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An Integration of Community Empowerment and Biodiversity Conservation Program through Social-Ecology Approach in Indonesia (Study Case: Kokolomboi Hamlet)

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Abstract

The endangered Peleng Tarsier primate species and the critically endangered Banggai Crow species live and breed in Kokolomboi Hamlet. However, for such a long time, natives hunt wild animals for food and for commercial interest. Land conversion and forest fires that become normal method for beekeeping and farming have resulted in a progressive loss of wooded area and degraded land. To address this, a community empowerment program with the integration of socio-cultural, socio-economic, and socio-ecological approach has been designed as a method to achieve sustainable exploitation and management of the forest area through honeybee production with apiculture as backbone. The objective of this community empowerment program is to make people of Kokolomboi Hamlet voluntarily conserve nature by developing conservation village while assuring their primary needs are met by the economic empowerment using environmentally friendly beekeeping method and eco-tourism activities. From year 2020 to 2023, this socio-cultural, socio-economic, and socio-ecological integration approach has empowered 30 members of Tourism Awareness Group (Pokdarwis), 11 beekeeping groups with 245 members, 30 households participated in environmental preservation, 60 foreign tourists have visited Kokolomboi Biodiversity Park, and flora biodiversity index monitored is 4.51 while fauna biodiversity index monitored is 3.75. The method of integrating social, economy, and ecological aspect as an approach along with engaging relevant stakeholders show significant impacts on transforming community's behavior in livelihood and biodiversity conservation.

Keywords: community empowerment, conservation, biodiversity, socio-ecological

1. Introduction

Geographically, Banggai Islands Regency is included in the Wallacea Region which is home to biodiversity with a very high level of endemism. The enormous potential of natural resources makes Banggai Islands Regency part of the Mega-Biodiversity Country. According to UN REDD Forest Carbon Statistic of Central Sulawesi (Suryadi, 2012), there are 270 hectares of severely degraded land; 1,761 hectares of critically degraded land; and 9,901 hectares of moderately degraded land in the Buko Subdistrict, Banggai Islands District, Central Sulawesi. Furthermore, over 20% of Leme-Leme Darat Village residents hunt wild animals for food and for commercial interests.

Other than that, the endemism and vulnerability of animals in Indonesia is an issue that requires special attention in order to maintain the sustainability of the ecosystem. The Peleng Tarsier (*Tarsius pelengensis*) is listed as Endangered by the International Union for the Conservation of Nature (IUCN) (Shekelle, 2020). On 2017, BirdLife International assessment also showed that Banggai Crow (*Corvus Unicolor*) is listed as *critically endangered* animal. The Peleng Tarsier is one of 2,573 species suffering near-term extinction, while the Banggai Crow is one of 1,742 species risking extinction in the near future, according to the IUCN Red List.



Figure 1. Left: Peleng Tarsier (*Tarsius pelengensis*), Right: Banggai Crow (*Corvus Unicolor*)

2. Methods

2.1 Integrating Socio-Cultural, Socio-Economical, and Socio-Ecological Approach

Community empowerment is closely related to social inclusion, namely a fair and equitable development process, as well as equal opportunities to achieve economic improvement, status, opportunities, and reducing feelings of inadequacy (Ahmad & Talib., 2015; Davey & Gordon., 2017). In the socio-economic approach to community empowerment, there are several aspects that need to be considered, those are financial conditions around industrial areas, the risk of decreasing community income, decreasing business activity numbers, and the risk of unemployment (Sandhyavitri, et al., 2019). By applying foresight methodology, it can be used to develop long-term strategies for socio-economic development to identify priority areas of scientific and applied research, as well as to increase interaction between community participation and the innovation system of empowering actors (Kosov, et al., 2016).

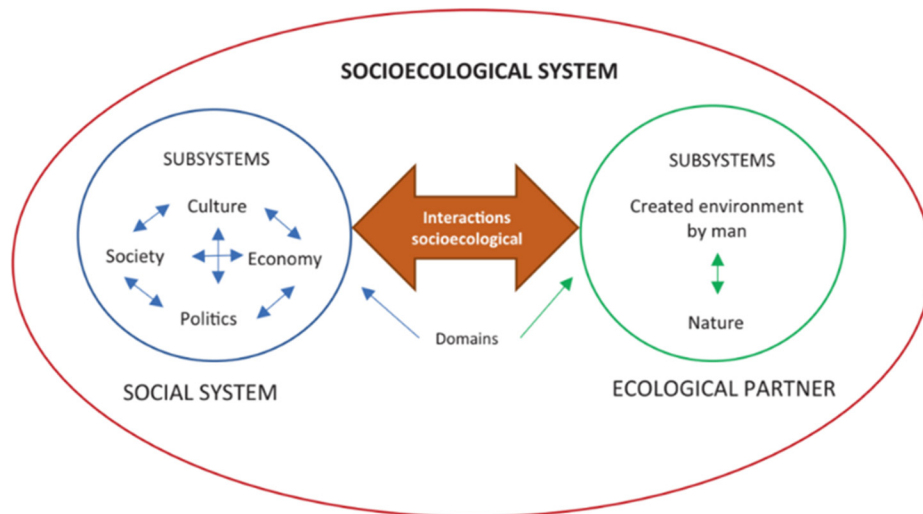


Figure 2. Socio-ecological system (Ortega-Rubio, 2022)

Another approach taken in community empowerment is the social-ecological approach. The social ecological approach is an approach that examines interactions between society and nature, especially to understand the dynamic processes in their interactions. It can be understood that the social system and the ecological system form an inseparable relationship, which has a reciprocal role as shown in Figure 2. The social ecological approach is considered an effective medium in regional development and management by analyzing the reciprocal relationship between humans and nature combined with internal and external factors. With a social-ecological approach, it can be used as a foundation for appropriate regional development, ensuring sufficient natural resources, and how to use them. Proper management and utilization of natural resources by integrating adaptive methods between human activities and social structures to ensure harmony in adaptation and development is expected to improve the quality of life, ensure security and sustainable development through increasing social-ecological capacity (Tran et. al., 2022). Another approach that is based on socio-cultural values that are acquired and passed on from one generation to another is called the socio-cultural approach. Culture is often considered the most important aspect of

information in societal activities which is manifested in behavioral patterns. The existence of culture helps people behave so that they are able to optimize the use of limited resources to meet as many needs as possible (Pylypenko, et. al., 2019). Hence, the community empowerment on Kokolomboi Hamlet integrates community engagement with conservation initiatives through an ecological approach, socio-economic approach, and socio-cultural approach.

2.2 Strategic Plan

The socio-cultural approaches become the cornerstone of the conservation work, preserving the indigenous Sea-Sea Tribe's wisdom through the Kuyak and Lakasinding dances for conservation advocacy and integrating endangered wildlife conservation into local elementary and middle school curricula. Then, the socio-economic approach commenced by empowering beekeeping communities with more environmentally friendly method which utilize non-timber forest products or apiculture and the development of eco-edu tourism. This socio-economic approach connects with global Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty). On the other hand, the socio-ecological method contributes to SDG 13 (Climate Action) through increasing and maintaining vegetation cover, constructing endemic plant nurseries, nurturing endemic plant, zoning of protected forest areas by indigenous community, conserving endemic biodiversity by indigenous community with traditional method and frequent biodiversity index monitoring and evaluation. These activities help to preserve natural food supplies and food chains for endemic species. Furthermore, the initiative helps achieving SDG 15 (Life on Land) by conserving and maintaining Kokolomboi Biodiversity Conservation Park, therefore conserving endangered flora and animals such as the Peleng Tarsier and Banggai Crow. The community empowerment program namely Kokolomboi Lestari is planned to settle within 5 years. The strategic plan from 2020 to 2025 can be seen as follows.

2020	2021	2022	2023	2024
Identify	Restore	Protect	Promote	Self Belonging
1. Stakeholder engagement 2. Social ecological mapping potential and problem issues 3. Organizing community groups 4. Zoning of Protected Forest Areas by the Togong Tanga Indigenous Community 5. Preparation of program and activity plans	1. Conservation by indigenous peoples (traditional ecology) 2. Enrichment and nursery of endemic plants 3. Improving critical land as a step for maintaining chain vegetation 4. Monitoring and evaluation of biodiversity indices	1. Legality of the biodiversity area 2. Development of the use of non-timber forest products through apiculture 3. Understanding indigenous knowledge: Lakasinding Dance and Sea-Sea local beliefs	1. Development of eco-edu tourism 2. Adopt conservation efforts in local content for elementary school, junior high school and senior high school	1. Replication of Conservation Villages 2. Optimizing voluntourism to increase local, national, and international exposure
KOKOLOMBOI LESTARI				

Figure 3. Strategic plan 2020-2024

A notable innovation is the use of palm tree trunks gathered from community gardens. These trunks go through a particular treatment process in which they are chopped to about 1.2 meters in length and then hollowed down to form chambers. These palm tree trunk cavities have been specifically treated to attract wild bees to nest inside them. It is feasible to generate 5 to 6 wild bee nesting mediums from a single palm tree trunk purchased from a community garden. Because each palm tree trunk can replace the need to take down 5 to 6 forest trees for the same purpose, this innovation considerably minimizes the possibility for forest tree logging. Furthermore, these palm tree trunk media can be reused as nesting locations for wild bees several times. This approach helps to reduce tree felling within the Peleng Island Forest. This invention also focuses on empowering and educating the community. Regular education and monitoring operations are carried out to teach the community how to produce honey products, minimizing the need for tree logging. Currently, the community uses dead palm tree trunks as bee nesting sites, avoiding the need for tree chopping in Peleng Island's Primary Forest. This innovation displays the program's commitment to environmental protection and sustainable practices while also benefiting local populations' lives.



Figure 4. Environmentally friendly beekeeping method

Beekeeping is an important component in forest regeneration because bees play an important role as pollinators, assisting in the fertilization of surrounding plant life. Furthermore, this program has evolved into an innovative project, as it has become a core Community Conserved Area, which is directly protected and monitored by the Indigenous Community (Togong Tanga) and the local society. This accomplishment has increased the community's awareness of environmental preservation tremendously.

To measure impact and effectiveness of this community empowerment program method of integrating socio-cultural, socio-economy, and socio-ecological aspect with backbone in environmentally friendly beekeeping method, these parameters are monitored:

- 1) Number of civil societies empowered on tourism awareness and number of tourists visited Kokolomboi Biodiversity Park.
- 2) Number of beekeeping farmers empowered by training and changes of economic income.
- 3) Number of households participated in achieving Ministry's Primary Climate Village Award.
- 4) Biodiversity index of flora and fauna monitored in Kokolomboi Biodiversity Park, especially endangered endemic fauna such as *Tarsius pelengensis* and *Corvus unicolor*.

2.3 Stakeholders Involvement

Corporate marketing is a relationship-based philosophy that explicitly considers stakeholders, society, and the company's ethical orientation (Maon et. al., 2021). CSR branding efforts direct corporate stakeholders to engage in ongoing efforts to understand and give meaning to emerging social issues and corporate actions. Therefore, scholars in management, business and society, and corporate communications have begun to discuss the sense-making and sense-giving processes that characterize how companies and their key stakeholders approach CSR-related issues and opportunities (Aguinis & Glavas, 2017). Corporate social responsibility (CSR) focuses on various types of stakeholders and outcomes, including stakeholders outside the organization and outcomes that go beyond financial results. Thus, CSR expands the notion of work to go beyond task, job, intra-individual, intra-organizational, and profit perspectives and provides an ideal channel for individuals to seek and find meaningfulness through work. In implementing the strategic plan, this community empowerment program involves multi-stakeholders as follows:

Table 1. Stakeholders and their involvement

Stakeholder	Expertise(s)	Involvement(s)
Pertamina EP Donggi Matindok Field	Oil and Gas Producer	Creating empowerment programs as part of environmental and social responsibility
Banggai Islands District Government Agency	Government Agency for Environmental Affairs	Government Agency for Environmental Affairs
Buko Sub-district Government and Leme-Leme Darat Village Government	Local Government Administrators	Providing education and understanding to the community about the importance of environmental preservation
Universities (Tadulako, Tompotika, Gadjah Mada)	Academic Institutions	Academic experts involved in measuring the impact of empowerment programs on community groups. Engaged in mapping plant and wildlife distribution, program implementation, training assistance for beekeeping community, and program sustainability evaluation
Omah Cipta Institute for Scientific Studies and Community Empowerment, and Indonesia	Research and Study Organizations	Experts in environmental studies and research. Conducting environmental studies and social mapping in collaboration with communities and relevant stakeholders
Togong Tanga Indigenous Institution, Kokolomboi Biodiversity Park Tourism Awareness Group, Beekeeping Community, and Local Community	Coordinators and Environmental and Cultural Preservers	Active participants in conservation efforts with the aim of enhancing community engagement. Transitioning from being conservation subjects to conservation actors, ensuring inclusivity and holistic conservation efforts.

2.4 Shannon-Wiener Index

Shannon index, which also popular with name Shannon's diversity index or Shannon-Wiener index, is used vast in ecological literature to measure and communicate biological diversity (Spellerberg and Fedor, 2003). Shannon-Wiener index, symbolized with H' which is given in the following formula is used to compare flora and fauna diversity respectively. In which H' stands for the diversity index and p_i stands for number of individuals of species/total number of samples belonging to the i th species in the dataset (Fufa, et. al., 2020).

The text size of formula should be similar with normal text size. The formula should be placed in the middle and serial number on the right. For example:

$$H' = - \sum_{i=1}^R P_i \ln P_i \quad (1)$$

Furthermore, Shannon meets several of the important properties of a diversity measure (Sherwin et. al., 2017), including the following:

- 1) When the species abundances are even, H' has its maximum value
- 2) For two even communities, the one with more species has a higher H'
- 3) H' is completely additive in a hierarchy, such as in local areas within a larger area within a continent

Diversity index in Kokolomboi Biodiversity Conservation Park is measured based on the monitoring of flora and

fauna species every semester from 2021 to 2023 involving Banggai Islands District Environmental Agency, Kokolomboi Biodiversity Conservation Park Management Team, local community, and beekeeping farmers. The diversity index of flora and fauna in year 2021 used as baseline for the program. Though Kokolomboi Biodiversity Conservation Park are divided into several areas based on its elevation, diversity index in this program is not measured from flora and fauna monitored in each area based on elevation, but rather as a whole area of Kokolomboi Biodiversity Conservation Park with a total area of 13,68 ha.

3. Results

3.1 Implementation Each Year

Before the positive impacts observed, there are several implementations of community empowerment and stakeholder engagement over a span of approximately 4 years until this journal published.

3.1.1 Year 2020

a. Inventory and Mapping of Endemic Plants and Wildlife

Collaboration with Banggai Islands District Environmental Agency, Kokolomboi Nature Conservation Area Tourism Awareness Group, and Leme-Leme Darat Village Government. Based on morphological blocks, this mapping endeavor developed a database of wildlife distribution. The information was used to create strategic strategies and annual work plans

b. Group Revitalization and Strengthening Institutional Capacity

The focus was on preparing conservation implementers. Recognizing that many people regard conservation as exclusively ecological, integrating the community and indigenous institutions becomes critical for achieving the best conservation results

c. Education and Awareness on Nature Conservation

Societal practices like illegal logging and hunting wildlife have persisted due to a lack of understanding. Through awareness campaigns, the program aimed to elevate community consciousness about ecosystems and the significance of preserving them. The District Environmental Agency of Banggai Islands and local Village Government were involved in these activities.

3.1.2 Year 2021

a. MoU Signing for Cooperation Between PEP Donggi Matindok Field and Banggai Islands District Environmental Agency

MoU number 1640/PPC82330/2021-S0 and 4/MoU/2021 on the Development of the Kokolomboi Biodiversity Park. This initiative represents both the company's and the government's commitment to collaborating on environmental protection, namely the preservation of the Kokolomboi Biodiversity Park. The company and the government share responsibility for the success of conservation activities under this MoU.



Figure 5. MoU signing between PEP Donggi Matindok field and Banggai islands district environmental agency

b. Development of Local Plant Nursery Facilities for Enriching Natural Food Sources for Endemic Wildlife

Efforts to increase the population of endemic plants through propagation and planting play a crucial role in the preservation of the Kokolomboi Biodiversity Park's ecosystem.



Figure 6. Plant nursery facilities

c. Restoration of Critical Land Areas for Vegetation Maintenance

In collaboration with relevant parties, has planted 1,200 trees of 10 different endemic species at various locations within the Kokolomboi Biodiversity Park. The species are as follows.

Table 2. Lists of endemic species planted in Kokolomboi biodiversity park

Local Name	Latin Name
Osa	<i>Castanopsis sp</i>
Meranti	<i>Shorea selanica</i>
Nantu	<i>Palagium dasiphylum</i>
Bintangor	<i>Calophyllum</i>
Sosong	
Suloi Pasok/Suloi Putih	<i>Lithocarpus</i>
Sosoling	
Sombuton	<i>Timonius sp</i>
Tasan	<i>Zyzygium</i>
Labani	

d. Assistance and Development of Climate Village Programs with the Togong Tanga Indigenous Group

This activity aims to provide communities with the skills needed for sustainable natural resource and environmental management.



Figure 7. Assistance of climate village program

e. Beekeeping Training and Environmentally Friendly Beekeeping Assistance

In addition to propagation and planting, the company provides education/training on environmentally friendly forest honeybee farming. Empowering and educating the community in forest honey production is achieved through infrastructure development, technical guidance, and capacity building.

f. Biodiversity Index Monitoring

Monitoring and evaluation activities are carried out every six months, involving relevant stakeholders, including the Kokolomboi Biodiversity Park Management, local communities, the Banggai Islands District Environmental Agency, the Kokolomboi Biodiversity Team, and beekeeping farmers who are direct partners in the community empowerment program.

3.1.3 Year 2022

a. Development of Eco-Tourism in Kokolomboi Biodiversity Park

To advocate conservation efforts locally, nationally, and internationally, the company and the Kokolomboi Biodiversity Park Management, along with community groups, are developing ecotourism potential in the area while prioritizing conservation. Tourists will be guided directly by local heroes to explore the diversity of Kokolomboi, particularly endemic wildlife and plants.



Figure 8. Eco-tourism in Kokolomboi

b. Program Dissemination

Education and awareness about the importance of environmental conservation are imparted to young generations, and conservation efforts are integrated into the local curriculum of elementary and middle schools.

3.1.4 Year 2023

a. Expansion of Climate Village Programs to Several Villages around Kokolomboi

The Climate Village program, initially covering 5 villages around Kokolomboi, has expanded to include 22 villages to be supported in submitting Climate Village Program proposals in 2023.



Figure 9. Expansion of climate village program

3.2 Increase in the Population of Endemic Species - Tarsius Peleng and Gagak Banggai Monitoring Status

Prior to the program's inception, the *Tarsius Peleng* and Gagak Banggai populations faced extinction due to dwindling food sources and the degradation of primary forests on Peleng Island caused by illicit logging and land clearance for communal agriculture. The conservation initiative for these indigenous species has resulted in changes in the subsystem through the enrichment of local plant-based food supplies. This includes approaches for restoring the ecosystem by enhancing local plants. Notably, the population of Peleng Tarsier increased from 18 in 2021 to 46 after the program's execution. Similarly, the population of Banggai Crow climbed from 4 to 8 from 2021 to 2023.

3.3 Protection of Primary Forests from Degradation

Activities involving the propagation and planting of endemic plants at critical points have enhanced the sustainability of the ecosystem within the conservation area. Reforestation efforts, coupled with community education, have facilitated smoother conservation efforts. This shift in community behavior and awareness towards forest conservation acts as a social barrier that safe-guards and enhances the integrity of the Kokolomboi Biodiversity Park's ecosystem. The primary task of the program's facilitators is to maintain the balance between ecological and social aspects within the scope of conserving the Kokolomboi Biodiversity Park.

3.4 Increase in Biodiversity Index

Flora and fauna census results were analyzed to obtain the Shannon-Wiener biodiversity index value of 0.08 (previously the Fauna Diversity Index was 3.219; now 3.279), and the Flora Diversity Index increased from 4.11 to 4.14. This increase in the biodiversity index for both flora and fauna demonstrates that the efforts to protect the ecosystem within the Kokolomboi Biodiversity Park have positively impacted the preservation of in-situ endemic species within the area.

3.5 Increase in Income of the Beekeeping Community of Kokolomboi Biodiversity Park

Below is the gross annual earning. The net benefit is further reduced by packaging costs, shipping, transportation, and other operational expenses. Broadly, the beekeeping community receive an additional profit of approximately Rp 9,832,244.00/month.

Table 2. Sales revenue of honeybee selling

Year	Product	Bulk Production (Liter)	Retail Production (250 mL/Bottles)	Sales Revenue (IDR)
2020	Wild Honey	217	868	56,420,000.00
	Rock Honey	129	516	33,540,000.00
	Total	215	1,384	89,960,000.00
2021	Wild Honey	250	1,000	65,000,000.00
	Rock Honey	130	520	33,800,000.00
	Total	380	1,520	98,900,000.00
2022	Wild Honey	350	1,400	91,000,000.00
	Rock Honey	450	1,800	171,000,000.00
	Total	800	3,200	208,000,000.00
2023	Wild Honey	375	1,500	97,500,000.00
	Rock Honey	490	1,960	127,400,000.00
	Total	865	560	224,900,000.00

3.6 Increased Community Awareness about the Importance of the Kokolomboi Biodiversity Park Ecosystem for the Local Community

The positive effects felt by the communities surrounding the Kokolomboi Biodiversity Park have raised their understanding of the importance of forest ecosystem protection. Local communities have stopped illegal logging within the protected forest area and are now actively involved in conservation activities. This frequently entails planting native plants within the Kokolomboi Biodiversity Park. Local people are currently involved in forest preservation and are spreading conservation activities to Kokolomboi's adjacent areas.

3.7 Development of the Climate Village Program

In compliance with Ministry of Environment and Forestry standards, the Kokolomboi Biodiversity Park contributed to climate change adaptation and mitigation in 2021. As a result, Leme-Leme Darat Village got the Ministry's Primary Climate Village Program (Proklm) Award the following year. In 2022, the Proklm initiative was expanded to four villages around Leme-Leme Darat: Bakalan Village in Tinangkung Sub-district, Bungin Village in Tinangkung Sub-district, Ambelang Village in Tinakung Sub-district, and Manggalai Village in Tinakung Sub-district. In 2022, all four communities got the Primary Proklm Award by the Indonesian Ministry of Environment and Forestry.

4. Conclusions

This community empowerment program has achieved significant milestones from year to year in various aspects:

- 1) Empowerment of 30 members of the Tourism Awareness Group (Pokdarwis).
- 2) Empowerment of 11 beekeeping groups with 245 members.
- 3) Active participation of 30 households in Leme-Leme Darat Village in environmental preservation.
- 4) Over 60 foreign tourists have visited Kokolomboi Biodiversity Park.
- 5) Increase in the population of Peleng Tarsier from 18 individuals monitored in 2021 to 46 individuals monitored in 2023.
- 6) Increase in the population of Banggai Crow from 4 individuals monitored in 2021 to 8 individuals monitored in 2023.
- 7) Increase in the biodiversity index of flora (Shannon-Wiener Index) from 4.38 to 4.51 through 2021-2023.
- 8) Increase in the biodiversity index of fauna (Shannon-Wiener Index) from 3.55 to 3.75 through 2021-2023.
- 9) Empowerment of beekeeping groups with a total income of IDR 2.4 billion per year.
- 10) Income per member of the beekeeping groups: IDR 9.8 million per person per month.
- 11) Nomination for the Sustainable Climate Village Program in 2023.

12) Expansion of partnerships and collaborations across sectors.

This community empowerment program represents a new breakthrough by integrating various approaches to benefit different sectors and create positive shifts in mindset and behavior of the community, leading to positive impacts on social and environmental aspects of life. This aligns perfectly with the goals of ESG (Environment, Social, and Governance), which advocate for sustainable business efforts. This community empowerment program has become an iconic symbol of protecting endemic flora and fauna. It has even been replicated in 7 other biodiversity conservation areas within Banggai Kepulauan Regency. Furthermore, it has emerged as a strategic research and study location for academics, both locally and internationally.

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Authors contributions

Achmad Setiadi: Conceptualization; Funding Acquisition from Pertamina EP Donggi Matindok Field; Supervision. Sofiana Nur Khasanah: Development of methodology in community empowerment (equal); Investigation – Data collection (equal); Writing - Original Draft Preparation (equal). Fitria Alhumaira: Development of methodology in community empowerment (equal); Investigation - Data Collection (equal); Writing - Original Draft Preparation (equal). Talitha Zafirah: Development of methodology in ecology-related aspect; Investigation - Data Collection from institutes; Writing - Original Draft Preparation (equal); Writing - Review and Editing.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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