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Macrozoobenthos as indicator for human activity along Asam-Asam River, South Kalimantan

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Abstract:
Background*:*
Water river evaluation to describe the level of pollution is important. The Asam-Asam River is one of the important ecosystem to support human living in South Kalimantan. The objectives of the research is to identify the macrozoobenthos of Asam-Asam river and describes the human activity along Asam-Asam River as an important aspect in determining the macrozoobenthos diversity as water bioindicator
Materials and Methods*:*
Field survey was done at Asam-Asam River ecosystem in South Kalimantan. Specimen of macrozoobenthos were taken from five sampling sites along Asam-Asam River. In each sampling sites, macrozoobenthos were sampled using Surber net having a mesh size of 250 µm. Macrozoobenthos taxa was identified though the morphological characterization. Important Value index of macrozoobenthos community were calculated following standard methods. The Shannon-Wiener diversity index for macrozoobenthos in different sampling area of the river were calculated systemkatically. In order to assess the impact of sampling sites situation, a rapid survey related to the human activity which were potentially caused river pollution were assessed. Data were analyzed descriptively.
Results*:*
Result of the study shows that Turitella (IVI = 21.32) was the macrozoobenthos with highest important value index in Zone 1, followed by Nerita longii (IVI = 34.84) in Zone 2, Neritina violacea (IVI = 63.73) and Neanthes (IVI = 62.75) in Zone 3, Neanthes (IVI = 100) in Zone 4, Thiara scabra (IVI = 88.60) in Zone 5 and Physa (IVI = 58.70) in Zone 6. This study confirm that the highest H' found at zone 1, followed by zone 6. Three zones with human activity has low H' index, represent the impact of human activity to water pollution in Asam-Asam River. The proper management to manage human activity along the river was needed to support the sustainability of river ecosystem to support human live and biodiversity conservation along river.
Key Word*: water pollution, river disturbance, river bioindicator*

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I. Introduction

Development in Kalimantan Island has been indentified contributes to biodiversity degradation. Globally, it has been reported that Kalimantan is home to numerous biodiversity. In Kalimantan, biodiversity was preserve in tropical forest. However, among the most affected ecosystem, huge tropical forest has been widely reported degraded. Human population growth, plantation and rise of agricultural activity lead to the decrease of forest cover. In some res with traditional practices in agriculture, changes of tropical forest to sustainable agroforestry system able to maintain biodiversity in settlement area. In are without indigenous knowledge practice and intensive industrial activity, ecosystem has been degraded. Significantly, the degradation of tropical forest has been also contribute to the river degradation [1] [2] [3].

River pollution is one of the crucial problem in many area in the world, including in Kalimantan. Scholars point out that pollution of rivers can contribute to the river biodiversity extinction in which it is important to support human live along the river. River pollution also potentially influences human health. Scholars point out that monitoring water quality plays an important role in ecosystem management. River has been identified important in human lives. River provides numerous ecosystem services to support human lives. In Kalimantan, river traditionally is corridors for public transportation. The significant of water for social and economical aspect of local people in Kalimantan lead to the rapid development of settlement along river corridors [2] [4] [5]

Characterizing water river quality is important and the use of animal and plant to assess the water quality has been widely applied [6] [7]. Macrozoobenthos widely used as bio-indicator for water quality. Macrozoobenthos is the invertebrates benthic animals, living in the bottom of river ecosystem. Fresh water in

natural habitat often contain specific macrozoobenthos, in which it is useful as references organism to evaluate the water quality. Naturally, river ecosystem under high-polluted materials shows different species structure and composition, in which it is provides data and information regarding degree of water pollution. There are numerous advantages for the application of macrozoobenthos as bioindicator in water quality assessment. Scholar point out that the use of macrozoobenthos applicable for water monitoring in developing countries. There are numerous advantages for the use of macrozoobenthos as an instrument of water river quality [8]. Bioindicator provides the integration of past and current environmental quality, in which it is possible to identify using chemical indicators.

Asam-Asam River in Kalimantan is one of the important rivers in South Kalimantan Province. Recent rapid development along the rivers are has been identified contribute to the decrease quality of water. Settlement, agricultural and industrial area grows significantly. In many case, the waste of human activity not managed in proper ways. The sanitation has identified poor and potentially led to the pollution. Many land uses changes have occurred and it is potentially led to the river ecosystem. There is, however, less water quality assessment in Asam-Asam River. The evaluation of water quality in Asam-Asam River not only crucial to enhance the human living quality along the river, but it is also significant to support biodiversity in river ecosystem, especially those who lives in Asam-asam River. Application of bioindicator assessment using macrozoobenthos provides significant tools to evaluate water quality of Asam-Asam River. Using biodindicator provides numerous advantages over other measurement techniques, including low cost in implementation. The aims of the research was to identify the diversity of macrozoobenthos in Asam-Asam River as a reference for the assessment of water quality of river ecosystem and describes the human activity which are influence the water quality of Asam-Asam River.

II. Material And Methods

Field survey was done at Asam-Asam River ecosystem in South Kalimantan. The development of South Kalimantan Province lead to the economic development of local community who live along river, including community along Asam-Asam River. Recent development has been influence some area along Asam-Asam River, in which it is potentially contribute to the river pollution. Along the river, sampling sites was set up at five location in five zones. Each zones were characterized by different human activity as shown in Table 1.

Table 1. The general situation of sampling sites

Zone	Area descriptions
1	Estuary ecosystem. High human interaction with river in with numerous human activity was found, i.e. coal stockpile, shrimp and fish pond. The natural habitats were recorded in this area, including population of *Nypa fruticans* and wild shrubs.
2	High densely settlement area. Some area has been occupied by intensive shrimp and fish pond. Limited number of *Nypa* forest remains due to the intensive land uses changes.
3	Plant power area (*Pusat Listrik Tenaga Uap*). Mangrove community exist in limited number. Many area has been converted into farm lands. Some area remain dominated by shrubs lands. The settlement in the area were considered low.
4	Settlement with less population. Some area is exploited as sand mining area.
5	This area is sites for coal mining of PT. JBG. Some area is opened as rice field and orchards.
6	Upstream. The area was dominated by natural vegetation. Some farmer open small area as farm lands. There are also fishing activity in limited number.

Methods

Field survey was conducted at 2018. Specimen of macrozoobenthos were taken from five sampling sites along Asam-Asam River. In each sampling sites, macrozoobenthos were sampled using Surber net having a mesh size of 250 µm [7]. Immediately after sediment collection, the river sediment was washed using 0.5 mesh sieve. The residues was fixed in formaldehyde solution 4%. Macrozoobenthos taxa was identified though the morphological characterization. The identified taxa were adjusted using standard Macrozoobenthos Identification Book.

The Important Value index of macrozoobenthos community along sampling area were calculated following standard methods. In order to describes the level of macrozoobenthos diversity, the Shannon-Wiener diversity index for macrozoobenthos in different sampling area of the river were calculated. In order to assess the impact of sampling sites situation, a rapid survey related to the human activity which were potentially caused river pollution were assessed. Data were analyzed descriptively.

III. Result

Totally, there are 100 taxon of macrozoobenthos was identified in sampling sites along Asam-Asam River. This data represent the important of Asam-Asam Rivers as habitat for river creatures, including macrozoobenthos. The existence of species, diversity and present community structure of macrozoobenthos represent the water quality of Asam-Asam River.

The description of macrozoobenthos in each zones was describes below.

Zone I. Zone I was characterized as area with traditional activity, including traditional fishing. In this area, water was extracted and used to support community daily life. The water also used as irrigation water to support agricultural activity. There are also stockpile of coal mining. About twenty-eight macrozoobenthos were identified in sampling area in zone 1. Macrozoobenthos with high important value index was *Turitella* (IVI = 21.32). It was followed by *Tegillarca* (IVI = 15.44), *Telescopium* (IVI = 15.02) and *Littoraria intermedia* (IVI = 15.02). *Turitella* belong to Mollusk and known as sea snail with tall spiral shell [9].

Zone 2. This area has been identified as area with highest population density intensive human activity. There are traditional activity in zone 2, including fishing. Water also used as irrigation in agricultural activity. River was used to facilitate local transportation. It has been observed that people use river as waste deposit sites. There are fourteen macrozoobenthos were identified. Macrozoobenthos with high important value index was *Nerita longii* (IVI = 34.84), followed by *Neritina violacea* (IVI = 27.79), *Cerithidea* (IVI = 25.68), *Tegillarca* (IVI = 15.44), *Telescopium telescopium* (IVI = 15.02), and *Littoraria intermedia* (IVI = 15.02). The relative diverse species in this area are seems to be related to the existence of *Nypa* forest. In this zone, mollusk were significant groups inhabited sediment, represent by the existence of *Neritiina, cerithidea, Tegillarca, Telescopium* and *Littoraria*. *Nypa* typically found in along river in coastal area with mud abundance. The population of *Nypa* along rivers is crucial for coastal and riparian conservation. *Nypa* has been considered as one of the important component of mangrove ecosystem. The conservation of *Nypa* population therefore crucial in coastal area management [10].

Zone 3. Traditional activity (i.e. fishing) was recorded in zone 3. The river also used as irrigation and transportation. Importantly, there is also plant power established in the site, in which it is potentially contribute in water pollution. Only four species of macrozoobenthos were identified in this area. Macrozoobenthos with high important value index was *Neritina violacea* (IVI = 63.73). It was followed by *Neanthes (*IVI = 62.75), *Macrophthalmus (*IVI = 50.98) and *Nerita longii* (IVI = 22.55). The establishment and activities of plant power area (*Pusat Listrik Tenaga Uap*) in this sites seems contribute to the quality of water and therefore determine the living system in bottom area of river. With the poor environmental management issues in plant power activity, there are potentiality for water pollution.

Zone 4. Zone 4 has been used for numerous purposes. The traditional activity found in zone 4 includes fishing and bathing. The water of Asam-Asam River also used as irrigation water to support agriculture. River was used as transportation. There are also sand mining activity was recorded. These activity potentially led to the water pollution. Three taxa of macrozoobenthos were identified, including *Neanthes* (IVI = 100) *Neritina violacea* (IVI=50.00) and *Neritina violacea* (IVI=50.00). Low number of macroozobenthos species seems to be related to the sand mining activity in river in zone 4. Sand mining is crucial problems in river conservation. Sand mining has been reported crucial as an agent to habitat degradation, including riparian system and rivers biodiversity. There are also possible oils pollution caused by sand mining activity [11].

Zone 5. Traditional activity (i.e. fishing) was recorded in this area. Water were used to support daily life and agricultural irrigation. There are also stockpile of coal mining. Macrozoobenthos in this area includes: *Thiara scabra spinulosa* (IVI = 88.60), *Thiara* (IVI = 61.21), *Nasarius* (IVI = 27.64), and *Neritina violacea* (IVI = 22.55). Water is important sources for agricultural system. An intensive agricultural system often develop in area surrounding rivers with the support of water irrigation networks. An intensive agricultural activity, however, potentially contribute to the water pollution. The activity of coal mining stockpile significantly contribute to the river disturbance.

Zone 6. Traditional activity (i.e. fishing), water were used to support daily life and irrigation. Macrozoobenthos in this area includes: *Physa* (IVI = 58.70), *Helix pomatia* (IVI = 27.33), *Goniobasis proxima* (IVI = 23.76), *Phos Montfort* (15.84). Traditional fishing is one of the local community activity with low environmental impact. The traditional activity is often sustainable. The use of traditional equipment allow natural resources exploitation was limited. Traditional human activity potentially contribute to the low river water pollution. With the increase

of human consumption and increase of human exploitation to river resources, there are possibility to the future disturbance.

Overall, the highest H' found at zone 1, followed by zone 6. Three zone with human activity has low H' index, represent the impact of human activity to water pollution in Asam-Asam River (Fig. 1).

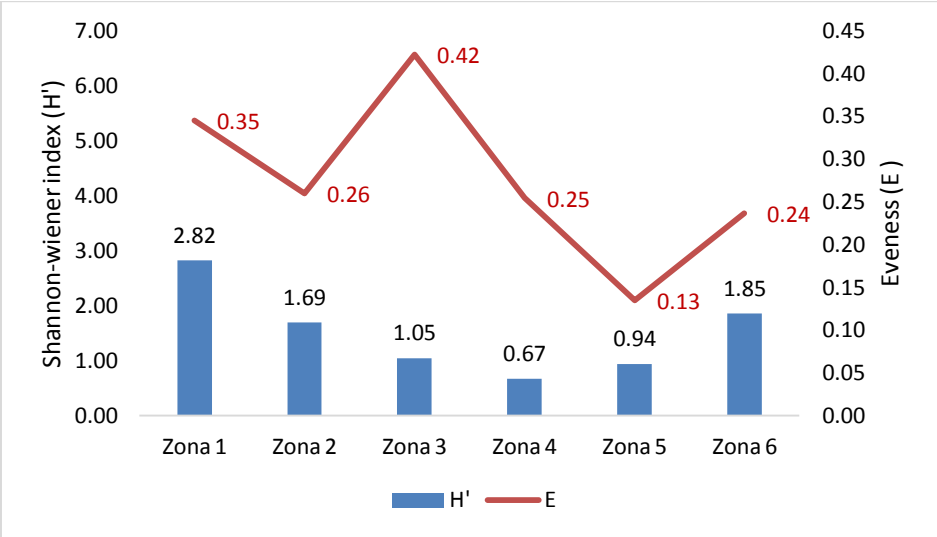

Fig. 1. Diversity index and evenness of sampling sites along Asam-Sam River.

The highest diversity index was found in zone 1 (the estuary ecosystem), and followed by zone 6 (upstream) (Fig.1). The composition of species, however, was difference. The macroozoobenthos in estuary ecosystem seems to be influenced by human activity. Most of the macrozoobenthos in estuary seem has good adaptation to the human influence to river ecosystem.
The highest evenness index was found in Zone 3, followed by zone 1 (Fig.1).

Human activity

Human activity has been identified plays an important role in water ecosystem. Waters river is especially fragile to disturbance. There are numerous materials which were important as pollutant, including metals produced by human activity. The high pollution has been reported occurs in area with high human activity. It is especially important in area with poor sanitation system. Poor sanitation has been identified as significant problem in developing countries. Poor sanitation also contribute to the status of human health. [12]. [13].

Rivers is an important corridors for transportation, including coal mining. In the absent of land transportation, river system in Kalimantan provide opportunities for coal mining transportation system. There are, however, without impact, especially in river pollution. Oil pollution is crucial problems contributes to the water river disturbance. Such poisonous material able to decrease biodiversity of rivers water, especially sensitive organism. There are also potential metal pollution caused by river transportation [14] [15].

Human settlement and infrastructure development are especially crucial to river disturbance. Changes of land uses to provide space for settlement and infrastructure development potentially disturb soil surface which was potentially lead soil erosion. The soil erosion especially crucial to water rivers quality and rivers biodiversity disturbance. Without proper planning, the development of human settlement and infrastructure in river side area are dangerous for the sustainability of river ecosystem [16] [17].

An intensive agriculture activity an adjacent to the river ecosystem potentially contribute to the water pollution and river biodiversity decrease. Intensive use of chemical fertilizer has been identified contribute to water pollution and water eutrophication [18]. The use of fertilizer contribute to the abundance of phospor as an important chemical material in eutrophication mechanism [19]

IV. Conclusion

The quality of water in Asam-asam river has been influenced by human activity. The *Turitella* was the macrozoobenthos with highest important value index in Zone 1(IVI = 21.32). In Zone 2, *Nerita longii* is the macrozoobenthos with the highest value (IVI = 34.84) in. *Neritina violacea* (IVI = 63.73) and *Neanthes (*IVI = 62.75) are the macrozoobenthos with higest important value index in Zone 3. *Neanthes* (IVI = 100) has the highest important value index in Zone 4 while *Thiara scabra spinulosa* (IVI = 88.60) has the highest value

indext in Zone 5. In Zone 6, *Physa* (IVI = 58.70) is the macrozoobenthos with the highest important value index. The highest H' was found at zone 1, followed by zone 6. Three zone with human activity has low H' index, represent the impact of human activity to water pollution in Asam-Asam River.

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