

## **Integrated Socio-Environment & Economic Initiatives in Pursuance of Sustainable Mineral Mining Operation in Indonesia: Point of View from Amman Mineral Nusa Tenggara, Batu Hijau Mine Site – West Sumbawa Regency**

Dewi Permatasari<sup>(2)</sup>, Budianto<sup>(1)</sup>, Jorina Waworuntu<sup>(1)</sup>, Aslan Aslan<sup>(1)</sup>, Aji Suryanto<sup>(1)</sup>, Priyo Pramono<sup>(1)</sup>, and Wudi Raharjo<sup>(1)</sup>

(1) Amman Mineral Nusa Tenggara, Batu Hijau Mine Site, West Sumbawa - Indonesia  
(2) CSRA – ICSP; Institut Teknologi Bandung, Bandung - Indonesia

### **ABSTRACT**

Indonesia is an archipelagic country with massive natural resources, one of the largest in the world, especially in the mining sector, both mineral and coal. In terms of managing the mineral mining sector, Amman Mineral Nusa Tenggara - AMMAN (previously operated by Newmont Nusa Tenggara) is an industry that manages and produces copper concentrate and has been operating for the last 22 years at the Batu Hijau mine site, West Sumbawa Regency. During its development of operation, AMMAN manages operational activities by pioneering the basis of sustainability in the environmental, economic, and social fields.

This paper discusses the AMMAN initiative in providing the best legacy for Indonesia by maintaining environmental sustainability and catalysing the development of human capital, sustainable infrastructure and an enabling environment for livelihoods, to enable dignified lives for all, including the most vulnerable and underrepresented groups. Some initiatives are building a 26 MW solar power plant to reduce fossil energy use and, simultaneously, becoming a pilot for zero-emission power plants. Another initiative is water management in reclamation and acid mine water reuse for operational activities. In managing 3R Solid Waste, the initiatives include using FABA waste as a road base, reuse of haul truck tire waste as an electric pole base, and plastic waste reduction by promoting tumblers as drinkable media for employees. In managing biodiversity, the Gili Balu conservation program was initiated and integrated with the socio-economic empowerment program to eradicate poverty and improve the livelihood of coastal communities.

All of these activities are in line with the sustainability principles in the Sustainable Development Goals (SDGs), which are also related to Environmental Social Governance (ESG) and Social and Environmental Life Cycle Assessment (S-E-LCA) in reducing environmental impact and optimizing the use of resources and 3R principal.

*Keywords: Amman Mineral Nusa Tenggara, Sustainability, ESG, LCA, Indonesia.*

## INTRODUCTION

Indonesia is an archipelago comprising 17,000 islands spanning from Sabang in the westernmost part of Sumatra to Merauke in the easternmost part of Papua. Indonesia's abundant natural resources have placed the developing country in the global spotlight, especially in terms of environmental sustainability and its people's socioeconomic welfare. Environmental and socioeconomic sustainability aspects are also essential for energy resources management in the mineral and coal mining industry sector.

Amman Mineral Nusa Tenggara – AMMAN (previously operated by Newmont Nusa Tenggara), is a mineral company that manages copper and gold concentrate mining activities. AMMAN operates in the Batu Hijau mining site, 27 kilometers from the Sumbawa Barat regency capital in Taliwang, West Nusa Tenggara (see Image 1). The Batu Hijau mining site has been operating for the last 22 years and has contributed significantly to the development of the Sumbawa Barat regency and its surrounding areas, which in the end also contributes to national development. Throughout its career, AMMAN has committed itself to always incorporating elements of sustainable energy, environment, and community management into its operational activities in order to leave its best legacy for Indonesia.



**Image 1. AMMAN's location in the Batu Hijau site, West Sumbawa Regency [1]**

This paper discusses the AMMAN initiative in providing the best legacy for Indonesia by maintaining environmental sustainability and catalysing the development of human capital, sustainable infrastructure and an enabling environment for livelihoods, to enable dignified lives for all, including the most vulnerable and underrepresented groups. Not only that, the company's sustainability initiatives and programs also synchronize aspects of its operational activity material life cycle management, including adhering to principles of good environmental and social governance (ESG), which is a highly relevant element to the company's sustainability programs and initiatives.

## **APPROACH & METHODOLOGY**

This paper emphasizes on discussing practical matters related to corporate sustainability programs, which seeks to provide insight on how such programs can be implemented and the parameters that should be used to evaluate their effectiveness. In order to provide such insight, this paper uses the following analytical methods and approaches:

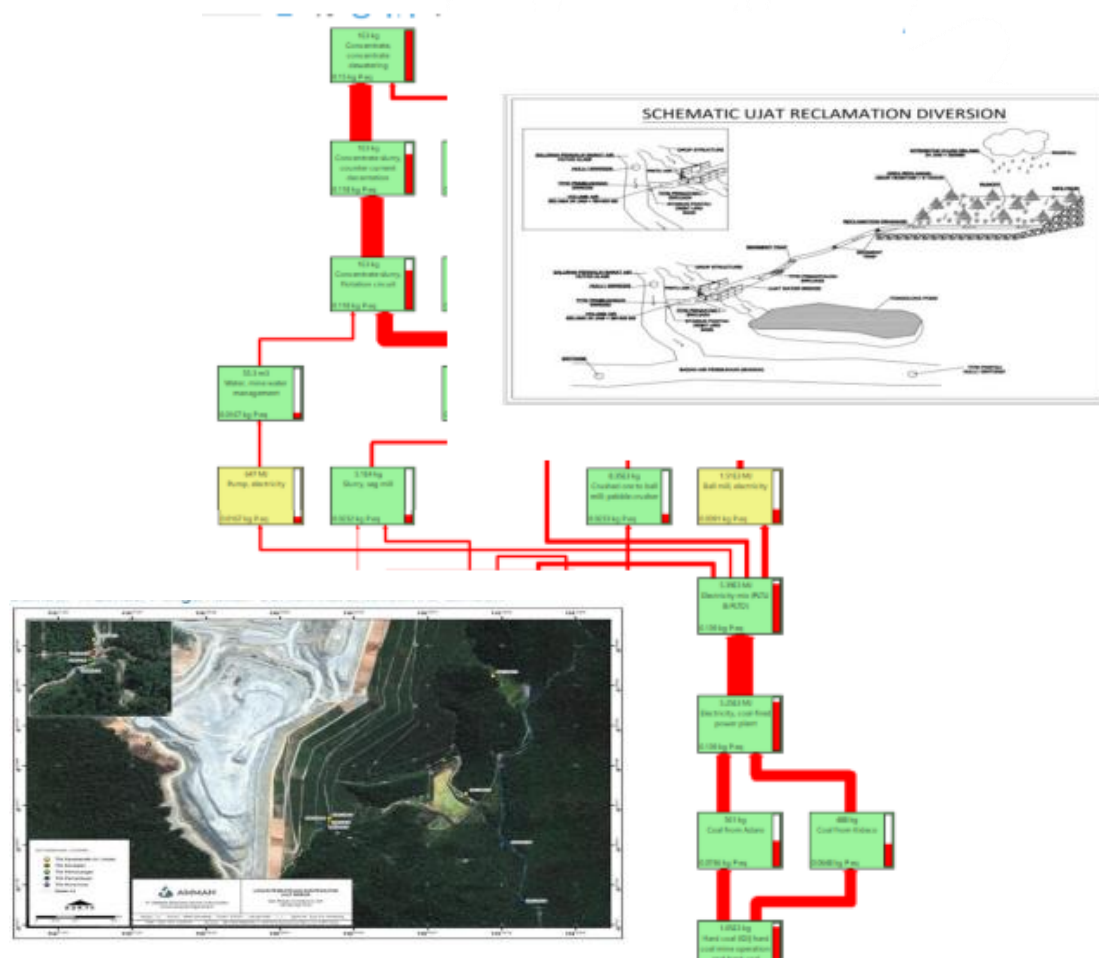
- This paper evaluates each corporate sustainability initiative based on the life cycle management principle, which considers the resource utilization efficiency in each operational process.
- This paper also reports the carbon emission reduction from the Sejong solar power plant's 26 Megawatt (MW) capacity, which operates during daylight hours without using any batteries. The effectiveness of the carbon emission reduction initiative using renewable energy is measured based on the energy consumption results and the company's greenhouse gas emission reduction target.
- The discussion on energy efficiency aspects of the company's operations focuses on fuel optimization by reducing the cooling fan pulley component diameter on the Haul Truck 793-C radiator. This paper uses calculations from the trial results from its operational activities.
- The evaluation of the reduction of wastewater burden initiative is focused on the results from the management of storm water runoff in the established reclamation areas, which has now incorporated a canal system to reduce the burden on the mining acid water pool to direct the runoff to the bodies of water within the canal system.
- The water consumption efficiency initiative's evaluation focuses on results from reusing the mine-impacted water in the sediment ponds as part of the water resource reduce-reuse-recycle (3R) principle.
- The evaluation of the company's toxic and hazardous waste management initiative utilizes the fly ash bottom ash (FABA) waste from its coal power plant as one of the elements mixed into the mining reclamation access road base materials.
- The evaluation of non-toxic and hazardous waste management initiatives, which, among others, utilize used tires as a basic construction material for portable electric poles.
- The evaluation of biodiversity protection initiatives focused on conserving the Gili Balu area as an ecosystem conservation hub.
- The evaluation of community empowerment initiatives, focusing on beneficiaries living in the coastal area of Kenawa Island, Gili Balu, and the surrounding area, which is integrated into a tourism-based empowerment program.

## **DISCUSSION**

In this section, we discuss AMMAN's experiences transforming its operational activities to create its best legacy for Indonesia, the country where it operates. As has already been explained in the previous section on methodology and approach, this paper focuses on the results of the corporate sustainability programs and initiatives without touching upon the technical planning aspects that preceded these results. The researcher might discuss the technical planning aspects of these programs and initiatives in a separate publication.

## Life Cycle Assessment

AMMAN has already pioneered the use of an inventory to assess the environmental impacts of copper concentrate mining activities. The scope of study it carries out focuses on the Cradle to Gate system of Company AMMAN's operational activities, starting from the production and transportation of auxiliary materials and land preparation as the cradle; mining and processing of ore as the main activities to concentrate product shipment process as the gate [2]. This research study has undergone a critical review phase to assess and analyse the effectiveness and validity of the company's activities. A glimpse of the company's resources management inventory is shown in Image 2, which has to do with a water efficiency program based on a life cycle management approach.



**Image 2. Water Efficiency Program Based on Life Cycle Management Approach [3]**

Looking forward, the evaluation of the life cycle management approach can be upgraded to include impact evaluation, as well as the declaration of environmentally friendly products, based on integrating environmental impact control into the company's operational activities.

Energy Efficiency: The reduction of the Cooler Fan Lifter Component Diameter on the Haul Truck 793-C radiator.

AMMAN's operational activities utilize the CAT 793 Haul Truck to transport the results of its mining activities. To transport the materials produced, 124 units of the Haul Truck 793 operate on a daily basis, fuelled by the B30 biodiesel. The effectiveness of the mining vehicle greatly influences the amount of fuel used, which ultimately will affect the level of carbon emission produced.

The reduction of the diameter of the radiator cooling fan pulley component from 297 millimeters (mm) to 275 mm has automatically decelerated the radiator cooling fan by 6 percent, thus reducing the B30 biofuel consumption by 16.5 litres per hour per truck, bringing carbon emission down more than 62,000 ton per year<sup>[4]</sup>. The program is visualized in Image 3.

1. HT050 installed with new 8 blade fan (362-7762) with standard large pulley. 2. HT053 installed with new 8 blade fan (362-7762) with 6% speed reduction small pulley. 3. HT070 installed with old 11 blade fan (110-2735). With standard large pulley.											
Unit Number	Route	Dlog date	Dlog time	Start Time	End Time	Δ Time	Start Distance	End Distance	Δ Distance	Fuel Consumption	
HT050	SH03 to Kanloka	20-Dec-17	10:43:26 AM	10:52:02 AM	10:58:02 AM	0:06:00	2049	3163	1114	36,7469	
HT053	SH03 to Kanloka	20-Dec-17	10:21:54 AM	10:30:46 AM	10:36:16 AM	0:05:30	2040	3152	1112	33,3937	

**Image 3. The results of reducing the cooler fan pulley component diameter on the Haul Truck 793-C radiator**

Since 2019, this small crankshaft pulley has been installed on 104 Haul Truck-793 units. This innovation supports the sustainable development goals number (9) Industry, Innovation & Infrastructure, (12) Responsible Consumption & Production, and (13) Climate Action.

Emission Reduction: Implementing the 26MW Sejong Solar Power Plant

AMMAN has initiated an energy transition program for its electric energy source as part of its energy conservation and emission reduction initiatives. The first initiative is to implement the development of a renewable energy source by constructing the Sejong Solar Power Plant, with a total capacity of 26 megawatts (MW). The Sejong Solar Power Plant was commissioned in May 2022 and connected with the company's grid. The renewable power plant has reduced carbon dioxide emissions by 2,721 tons as of June 2022 and will reduce up to 46,000 tons per annum<sup>[5]</sup>.





**Image 4. The 26MW Sejong Solar Farm [6]**

This initiative supports sustainable development goals number (7) Affordable Clean Energy, (12) Responsible Consumption and Production, and (13) Climate Action.

Hazardous Waste Management: The Utilization of FABA as Roadbase Material

As part of Company AMMAN's effort to reduce, reuse and recycle toxic and hazardous waste, the company also utilizes the fly ash and bottom ash (FABA) waste resulting from its coal power plant activities. The FABA waste is used as a raw material for road base mix on the mining reclamation access road up to 17,000 m<sup>3</sup>/year. The Ministry of Environment and Forestry (MoEF) has issued permits for this activity. Look at Image 5 for more information on program implementation.



**Image 5. The use of FABA as Roadbase material [7]**

On average, this initiative uses approximately 100% of FABA produced per annum, reducing the use of soil from the land clearance process as a raw material. This unused soil can later be used for the mining closure process. This initiative supports sustainable development goals number (9) Industry, Innovation, & Infrastructure, (12) Responsible Consumption and Production, and (13) Climate Action.

#### Solid Waste Management: Utilizing Used Tyre as Hardening Material for Portable Electric Poles

The term “used tire” refers to Hauling Truck tires which have already expired, generally after being used for 2,500 hours, or equal to 3.5 months of operation. After turning into a non-toxic and hazardous solid waste, commonly used tires idle in a waste rock dump, thus not being utilized well. Currently, however, the company has come up with innovative ways to utilize used tires as a hardening material to make portable electric poles. The activity is documented in Image 6.



**Image 6. Utilization of Used Tyre as Movable Electric Poles Application**

To date, about 100 tons per annum on average of used tires around the Batu Hijau mining sites have been utilized as a hardening material for the portable electric poles <sup>[8]</sup>. This program supports sustainable development goals number (9) Industry, Innovation, & Infrastructure and (12) Responsible Consumption & Production.

#### Water Efficiency: Reusing Mining Waste Water Effluent for Process Plant Water Use

AMMAN’s copper and gold mining activities produce acid wastewater, processed in sedimentation control structure (SCS) ponds. After it is processed, the acid wastewater can be utilized to power the concentrate manufacturing process to reduce groundwater use. Image 7 shows the location of an SCS pond and pump facility to use the mine water in the processing plant.





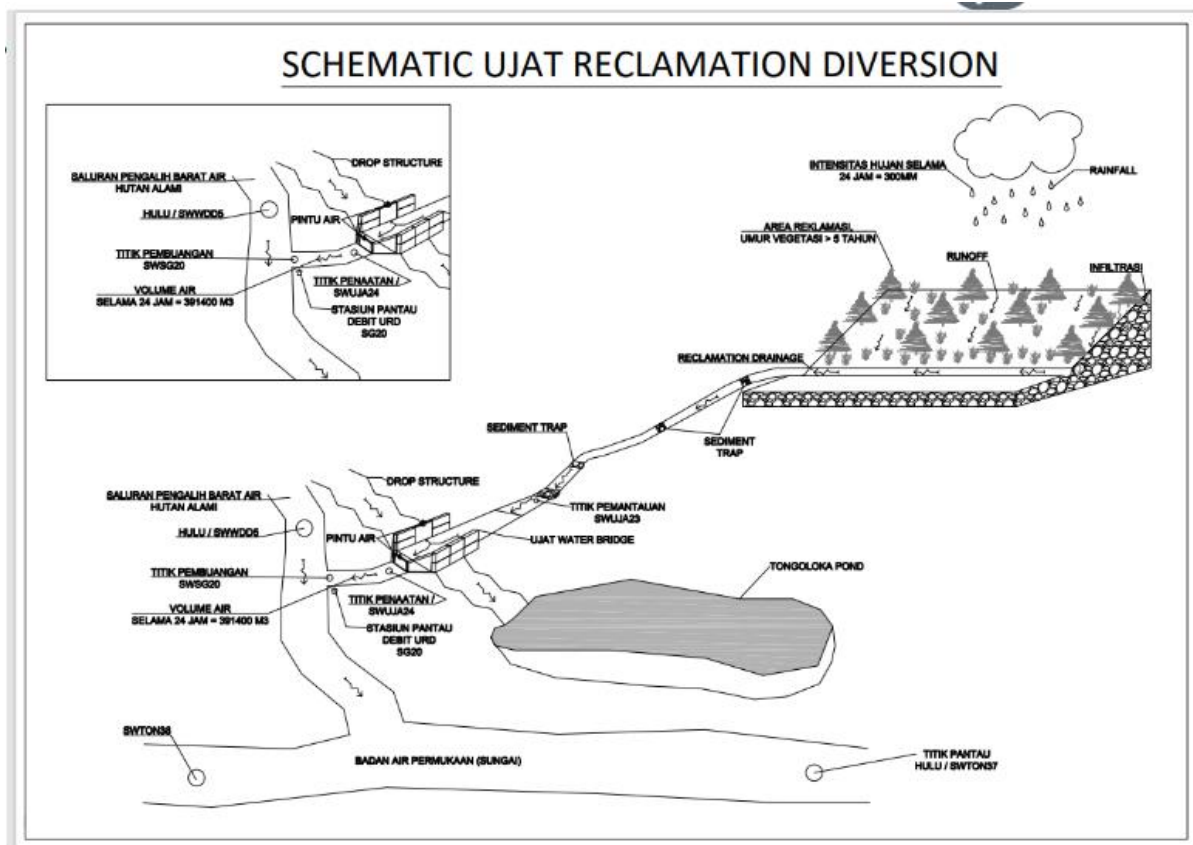
**Image 7. The Mining Wastewater Processing Location at SPS Santong 3 [9]**

This initiative has also supported water efficiency initiatives by saving groundwater usage. This initiative promotes sustainable development goal number (12), Responsible Consumption and Production.

#### Wastewater Management: Ujat Reclamation Diversion (URD)

Part of the reclamation area managed by company AMMAN is called "Ujat," which means civet in the local Sumbawan language. In the beginning, it was discovered that the rainwater runoff around the Ujat area also discharged to the SCS, thus adding to the processing burden. Therefore, this reclamation site modifies the water flow by applying a 145 m<sup>3</sup>/s capacity canal system to flow the good quality rainwater runoff from 166 Ha of established reclaimed area directly to the bodies of water. Image 8 shows the location of the canal to manage the water at the Ujat reclamation site.





**Image 8. Water Management in Ujat Reclamation Area [10]**

This program is still under the commissioning process. Two different reclamation runoff diversion facilities have been in operation in separate locations: the Tongoloka Reclamation Diversion and the Kanloka Reclamation Diversion. This program supports the sustainable development goals number (12) Responsible Consumption and Production, and (14) Life below Water.

#### Biodiversity Conservation: In the Gili Balu and Kenawa Island Areas

The word Gili Balu comes from the Sumbawan language, meaning "Eight Islands." The Gili Balu comprises an integrated conservation area vital to protecting ecosystem balance in the sea and the coastal regions. The conservation area also includes Kenawa Island, a populated island that unfortunately has not been well-managed, despite its high accessibility for humans. Image 9 shows the map of Gili Balu.



**Image 9. The Kenawa Island and the Gili Balu Conservation Area [11]**

The conservation activities conducted on Kenawa Island include deploying and monitoring artificial reefs and releasing the green turtle, which has been classified as endangered since 2022 by the IUCN Redlist of Threatened Species. Image 10 shows the conservation process.



**Image 10. Reef and Green Turtle conservation on the Kenawa Island**

To date, about 5,000 green turtles have been released in West Sumbawa Regency as part of a biodiversity program managed by AMMAN [12]. This program also supports Sustainable Development Goals number (13) Climate Action, (14) Life below Water, and (15) Life on Land.

#### Community Development: Empowering the Locals in the Kenawa Island through the Development of Ocean Tourism

One of the integrated conservation activities in Gili Balu is the development of locals' professional skills through ecotourism training, beach clean-up activities, repair of local tourism infrastructure, as well as several research studies analysing the potential of coastal areas for tourism. This community empowerment activity is a concrete action to achieve environmental, economic, and social sustainability in the area. Image 11 shows community empowerment activities on Kenawa Island.



**Image 11. Pilot Community Empowerment Projects**

This program was pioneered in 2022 and will continue to be developed in the future. Until today, the Gili Balu management has received lots of support from the local tourism industry task force and business players. The Pototano village administration and the local fishermen also play a crucial role in making this program possible [13]. This activity supports sustainable development goals (1) No Poverty, (2) Zero Hunger, (6) Good Health and well-being, (8) Decent Work and Economic Growth, (12) Responsible Consumption and Production, (13) Climate Action, (14) Life below Water, (15) Life on Land, and (17) Partnerships for the Goals.

## **CONCLUSION & RECOMMENDATION**

Some conclusions from our analysis of AMMAN's sustainability initiatives are:

- The initiatives conducted by AMMAN in supporting operational sustainability aspects are divided into three main components:
  - The management of mining activities comprising hauling, mining, acid water management, wastewater pollution prevention, including the optimization of raw material reuse as product components for supporting activities.
  - Other supporting activities include the shift toward the utilization of renewable energy, like solar farms, and the utilization of fly ash bottom ash waste from its steam power plant.
  - Supporting the improvement of the Gili Balu ecosystem and residents' social welfare.

All these activities support various aspects of the sustainable development goals (SDGs).

- In principle, the sustainability aspect of the initiatives conducted by AMMAN has also supported the establishment of the circular economy system, both from the company side as well as from the societal side, with its life cycle thinking principle based on good governance in alignment with the environmental, social governance (ESG) rules.



Several suggestions for AMMAN to further improve and develop its sustainability initiatives are as follows:

- Mapping program areas to integrate all related sustainability aspects into a single initiative;
- Developing innovations based on sustainability principles; and
- Expanding the scale and impact of ongoing programs.

## **ACKNOWLEDGEMENT**

The authors thank the management of AMMAN and its entire team which have already implemented the program to the best of their abilities, thus creating collaboration among parties in supporting society's welfare through the good governance and practices initiated by AMMAN. The authors also thank local community groups and related stakeholders who have participated in managing the ecosystem around the Sumbawa Barat regency.

## **REFERENCES**

- [1] SGS Indonesia. 2022. "Final Report of Energy Audit PT Amman Mineral Nusa Tenggara: Batu Hijau Mine Site". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [2] Life Cycle Indonesia. 2021. "Laporan Penilaian Daur Hidup Produksi Konsentrat Tembaga untuk PT Amman Mineral Nusa Tenggara". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [3] Hartinah., and Anungstri, R. 2022. "LCA Based Analysis for Ujat Reclamation Diversion (URD)". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [4] Pasadita, A., Putri, I.W., and Husni, M.A. 2022. "Innovation Based Analysis for Haul Truck 793 (HT793) Pulley Upgrade PT Amman Mineral Nusa Tenggara". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [5] Putri, I.W., Pasadita, A., and Husni, M.A. 2022. "Valuation of Emission Reduction Potential of PLTS Sejong Implementation – Prepared for Absolute Quantification of Emission Reduction Aspect on Beyond Compliance". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [6] Tractebel Engie, and MedcoEnergi Power. 2020. "Feasibility Study of Solar PV Plant in West Sumbawa: PT Medo Power Indonesia, Jakarta – Indonesia". Internal Report, Unpublished. Jakarta – Indonesia.
- [7] Firmansyah., Huda, N., and Husni, M.A. 2022. "Report of Non-Dominant Hazardous Waste Utilization". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [8] Salsabila, A. 2022. "Innovation Based Analysis for Used Tyre Utilization as Electric Pole Base". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [9] Hartinah., and Anungstri, R. 2022. "Report of Activity and Monitoring for Water Efficiency Initiative". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [10] Hartinah., and Anungstri, R. 2022. "Innovation Based Analysis for Ujat Reclamation Diversion (URD)". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [11] Maswahenu, M., Rahmandhana, A.D., and Mahendra, D. 2022. "Memorandum of Gili Balu Location Survey". Internal Report, Unpublished. West Sumbawa, Indonesia.

International Conference on Sustainability  
7<sup>th</sup> Sustainability Practitioner Conference 2022  
Bali, Indonesia

- [12] Setianto, A., Noerfahmy, S., Irda, M.H., Rahmadhana, A.D., and Mahendra, D. 2022. "Innovation Based Analysis for Turtle Conservation and Reef Ball in Gili Kenawa". Internal Report, Unpublished. West Sumbawa, Indonesia.
- [13] Suryanto, A., Purnama, D.P., Karyawansyah., Amril, A., Susanto, A., and Indarto, D.T. 2022. "Conservation of Gili Balu PT Amman Mineral Nusa Tenggara: Background and Kickoff". Internal Report, Unpublished. West Sumbawa, Indonesia.