst landscape, with recesses, cliffs, and partially mapped active cave networks. The karst vegetation differs from that of other forest types. It consists of plant types adaptable to dry, rocky, and nutrient-poor limestone substrates. The karst ecosystem also functions as a natural water reservoir, given that limestones have high porosity that allows infiltration and underground streams. The observation results indicated that there are at least two permanent water springs inside the Folili karst area, confirming its vital role as a water source for the surrounding communities. Figure 27 shows one of the karst recesses with unique vegetation found in the research area.



Figure 27. One of the Karst Recesses Found in Folili Limestone Hills

Inside the karst cave network, there are faunas unique to the cave, such as cave crickets (*Rhaphidophoridae*), cave cockroaches, bat bugs, and microchiroptera. These species are troglobites, i.e. animals that are heavily dependent on the stability of the cave's microclimate. The loss of the cave or any disturbances to the karst system shall mean the loss of the habitat irreplaceable with other ecosystems. Not only plays a crucial role in geohydrology, the Folili karst also possesses unique biodiversity that is still under-researched.

Threats against the two endangered ecosystems have now become apparent. Limestone minings around the limestone hills are causing visual and structural damages to the karst cliffs. On the other hand, the development plan of PT BTIIG industrial park has been increasingly threatening the Folili ultrabasic forest. If it continues without any conserving interventions, the loss of the ultrabasic forest and karst ecosystem will become permanent, not only for Morowali, but also for the whole Sulawesi.

Therefore, the existence of an ultrabasic forest and karst ecosystem in the area of PT BTIIG allows this landscape to strongly qualify for HCV 3. The two are rare and endangered, and offer irreplaceable ecological values. Protecting and managing them sustainably is a must, because the loss of these ecosystems is irrev.

3.1.4 HCV 4 - Important Ecosystem Services

The high conservation value category of HCV 4 is associated with the important role of an ecosystem in providing vital environmental services for humans and the environment itself. In the area of PT BTIIG and its surroundings, the ecosystem services include flood control, clean water supply, as well as erosion and sedimentation control. The existence of hill forests, river basins (DAS), karst systems, and riparian forests, which are still relatively intact, shows that this area becomes the main support in maintaining the ecological balance and the livelihood of the locals.

An evident proof of HCV 4 is the riparian forest located alongside Ambunu River, Moburu River, and Monsombu River. These rivers flow across the hills into the coastal area, with clear, odorless water that may be directly consumed by the people for their daily needs, such as showering, cleaning, and domestic consumption. The ecological functions of the riparian forest are evident: vegetation alongside the riverbanks serves as a natural filter, sediment retainer, and a barrier that prevents direct pollutants from entering the stream. This forest also maintains the stability of riverbanks, reducing landslide risks, and providing a habitat for reptiles, amphibians, and birds dependent on the river ecotone.

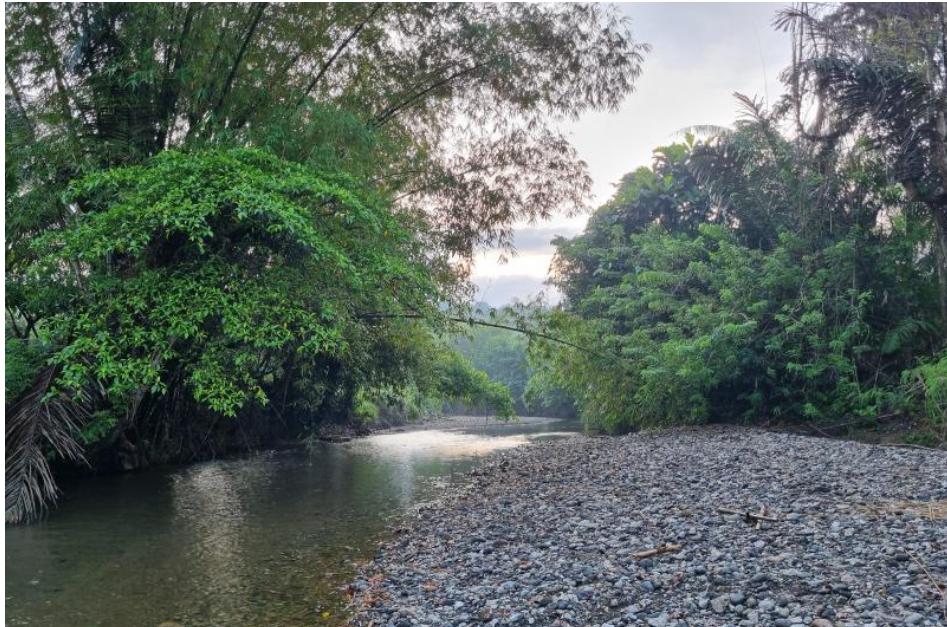


Figure 28. Riparian Forest at Monsombu River

Other than riparian, the karst ecosystem in Folili plays a vital role as a natural water reservoir. The limestones forming the karst hills absorb rainwater, reserve the water in underground cavities, and release it gradually in the form of springs. In the research site, there is an active cave called Kumapa Cave that has an underground river with a strong current for the whole year. The outflow of this stream becomes a permanent spring utilized by the people of Wana (Tau Taa) around Sigendo. While the water from Kumapa cave contains high minerals, indicated by its hardness, people still use it as an important resource to meet their basic needs. The role of Kumapa Cave in supplying underground water not only makes it an important part of HCV 4, but also forms a connection to HCV 5 due to its direct support to the livelihood of indigenous community.



Figure 29. Underground River Flowing from a Cave
Near the Taa Indigenous Group Village

The hill forest around Sigendo and Folili works as a barrier to prevent erosion and sedimentation. Most of the area has a slope inclination of more than 20°, making it susceptible to landslides if no vegetation is planted on it. The cover of the secondary and the karst forests is still dense, keeping the ground stable and absorbing the rainwater to avoid direct overflow from becoming a surface runoff. If this forest is cleared for haul roads or tailing disposal sites, the soil material will be eroded faster, drift to the river, and eventually will result in siltation and flooding in lowland areas.

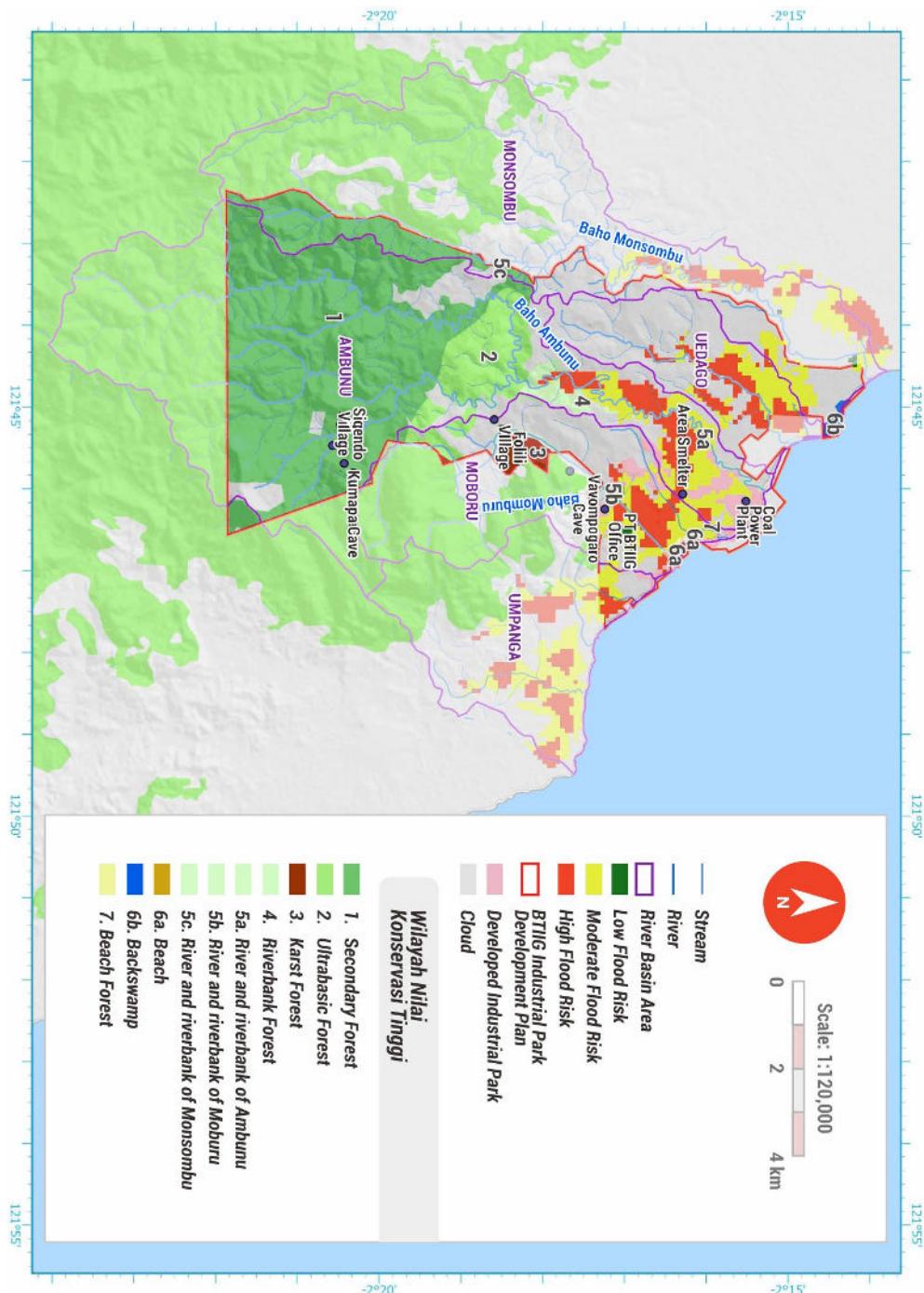


Figure 30. Map of Flood Hazard in the Area of BTIIG Industrial Park Development Plan

On the coast, the existence of mangrove and coastal backswamp ecosystems in Ambunu Beach adds an important layer to HCV 4. These ecosystems function as a natural protector of the beach against abrasion and intrusion of seawater, as well as a support against storms. Despite its relatively small area, the remaining combination of a mangrove, a backswamp, and a beach forest demonstrates its high ecological importance by being a physical protector of the coastal area and the wildlife habitat, including migratory birds that stop over in Ambunu area.

Therefore, the wide range of landscape elements found in PT BTIIG area indicates its significance as the provider of essential ecosystem services that directly support the livelihood of the people and the balance of the environment. These services are irreplaceable and will greatly impact the surroundings if they are disrupted by extractive industrial activities. For this reason, these areas are clearly qualified for HCV 4, whose existence needs to be preserved not only based on its ecological values, but also by their strategic functions in supporting the sustainability of humans' lives and the overall ecosystem.

3.1.5 HCV 5 - Area for Local Community's Basic Needs

HCV 5 refers to any natural area that plays a crucial role in fulfilling the basic needs of local or indigenous communities by providing food, water, timbers, or living spaces. Around the industrial park of PT BTIIG, the existence of natural ecosystems such as secondary forests, karst forests, and active caves becomes the main footing of the people, especially indigenous community of Wana (Tau Taa) and villagers in Tondo, Topogaro, Ambunu, and Umpanga. While some locals are starting to get absorbed into the industry, their dependency on natural resources in this landscape remains high, indicating that the area is clearly an HCV 5.

Sigendo Secondary Forest has become one of the main areas that support the basic needs of the people. The Wana community has been using this forest for a long time to hunt wild animals and to collect forest honey, resin, rattan, and various medicinal plants. The forest is also used for traditionally-managed shifting cultivation, where people plant upland rice, cassavas, and nuts for everyday consumption. The shifting cultivation system is not just a farming method, but also an integral part of the cultural identity and the subsistence lifestyle of the Wana community. Sigendo forest, therefore, is not just important ecologically, but also socially and culturally.

Timber resources from the forests also play a vital role. Interviews with locals showed that there are at least eight types of timber they often use, such as *bitti* (*Vitex cf. cofassus*), *nyatoh* (*Palaquium spp.*), dammar pine (*Agathis alba*), *jabon* (*Neolamarckia cadamba*), sandalwood (*Santalum cf. album*), and *kumea* (*Manilkara cf. celebica*). These timbers are utilized for constructing houses, creating tools, and fulfilling any other basic needs directly related to everyday life. The availability of the timbers from the natural forests shows that people here are still highly dependent on healthy ecosystems to sustain their lives.

Aside from timber and other non-timber forest products, water is also a basic need fulfilled by the natural landscape surrounding PT BTIIG. Kumapa Cave, for instance, is a permanent spring that flows from Folili karst systems. The people of Wana consume this water for drinking, cooking, and small-scale irrigation. Despite the high mineral content, water from Kumapa cave is irreplaceable as it is the only clean water source accessible throughout the year. For this reason, Kumapa cave carries two functions at the same time: as an ecosystem with high ecological value (HCV 4) as well as the support for the basic local needs (HCV 5).

In addition to the indigenous people, the fishermen at Ambunu coast still rely on the ecosystems of beach and backswamp. Marine products, such as fish, shells, and other aquatic biota remain an important part of their household consumption, as well as source of incomes for their families. This relationship highlights a strong link between coastal ecosystem health and local food security. Any damage to the coast caused by the reclamation or the jetty construction might lead to the people losing their access to vital protein sources.

Based on these findings, it is clear that the areas surrounding PT BTIIG contain HCV 5. Forests, caves, and coasts are not merely ecological spaces, but also socio-economy spaces that are fundamental to the locals. The loss of these ecosystems equals the loss of sources of food, water, building materials, medicines, and living spaces inherited across generations. Hence, the protection of HCV 5 is tightly associated with the efforts of maintaining social sustainability of the people that have adapted to the rhythms of nature in West Bungku.

3.1.6 HCV 6 - Cultural, Religious, and Historical Values

The sixth high conservation value found in the area of PT BTIIG is closely related to the cultural and historical heritage significant to the local communities as well as to archaeological and anthropological identity of Sulawesi as a whole. In this context, HCV 6 is clearly identified by the existence of the ancient cave of Vavompogaro (also known as Topogaro or Tokandindi Caves) located approximately 300 meters away from the border of PT BTIIG industrial park.

This cave is one of the most significant archaeological sites of Central Sulawesi, containing life traces of prehistoric humans from Pleistocene to Holocene eras. Several researches by various archaeological institutions, national and international, have shown that Vavompogaro Cave is a home to cultural artifacts, cave paintings, and remains of prehistoric humans that recorded the early migration traces of *Homo sapiens* in Wallacea. Given this status, the cave is not only sacred for the locals, but also a part of humanity's legacy. It is not just valuable locally or nationally, but globally.

Vavompogaro Cave has been legally acknowledged as a protected cultural heritage by Law Number 11 of 2010 on Cultural Heritage and by Regulation of Morowali District Head No. 188.4.45/KEP/0211/Disdikda/2019. However, while it has been administratively designated as a protected area, the on-field findings showed that the protection of this area is not even close to adequate. Mining activities around the cave and the expansion of the industrial park has structurally damaged some parts of the cave, indicating a weak implementation of HCV 6 protection.

Beyond Vavompogaro Cave, there is Kumapa Cave, an active cave yet to be fully explored, but widely known and used by the indigenous people of Wana (Tau Taa) as their springs and a part of their spiritual sites. This cave has a network of underground tunnels with a river flowing throughout the year and is an integral part of the Wana people's living system. Aside from having ecological functions, this cave lies within an indigenous territory regarded as sacred. The name "Kumapa" derived from the local language that has spiritual and symbolic meaning in indigenous cosmology.

Destruction of this area for industry purposes will not just affect the ecosystem, but also impact a far deeper aspect—the cultural identity and the sustainability of people's spiritual values. When these caves are damaged or losing their functions as social and religious spaces, the stones and water will vanish along with historical narratives, local knowledge, and human traces from thousands of years ago.

That is why the existence of Vavompogaro Cave and Kumapa Cave in PT BTIIG industrial park clearly qualifies for the category of HCV 6 as both caves possess priceless and irreplaceable cultural and historical values. Protecting this area is of critical importance, as every damage made to it is a removal of history and a violation of rights of the indigenous and local people for their cultural heritage.

Photo Source: AEER Documentation



3.2 Indonesia's Commitment to Protecting Biodiversity

The government of Indonesia has established Indonesia Biodiversity Strategy and Action Plan (IBSAP) 2025–2045 as their main guidance in managing biodiversity as an attempt to support sustainable development on national and regional scale. This document is not a standalone. It is integrated with the National Long-Term Development Plan (RPJPN) 2025–2045, National Medium-Term Development Plan (RPJMN) 2025–2029, and Kunming-Montreal Global Biodiversity Framework (GBF), aligning the direction of the national policies with the global commitment.

IBSAP highlights that High Value Conservation (HCV) Areas are crucial indicators in maintaining the ecosystem functions, as stated in Target 1 GBF (indicator 3.3.1). In protecting HCV areas, Precautionary Principle is applied, where any identification results of HCV must be deemed valid and binding unless proven otherwise by any valid scientific evidence. This principle protects the HCV areas from permanent damages as it places the burden of proof to the party planning the intervention instead of the party trying to preserve nature. On that account, the HCV inventory results in PT BTIIG industrial park as examined in this research shall become the official reference to prevent industrial expansion that might harm the high conservation value.

IBSAP also puts private sectors as strategic partners. In Target 18, the government encourages transparency and responsibility of the companies in managing biodiversity. This Target aligns with Target 15 GBF, and has a solid legal basis through Law Number 40 of 2007 on Limited Liability Company and Government Regulation Number 47 of 2012 on Social and Environmental Responsibilities. With such legal framework, a company like PT BTIIG should bear not only social responsibilities, but also legal and moral obligations to respect and protect the identified HCVs, unless proven otherwise by any valid evidence.

The principle of biodiversity integration in development is also highlighted in Target 14 of GBF, which demands biodiversity to be incorporated in all of the policy phases, from planning, implementation, to evaluation. This integration will result in wiser and more sustainable development decisions, while also raising awareness of the importance of conservation to all stakeholders.

Furthermore, IBSAP underlines a participative and fair approach by respecting the rights and the wisdom of the local and indigenous people. In the case of PT BTIIG industrial park development, it means that the attitude, opinions, and involvement of the people, particularly the indigenous community of Wana, shall become an integral part of the industrial planning, construction, and operational monitoring phases. Without them, the existence of HCVs and the people's social and cultural value may be overlooked.

The protection of landscape-based biodiversity, aside from being relevant to conservation, also directly contributes to achieving the nation's climate targets. Indonesia has committed to achieve FOLU Net Sink 2030, targeting to reduce emission by 140 Mt CO₂e from forestry sector and other land uses. However, without any strong policy intervention, deforestation and degradation in any HCV area caused by industry expansion, including the ones in Morowali, will lead to the failure in achieving such target and accelerate the loss of national biodiversity.

Photo Source: AEER Documentation



3.3 Conclusion

This study has successfully identified at least 58 plant types (45 trees, 8 bushes and shrubs, and 5 understories) and 64 animal types (5 mammals, 19 reptiles, 5 amphibians, and 5 fishes) in the concession area of PT BTIIG. This diversity indicates that the industrial park is still within the landscape with rich, unique biodiversity that holds high conservation value.

Other than that, there are at least 8 natural plant types that are important for the locals, used as food sources, medications, as well as construction materials. The existence of these plants highlights a tight connection between forest ecosystems and the livelihood of the locals, especially for the indigenous people of Wana.

The high conservation value (HCV) area within PT BTIIG approximately covers 3,945 hectares, mainly consisting of forests with a wide range of cover conditions and types of ecosystems. The conservation values in the area include habitat for endangered species, rare and endangered ecosystems, ecosystems vital for water regulation, and ecosystems with direct impact to the fulfillment of basic needs of the locals.

Nevertheless, all of the high conservation values are in serious danger due to the expansion of the industrial park, land clearing for haul road, tailing disposal plan, and limestone mining around the karst hills. Failure to control these threats could jeopardize the survival of key Sulawesi species—such as maleos, anoas, babirusas, and hornbills—and may also lead to the loss of vital resources for local communities, including water, food, and habitable land. Cultural sites such as Vavompogaro Cave and Kumapa Cave are also vulnerable to irreversible damage, which could result in the loss of the irreplaceable historical and spiritual heritage.

Based on these findings, the HCV areas in PT BTIIG shall be considered as a legally recognized and binding protected area, as regulated by the Precautionary Principle. It means all HCV identification results shall be deemed valid unless proven otherwise through any credible scientific studies. Without applying this principle, industrial construction might accelerate the loss of biodiversity, disrupt the functions of ecosystems, harm the local community, and hinder the progress of Indonesia's national commitment in IBSAP 2025–2045, GBF, and FOLU Net Sink 2030.

3.4 Recommendations

1. For the Central Government

- Thoroughly map all HCVs in Morowali, including the ones within the concession of PT BTIIG, to establish the area as a legitimate preservation area.
- Ensure that the protection of HCVs also secure the rights of the indigenous people, including their assets and access to the sources of water, food, timbers, and cultural sites.
- Provide a strict monitoring mechanism on the management of HCVs in the industrial area to prevent ecosystem damages.
- Integrate the protection of HCVs into the national targets, primarily IBSAP 2025–2045 and FOLU Net Sink 2030 (CO₂e emission reduced by 140 Mt from forestry sector and land uses).
- Involve the local and indigenous communities in planning, constructing, and monitoring the industrial park.

2. For PT Baoshuo Taman Industry Investment Group (BTIIG)

- Involve and respect the local and indigenous communities, especially the Wanas, in planning, constructing, and monitoring the industrial park.
- Set a comprehensive Environmental Management and Monitoring Plan (*Rencana Pengelolaan dan Pemantauan Lingkungan / RKL-RPL*) that specifically accommodates the existence of HCV 1–6.
- Ensure that the documents for AMDAL and implementation reports of RKL-RPL are publicly accessible for transparency and accountability.
- Refrain from expanding the industrial park, mainly in HCV areas.

3. Communities and Stakeholders

Enhance social control through public participation to make sure the industrial activities are always aligned with the precautionary principle and sustainability.

GLOSARIUM

AMDAL	= <i>Analisis Mengenai Dampak Lingkungan</i> (Environmental Impact Assessment)
BIG	= <i>Badan Informasi Geospasial</i> (Geospatial Information Agency)
BPS	= <i>Badan Pusat Statistik</i> (Statistics Agency Indonesia)
BIIIG	= Baoshuo Taman Industry Investment Group
CSO	= Civil Society Organisation
DAS	= <i>Daerah Aliran Sungai</i> (Watershed)
DEM	= Digital Elevation Model
EBA	= Endemic Bird Area
ESDM	= <i>Energi dan Sumber Daya Mineral</i> (Energy and Mineral Resources)
ESIA	= Environmental and Social Impact Assessment
FS	= Feasibility Study
GBIF	= Global Biodiversity Information Facility
GPS	= Global Positioning System
HCV	= High Conservation Value; sometimes written as NKT (<i>Nilai Konservasi Tinggi</i>)
IBA	= Important Bird Area
IHIP	= Indonesia Huabao Industrial Park
KBA	= Key Biodiversity Areas
KLHK	= <i>Kementerian Lingkungan Hidup dan Kehutanan</i> (Ministry of Environment and Forestry)
NGO	= Non-Governmental Organisation
PIAPS	= <i>Peta Indikatif Areal Perhutanan Sosial</i> (Indicative Map of Social Forestry Area)
PIPIB	= <i>Peta Indikatif Penundaan Pemberian Izin Baru</i> (Indicative Map of New Permit Issuance Moratorium)
PLTU	= <i>Pembangkit Listrik Tenaga Uap</i> (Coal-Fired Power Plant)
RePPProT	= Regional Physical Planning Project for Transmigration
UN-CBD	= United Nations Convention on Biological Diversity
USGS	= United States Geological Survey
VES	= Timed Visual Encounter Survey



PT Boashuo Taman Industry Investment Group (BTIIG) plans to build and develop an industrial area in West Bungku, Morowali, covering an area of approximately 7,376 hectares. The study indicates that 3,945 hectares, or 53.47 percent, of the total area is High Conservation Value (HCV), meaning more than half of the planned industrial area has ecological, social, and cultural functions critical to sustainability.

The largest portion of HCV is located in the 3,080-ha Sigendo Secondary Forest, which is a key habitat for the anoa, babirusa, maleo, and Sulawesi hornbill. This forest also plays a role in maintaining water management, preventing erosion, and providing forest products such as honey and resin for the community. Furthermore, there is the 478-ha Folili Ultrabasic Forest, a unique ecosystem growing on nickel-rich soils with unique vegetation that, if damaged, is nearly impossible to restore.

In the karst area, 69 hectares of Folili Karst and Kumapa Cave have been identified, a cave system that provides permanent and vital water for the Wana community. In addition, there are 283 hectares of riparian areas along the Ambunu, Monsombu, and Moburu Rivers that maintain water quality and prevent sedimentation. There is also a 31-hectare coastal mosaic of mangroves, swamps, and coastal forests in Ambunu that serves as a habitat for migratory birds and a natural coastal barrier. Another high conservation value is the Vavompogaro/Tokandindi Cave Cultural Site, which is recognized as a cultural heritage site and holds significance for the identity and history of the local community.

These findings confirm that nickel industry development in this area poses significant risks to the unique ecosystem, endemic and endangered biodiversity, and socio-cultural sustainability. Due to the irreplaceable nature of these areas, particularly the ultramafic and karst ecosystems, the precautionary principle must be applied. Therefore, the entire 3,945 hectares of HCV area should be treated as an operational protected area (no-go area) until there is valid scientific evidence to refute this value.

HCV protection is also aligned with national policies and global agendas, including the Indonesian Biodiversity Strategy and Action Plan (IBSAP) 2025–2045, the Kunming–Montreal Global Biodiversity Framework (GBF), and the 2030 FOLU Net Sink national target. Thus, maintaining 3,945 Ha of HCV in Morowali is not only an ecological obligation, but also part of a sustainable development strategy and Indonesia's real contribution to the global conservation agenda.



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