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by Nurlita Pertiwi

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The Diversity of Riparian Trees Vegetation at Around The Lawo River, South Sulawesi, Indonesia

Nurlita Pertiwi*, Nur Anny Suryaningsih Taufieq

Department of Civil Engineering and Planning, Faculty of Engineering, Universitas Negeri Makassar, South Sulawesi, Indonesia

St. Fatmah Hiola

Department of Biology, Faculty of Mathematics and Natural Science, Universitas Negeri Makassar, South Sulawesi, Indonesia

*Corresponding author: nurlita.pertiwi@unm.ac.id

Abstrak. The study aimed to examine the diversity of riparian tree vegetation on the banks of the Lawo River in Soppeng Regency. This research is descriptive and carried out for three months, starting from June to August 2018. This study uses a quadrant method with a plot size of 20 m x 20 m. Data analysis was performed to calculate diversity index, evenness index, and similarity index of riparian tree vegetation. The results showed that riparian tree vegetation found in the littoral zone of the Lawo River totaled nineteen (19) species belonging to eight families. Plant *Gmeliana arborea* (fam: Verbenaceae) is the most common plant. Species Diversity Index is a medium category. The Species Evenness Index is high (close to 1). Riparian tree vegetation on the banks of the Lawo river observed at five points shows almost the same vegetation conditions.

Keywords: tree vegetation, riparian, species diversity, evenness of species.

1. Introduction

The Lawo River is one of the main rivers located in Soppeng Regency, South Sulawesi, Indonesia. This river has a headwaters on Mount Lapancu and empties into Lake Tempe. This river trajectory includes several residential areas namely Lawo, Ompo, Paowe, and Ganra. The use of water resources in the Lawo River is generally intended for household needs and irrigation needs. However, in some parts, the condition of the Lawo River experienced changes in the physical of the river, especially in the form of erosion and sedimentation.

Riverbanks are an ecosystem component that has an essential function in maintaining river quality. Riverbanks can be in the form of built areas or conservation areas. River morphology in conservation areas formed naturally and protects water flow. Vegetation that grows on riverbanks and cliffs, also called riparian vegetation, is a marker of river ecological stability [1]. The quality of river ecosystems



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contributes to the well-being of humans who live on the banks of rivers. Therefore, the strategy and development of the right innovation are needed for the management of river cliffs. In addition, it can also have an impact on the sustainability of flora and fauna [2].

Vegetation in riparian areas is an indicator of the quality of river ecosystems. This is because riparian vegetation has resistance to wet and dry conditions and the dynamics of river flow. Riparian tree vegetation also functions as a water management arrangement. Large runoff during the rainy season is controlled by the presence of dense vegetation. In addition, riverbank vegetation is also important in the hydrological cycle, namely its ability to absorb water into the soil and increase the potential of groundwater with its root system.

The dynamics of water flow in rivers can affect vegetation on river banks. Vegetation can be protective against river cliff damage and prevent cliff erosion. The cliff protection system in eco-engineering is an alternative to river protection [1]. Eco-engineering systems develop by utilizing the vegetation potential of river banks. The diversity of riparian vegetation is an indication of the quality of river banks. As an ecological buffer, the riverbank is an essential area for the sustainability of the river. This area experiences varying conditions, which are inundated by river water at the time of discharge of broad rivers and into land areas at low flow rates. With these properties, the riverbank becomes an eco-tonic area between the aquatic system and the land ecosystem. As an ecotony, river banks have an important role in regulating an organic supply of aquatic systems and giving meaning to the visual quality of rivers.

Riparian was included as a special conservation area that also needs to be preserved in its original vegetation. At present, in various countries, especially in developed countries, many activities have been carried out to conserve the riparian vegetation. It was done because the functions and benefits of riparian vegetation are essential for ecosystems in riverbanks. But in Indonesia, conservation policies including conservation of riparian as a conservation area have not been a priority due to economic pressure. Therefore, riparian vegetation is shrinking which has an impact on biodiversity loss and loss of function of riparian vegetation [3]. This habitat loss process will eventually disrupt the river ecosystem and can subsequently lead to macro ecosystem changes [4]. If riparian vegetation is lost, all ecological functions of riparian vegetation will be lost [5].

In Indonesia, the presence of riparian vegetation varies according to human activities that manage river banks. In the upper reaches of the river usually, have riparian vegetation that is better than the middle and downstream areas. The difference in environmental quality is generally due to population pressure by making settlements and agricultural land. Changes in the use of riverbanks have resulted in the loss of riparian vegetation capacity to withstand river flow, and consequently downstream flooding, and the extinction of the number and type of riparian biodiversity [6].

In the Lawo Watershed, some parts are erosion-prone areas. As a result of erosion in the downstream area, excessive sedimentation is formed which causes the narrowing of the river to be up to 6 meters. According to Lal [7], erosion in rivers can be affected by water velocity, vegetation along riverbanks, farming activities on the river banks, river depth and width, river channel shape and soil texture. According to [8] the incidence of cliff erosion can be observed in two ways, based on the presence of tree roots that appear on the riverbank, and the condition of the absence of vegetation on the cliff. Therefore, this study was conducted to determine the diversity of riparian tree vegetation in the area around the Lawo River. Considering the results of this study can be the basic data in subsequent research related to the quality of the Lawo River.

2. Research Method

The study was conducted in June-August 2018 in the area around the banks of the Lawo River, Soppeng Regency, South Sulawesi Province, Indonesia. The location of the study consisted of five observation points along the path of the Lawo River selected by purposive sampling, namely the area

representing the upstream to downstream areas of the river, covering the Paowe, Gar, Bakke, Lawo, and Cenrana regions. Altitude in the upstream area of the Lawo watershed $\pm 1\ 000$ meters above sea level, the middle part of the watershed 180 - 500 meters above sea level, and the lower part of the watershed 32 meters above sea level.

This research used tools and materials including meters, measuring tape, GPS, digital cameras, Sasak, scissors, raffia, 70% alcohol, plastic bags, labels, and tally sheets. Data collection was carried out at five points along the path of the Lawo River which had a river length of 12.4 km. This study used the quadrant method. The plot size was determined by using grouping categories according to Fachrul [9] that for tree observation using plot size of 20 m x 20 m. Riparian plants were collected and identified in the Biology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, using identification books [10][11][12][13]. Riparian tree vegetation profiles were observed for their density and dominance; analyzed by diversity index, and evenness index of riparian tree vegetation. Species diversity was known based on the species diversity index (H') from Shannon-Wiener [14][15] with the following formula:

$$H' = - \sum p_i \ln p_i \quad (1)$$

Information:

- H' = Shannon-Wiener Species Diversity Index
- P_i = the proportion of density type $i = (n_i/N)$
- n_i = type density for i
- N = density of all types
- K = density

The level of species diversity criteria, namely: if H' value > 3 ; that means showing that species diversity was high. If H' value $1 \leq H' \leq 3$; that means showing that species diversity was moderate, and if $H' < 1$; that means showing that species diversity was low or small [9]. Species evenness was known based on the species evenness index [16] with the following formula:

$$E = \frac{H'}{\ln(s)} \quad (2)$$

Information:

- E = Species evenness index
- H' = Shannon-Wiener Index
- S = number of species found
- \ln = natural logarithm

Evenness index ranges from 0 to 1. If the index value was close to 0, the evenness of the species was low, on the contrary if it is close to 1, then evenness is high.

3. Result and Discussion

3.1 Riparian tree vegetation profiles on the banks of the Lawo River

Riparian tree vegetation species richness found in riparian zones Lawo River totaled nineteen (19) type. Based on the highest density level to the lowest that is type *Gmelinia arborea* (66 individuals), *Nuclea orientalis* (27 individuals), *Tamarindus indica* (11 individuals), *Cocos nucifera* (9 individuals), *Mangifera indica* (8 individuals), *Leucaena leucocephala* (5 individuals), *Ficus*

rasemosa (3 individuals), *Ficus septica* (3 individuals), *Lannea grandis* (2 individuals), *Scheleicera oleasa* (1 individual), *Tectona grandis* (1 individual), *Vitex cofassus* (2 individuals), *Ceiba petandra* (2 individuals), *Moraceae* sp. (2 individuals), unidentified 1 (WP) (1 individual), unidentified 2 (3 individuals), dan unidentified 3 (1 individual), unidentified 4 (1 individual), and unidentified 5 (1 individual).

These types of riparian tree vegetation are members of eight (8) families namely Family Verbenaceae, Moraceae, Arecaceae, Anacardiaceae, Sapindaceae, Rubiaceae, Fabaceae, and Malvaceae. Based on the order of abundance, the highest to lowest abundance are presented in Table 1.

Table 1. Dominant and Co-dominant families in the riparian of the Lawo River

Family	Σ Individu	Family (%)
Verbenaceae	69	45.39*
Rubiaceae	27	17.76*
Fabaceae	16	10.52*
Anacardiaceae	10	6.58
Arecaceae	9	5.92
Moraceae	7	4.61
Malvaceae	2	1.32
Sapindaceae	1	0.65
Unidentified	10	6.58
Total	151	

In this study, in addition to being found with the highest number of species, the Verbenaceae Family is also a dominant family with a percentage of 45.39% (Table 1), while the co-dominant families are Rubiaceae (17.76%), and the Fabaceae Family (10.52%). Dominance and co-dominant of a family can be determined by the number of constituent species and also the number of individuals in the family. The Verbenaceae family was found with 3 species and 69 individuals, while the Rubiaceae family and Fabaceae family were 1 species each, 27 individuals and 2 species and 16 individuals.

The plants of white teak (*Gmelinia arborea*) included in the Verbenaceae family were found abundantly and occupy the highest order of attendance at the study site. This plant is intentionally planted by people living around the banks of the Lawo River to prevent erosion as well as investment in the future. According to Sudrajat [17], this plant can grow optimally at an altitude of 0-800 m above sea level with rainfall of 1778-2286 mm per year with a maximum number of dry months 2-4 months per year; the desired temperature is between 21-28°C and soil pH 4-7.

The Rubiaceae family (*Nuclea orientalis*) includes plants that rank second in abundance and the fourth largest group of flowering plants with members of about 650 genera and more than 13,000 species. Rubiaceae has a cosmopolitan distribution, but, the largest species diversity is concentrated in (sub) tropical regions [12][18]. Riparian tree vegetation on the banks of the Lawo River observed at five points indicates the existence of various vegetation conditions, ranging from those that are still conserved to those that have been degraded.

3.2 Species Diversity Index (H') and Species Evenness Index (E)

The diversity of riparian tree vegetation on the banks of the Lawo River is only owned at 3 locations of observation points, namely at observation points I to III (Table 2). Vegetation diversity of the Lawo riparian tree that all of which included the moderate diversity level group ($1 < H' < 3$). According to

Fachrul [9]), the diversity index values can range from 0-7, with criteria: 0-1 (low), 1-3 (moderate), and > 3 (high), thus the tree-level species diversity index at the banks The Lawo River is classified as medium. According to Barbour et al. [19], species diversity indices are important information about a community. Species diversity index values are in line with the sample area and the number of species found. Shrubs. While for communities that have reached a climax, the species diversity index is relatively low.

Table 2. Diversity index and evenness index of species at each observation location

Point	Location of observation	Species Diversity Index	Species Evenness Index
I	Paowe	2.19	0.91
II	Ganra	1.94	0.88
III	Bakke	1.94	0.88
IV	Lawo	0	0
V	Cenrana	0	0

At the location of the IV point of observation, the riverbank area has been used by the community as a settlement area which causes a decrease in riparian vegetation, especially tree level. Vegetation diversity of riparian trees needs to be conserved. This is because the function and benefits of riparian tree vegetation are essential in maintaining river water quality. The decline in vegetation diversity of riparian trees can also have an impact on the decline in fauna which makes the vegetation a place to find food and breed. At the location of the V point of observation, the presence of riparian tree vegetation was not found. This is due to quite a heavy river flow conditions so that the banks often eroded by river currents. Also, part of the riverbank area has changed into the local agricultural land, so the presence of trees in the area has not been found.

Evenness index values (Table 2) at observation points I to III are in the high category (close to 1). This shows that the number of individuals of each type is almost the same, while at the observation points IV and V are relatively low. This is because at location IV only one type of tree was found, whereas in the location V there was no tree. Diversity index and evenness index are two different things. According to Barbour et al. [19] sometimes species richness is positively correlated with species diversity, but environmental conditions throughout the study area are heterogeneous so increasing species diversity can occur along with a decrease in species richness.

4. Conclusion

Riparian tree vegetation found in the Lawo River, Soppeng Regency, South Sulawesi as many as 19 species with 151 individuals. Riparian vegetation includes members from eight (8) families with three (3) largest families, namely Verbenaceae (45.39%), Rubiaceae (17.76%) and Fabaceae (10.52%). The diversity of riparian (H') vegetation at the tree level at the study site was medium ($1 \leq H' \leq 3$). Riparian tree vegetation in the Lawo River generally has a high level of evenness which is close to 1 which shows the number of individuals of each type is the same or not much different.

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