The Biodiversity of Flora and Fauna in the Re-vegetation Area in The Post-Mining Area of Pongkor

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Abstract. The Pongkor post-mining area is designated as one of the ecotourism areas in Bogor. This area has biodiversity of flora and fauna. This study aims to: (1) analysis the importance value index (IVI) of flora types; (2) analysis species richness index, species diversity index, and relative species abundance index; (3) analysis the beauty, the uniqueness and the rarity of the flora and fauna types. The method used in this research is quantitative descriptive. Based on the identification results, 185 species of flora are distributed in this region. During the rainy season, 15 species of herpetofauna were identified, 32 types of aves, and 4 types of mammals, while in the dry season 19 species of herpetofauna were identified, 23 types of aves, and 2 types of mammals. Based on the results of the analysis conducted on these flora and fauna, there are flora species that have high IVI values and some beautiful and unique flora species that are in the category of endangered species. Besides that, there are also fauna species which have a value of species richness index, species diversity index, and relative species abundance index, as well as some beautiful, unique, and fauna species that are in the category of endangered species.

Keywords: Biodiversity of Flora and Fauna, Re-vegetated Area, Post-Mining Area, Ecotourism, Landscape Planning

1. Introduction

Pongkor post-mining area is an area designated as one of the ecotourism areas in Bogor. This area is an area with lowland forest vegetation type, which has a good biodiversity of flora and fauna. In this area, there are beautiful and unique flora and fauna species which are in the category of rare and protected species.

Biodiversity of flora and fauna are elements of the landscape as one of the ecotourism objects in the region. Biodiversity is one of the important things for ecotourism [1][2][3]. In this case, efforts to protect it will have a positive impact on the development of the desired ecotourism. Ecotourism is a model of tourism development that respects the rules of nature by implementing integrated development and conservation programs between efforts to conserve
natural resources and sustainable development of the community’s economy [4][5][6]. Protection of flora and fauna biodiversity in the context of ecotourism development is an effort that must be done to reduce the negative impact of the presence of visitors on the environment of tourist destinations and local residents [7].

Landscape changes that occur in this region have a significant impact on changes in the character of the landscape and the fragmentation of flora and fauna habitats. Some of the activities that are currently being worked on include the construction of tailings storage ponds, construction of tailing processing industrial factory and WWTPs), construction of tourist facilities, and road networks for tailings material transport vehicles. This activity will ultimately have an impact on ecosystem changes [8]. This condition requires protection of the biodiversity of flora and fauna [9], so that efforts are needed to identify and analyzing the types of flora and fauna that have potential as ecotourism objects. Based on the foregoing, this study aims to: (1) analyzing the important value index (IVI) of flora, (2) analyzing the species richness index, species diversity index, and the relative abundance index of fauna species and (3) analyzing the beauty of the uniqueness and the rarity species of flora and fauna.

2. Methodology
The study was conducted in the Gold Mining Business Unit of Pongkor (GMBUP), at 9266297 - 9263636 South Latitude and 673097 BB - 674746 BT UTM (Universal Transverse Mercator) (Figure 1). The study was conducted from January to December 2018. This research area was at an elevation of 400 meters to 650 meters above sea level.

This study uses quantitative descriptive methods through surveys, interviews, and library research. The survey was conducted to identify the types of flora and fauna. Surveys for species of fauna are carried out in the rainy and dry seasons.

2.1. Research Data Collection
The research data collected is primary data. Some information not found was identified through interviews with local residents and through library research. The steps to identify flora were:

a. Determining the location surveyed through a map of research sites that have been made previously.

b. Using the plot path method to identify flora with a plot size of 20 x 100 m. Furthermore, the sample plot is further divided into 20 x 20 m plots in each landscape character [10].

c. Counting the number of individuals in each observation plot. Each point is made to record coordinates using Global Positioning System (GPS).
The steps to identify fauna were:

a. Identification is done by the point count method, by observing the presence of animals directly and by listening to its voice, in a circle with a predetermined radius.

b. Using the distance between points should not be less than 200 m in the entire study site, if the point is too close there will be individuals who are counted more at some points.

c. Use a time period of 10 minutes for each point, by waiting 2 minutes upon arrival at the observation point. Each point is made to record coordinates using GPS. Field samples were adjusted to plot samples in vegetation analysis.

2.2. Data Analysis
The analytical method used in this study is the analysis of biodiversity of flora and fauna. The steps carried out in the data analysis are: (1) analyzing the IVI of flora; (2) to analyzing of species richness, species diversity index, and relative species abundance index; (3) analyzing of beauty, uniqueness, and the rarity species of flora and fauna.

2.2.1. Analysis of The Important Value Index of Flora
The Importance Value Index (IVI) is a quantitative parameter used in vegetation analysis. This analysis is used to state the level of dominance of species in a plant community [11], [12], [13]. The IVI is an index as the sum of relative density (RD), relative frequency (RF), and relative closure (dominance) area (RC) [14], as follows:

\[ \text{IVI} = \text{RD} + \text{RF} + \text{RC} \]

where:
RD : Relative Density; RF : Relative Frequency; RC : Relative Closure (dominance) Area
2.2.2. Analysis of Species Richness Index, Species Diversity Index, and Relative Species Abundance Index of Fauna

The analytical method used to analysis fauna (wildlife) are the species richness index, species diversity index [15], and relative species abundance index [16].

a. Species richness index. Species richness index are calculated by the Margalev method [14] with the formula:

\[ D_{mg} = \frac{S - 1}{\ln(N)} \]

where :
Dmg : Margalev Index; N : The number of individuals of all types; S : The number of fauna

b. Species diversity index are calculated by the Shannon-Wiener Species Diversity Index [10], [15], with the formula:

\[ H' = \sum_{i=1}^{S} (P_i) \ln(P_i) \]

where :
P_i : \sum n_i/N; H : Diversity index Shannon-Wiener; P_i : the number of individuals of a species / the total number of all species; n_i : the number of individual species i; N : total number of individuals

c. Relative species abundance index. The relative abundance index of species is known by using the Relative Abundance Presentation equation [16], as follows:

\[ P_{si} = \frac{n_i}{N} \times 100 \% \]

where :
Psi : Percentage value of i-type abundance; n_i : number of i-type individuals; N : total number of individuals

2.2.3. Analysis of the Beauty, Uniqueness and Rarity of Flora and Fauna

The value of beauty and uniqueness is obtained through perception analysis. The method of analysis carried out is by displaying the names of flora and fauna types that have been prepared based on the location of the observation to be assessed by students of the Department of Forest Resources and Ecotourism Conservation, Faculty of Forestry, IPB University.

The assessment uses a Likert scale [17] with a rating scale of 1 (very beautiful and very unique), 2 (beautiful and unique), 3 (not beautiful and not unique). The rarity values of flora and fauna are obtained by looking at the list contained in [18][19][20]. Rating grades are 1 (very rare), 2 (rare), and 3 (not rare).

3. Result
3.1. Flora and Habitat

The study area has the characteristics of lowland forest vegetation. In this area scattered 185 species of flora. The point of observation can be seen in Figure 2.

Based on observations at ten points of observation, there are some flora that have an IVI and beautiful, unique, and rare flora. Tree species that have the largest IVI according to the observation area are Acacia mangium (162.49), Eucalyptus urophylla (86.51), Elaeocarpus angustifolius (123.46), Altingia excelsa (204.04), Gmelina arborea (29.39), Khaya anthoteca (42.58). The types of flora that are quite beautiful and unique are Acacia mangium, Alstonia scholaris, Altingia excelsa, Antidesma bunius, Arthropodium diversifolium, Asystasia gangetica ssp. micrantha, Calliandra calothyrsus, Camellia sinensis, Castanopsis acuminatissima, Cheilocostus speciosus, Cinnamomum sintoc, Garcinia mangostana, Hibiscus cf. similis, Imperata cylindrica, Lagerstroemia speciosa, Lantana camara,
Manglietia glauca, Melastoma malabathricum, Merremia umbellate, Mimosa pudica, Neolamarckia cadamba, Nephelium lappaceum, Persea americana, Pinus merkusii, and Schima wallichii. The types of flora that are rare include Dalbergia latifolia, Dimocarpus longan, Horsfieldia glabra, Pinus merkusii, Podocarpus neriifolius, Shorea selanica, and Swietenia macrophylla.

Figure 2. The point observation of flora

Almost all of the beautiful, unique and rare of flora is in the re-vegetation area. Biodiversity of flora species in re-vegetation areas strengthens the value of excellent landscape character for ecotourism destination. This can be seen from the performance of the types of flora that have different heights, canopy shapes, canopy widths, and stem diameters. The diversity of flora species, both as individuals and groups in the re-vegetation area can be an object of ecotourism, so that it can be an attraction for visitors to do ecotourism activities.

3.2. Fauna and Habitat
The research area has a diversity of beautiful, unique and rare fauna. During the rainy season 15 species of herpetofauna were identified, 32 species of aves, and 4 types of mammals, while in the dry season 19 species of herpetofauna were identified, 23 types of aves, and 2 types of mammals. Based on observations, the location of the dominant presence was in the revegetation area, but in the dry season, fauna especially birds spread to other areas. The diversity of flora is a good habitat for birds, mammals, and herpetofauna. The point of observation of fauna during the rainy season and dry season can be seen in Figures 3 and 4.
The type of mammal that has the beauty, uniqueness, and scarcity and protection found in the rainy season is *Trachypithecus auratus* with a species wealth index of 0.33. Another type of mammal that has beauty, uniqueness and rarity and is protected is *Nycticebus coucang* with a species wealth index of 0.67. The rainy season bird species that has very beautiful, very unique and protected values is *Spilornis cheela* which is found in the re-vegetation area with a
species richness index of 0.125 and found also near the GFA (Green Fine Aggregate) plant with a species richness index of 0.11. *Falco moluccensis* is a protected species of fauna, found in re-vegetation areas with a species richness index of 0.053. Species of birds found in the dry season which are quite beautiful and quite unique but including endangered bird species are *Prinia familiaris* with a species richness index of 0.019 (re-vegetation area) and 0.083 (mixed plantation area). In addition, *Cacomantis sepulcralis* with a species wealth index of 0.019 in the re-vegetation area. Re-vegetation area is a fauna habitat (eating, perching, storing eggs and children, chatting). Re-vegetation areas as fauna habitat need to be protected, accentuated natural forms, and intensified landscape forms [1].

The types of flora and fauna in this area are one of the ecotourism objects. Re-vegetation area where there is diversity of flora is a fauna habitat. Efforts to protect re-vegetation areas, improve the condition of re-vegetation areas that have undergone changes in cover and land use by returning to their natural form, and to plant diversity of local vegetation in damaged re-vegetation areas, as well as protecting river bodies and river flow shapes as a fauna corridor is an effort to protect the diversity of flora and fauna. Another thing that can be done is to strengthen the character of the natural landscape as habitat for flora and fauna species and to establish corridor connectivity between vegetation areas as fauna habitat.

4. Conclusion
The post mining area of *Pongkor* has a diversity of flora and fauna. The existence of flora species that have the largest IVI and the existence of beautiful, unique, and rare flora are habitats for fauna types and as ecotourism objects. There are species of fauna that have a species richness index, a species abundance index and a good species diversity index and have a value of beauty, uniqueness, rarity, and protected status. The protected fauna are mammals and birds. Re-vegetation area is a fauna habitat, both in the rainy season and dry season. In the case of protection, improvement, strengthening the character of the natural landscape, and building connectivity between re-vegetation areas

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