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Vegetation Analysis and Population Structure of Plants at Forest Area, Solok Regency, West Sumatra, Indonesia

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Abstract – Solok Regency is a highland area in West Sumatra with a topography that varies between plains, valleys and mountains. The aim of this study was to determine the vegetation structure that affects the population of Bilongkiang (Zingiber sp.). This study used the quadratic method and determined the research location by purposive sampling with plot size determined based on the vegetation strata, namely: understorey and seedling (2x2 m^2, poles (5x5 m^2, and trees (10x10 m^2). Data analysis was carried out qualitatively and quantitatively. Quantitative data analysis by calculating: Density (Kr), Frequency (Fr), Dominance (Dr), Importance Value Index (INP) and Diversity Index ($H^{'}$). The results of the study found as many as 33 families consisting of 53 species with a total number of 79 individuals spread over two research locations which were divided into understorey plants/seedlings, poles and trees. The highest Important Value Index (INP) in Nagari Surian was found in the pole strata, which was 180.30% and in Nagari Talang Babungo, the INP was also found in the pole strata, which was 91.85%. This value is included in the high category. The diversity index ($H^{'}$) of plants in the study area is $H^{'}$ = 2.12, which means that the diversity of species in the study area is moderate.

Keywords – Bilongkiang, Environment, Population Structure, Solok, Vegetation Analysis.

I. INTRODUCTION

Bilongkiang is a type of plant from the Zingiberaceae tribe that is used by humans as a food source (spices and flavorings). The flowers and inflorescences of Zingiberaceae are widely used as ornamental plants, such as *Curcuma, Globba*, and *Kaempferia* [1]. Several types are also used by humans as a mixture of cooking ingredients, some of which are *Etlingera elatior* which is used by the community on the young shoots, flowers and fruit. For local people, especially on the island of Sumatra, *E. elatior* is widely used as fresh vegetables and ingredients for dressing sauce. The other type is *Zingiber mioga* which is widely used by local people in Japan and Korea. Meanwhile, *Bilongkiang* is one of the wild plant species from the Zingiberaceae family that is used by the community as a food ingredient found in Solok Regency, West Sumatra and there is no discovery data outside this location. so it is necessary to collect further data related to this type of population. In this study, a vegetation analysis will be carried out to determine the structure of the vegetation in the two research locations to see the dominant vegetation around the Bilongkiang population.

This study will analyze the vegetation to determine the structure of plant vegetation around Bilongkiang and determine environmental factors that affect the population of Bilongkiang (*Zingiber* sp.). This research is expected to provide information

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about the dominant vegetation types in the study area and the main environmental factors that affect the population of *Bilongkiang* (*Zingiber* sp.).

II. Research Methodology

This study was conducted in Nagari Surian Jorong Koto Tinggi, Pantai Cermin District ($01^0$20'27" North Latitude and $01^0$21'39" South Latitude and $100^0$48'36" West and $100^0$48 '47" East Longitude) and Nagari Talang Babungo, Hiliran Gumanti District, Solok Regency, West Sumatra (0-57 360-1 17 43.6 "LS.100 45 16.30-101 14 50 "E) (figure 1). Data were collected from May to August 2021. Characterization and identification of plants was carried out at the Andalas Herbarium, Faculty of Mathematics and Natural Sciences, Andalas University.

The method used in this study is the *purposive sampling method* which is a modification of the method used by Mueller Dumbois and Ellenberg (1974). Based on the number of clumps *Zingiber* sp. found in 10 research plots. Plots are made with sizes of 10x10 m, 5x5 m and 2x2 m. Each plot has a different function. The 10x10 m plot was used for tree data collection *tree* trunk diameter of 4 cm. The 5x5 m plot was used for data collection of tillers (poles) with diameters between 1-4 cm. While the plot measuring 2x2 m was used for data collection of understorey and seedling *with* a height of < 1 m. For each species whose Latin name is not known in the field, a herbarium specimen is made for identification. Then data on environmental variables such as soil samples, soil moisture, soil temperature, light intensity, air temperature and humidity were taken.

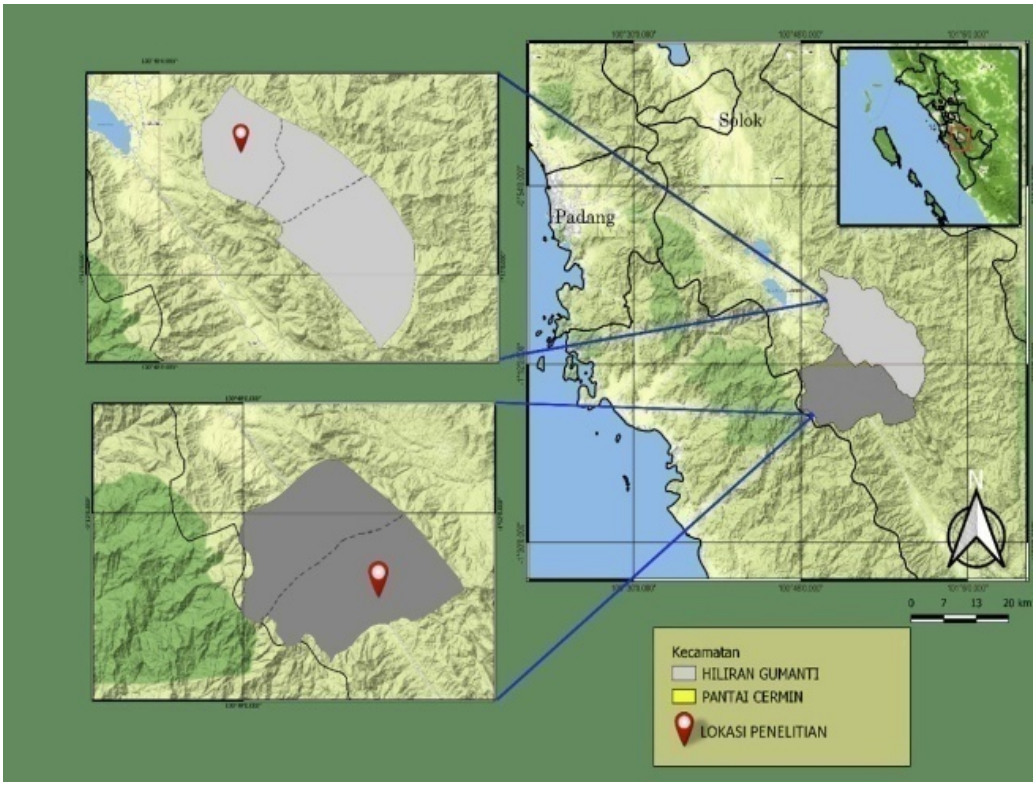

Figure 1. Map of Solok District

Analysis of vegetation structure data was analyzed using the Mueller-Dombois and Ellenberg (1974) formula or equation.

$$\text{K (Density)} = \frac{\text{Number of individuals of species}}{\text{Plot area}}$$

$$\text{KR (Relative Density)} = \frac{\text{Species density}}{\text{Density of all species}} \times 100\%$$

$$\text{F (Frequency)} = \frac{\text{Number of plots found of a type}}{\text{Total number of plots}}$$

FR (Relative Frequency) = $\frac{\text{Frequency of a Species}}{\text{Frequency of all types}} \times 100\%$

D (Dominance) = $\frac{\text{Number of basfe area of a type}}{\text{Total area of plots}}$

DR (Relative Dominance) = $\frac{\text{Dominance of a species}}{\text{Number of dominan of species}} \times 100\%$

INP= Relative Density (%) + Relative Frequency (%) + Relative Dominance (%)

Diversity Index

To see the comparison of plant species diversity between the two locations, it is done by calculating the Shannon Winner (H') diversity index.

$H' = -\sum_{i=1}^{n} pi \ln pi$

Information:

H'= diversity index

pi= ni/N

ni= INP of a species

N= Total INP

Determination Criteria:

H'≤ 1 = low diversity

1≤ H'≤ 3 = moderate diversity

H'≥ 3 = high diversity

III. Result And Discussion

The structure of plant vegetation at the Research Site. Based on the results of the study found as many as 33 families consisting of 53 species with a total number of 79 individuals spread over two research locations. The results of the quantitative analysis of tree, pole, undergrowth and *seedling* in the research location are presented in full in the following table. The quantitative results of the calculation of the vegetation analysis show that the composition and structure of the vegetation at the study site has varying values for each species due to the different characters of each vegetation strata. According to Kimmins (1987), variations in the composition and structure of vegetation in a community are influenced, among others, by vegetation phenology, dispersal, and natality. Its success in becoming a new individual is influenced by the fertility and fecundity of each species, so that there are differences in the composition and structure of each species [6].

The composition of vegetation strata of understorey and *seedling* in the two research locations were 31 species from 17 families consisting of herbs, grasses and ferns (2 species). The most common plant species found at the research site were *Elatostema* sp. and *Zingiber* sp. (Table 1).

The types of understorey are annual, biennial, perennial and the distribution pattern can occur randomly, clump / group and evenly. Nirwani (2010) reported that the understorey found were generally members of the Poaceae, Cyperaceae, Araceae, Asteraceae, and ferns [7]. The presence of undergrowth on the forest floor can function as a barrier to rainwater and surface runoff thereby minimizing the risk of erosion. In addition, understorey vegetation plays an important role in forest ecosystems and determines the microclimate [8].

Table 1. Strata Vegetation Structure Undergrowth and *Seedling* in the Research Site

No	Nagari Surian				Nagari Talang Babungo			
	Jenis	KR	FR	INP	Jenis	KR	FR	INP
1	*Elatostema* sp.	1,44	1,92	43,27	*Zingiber* sp.	37,5	20,41	57,91
2	*Zingiber* sp.	6,25	3,85	36,54	*Chromolaena odorata*	13,59	10,20	23,79
3	*Rubus* sp.	6,25	1,92	16,35	*Rubus moluccanus*	7,07	14,29	21,35
4	*Globba pendula*	33,65	9,62	12,98	*Elatostema* sp.	7,07	6,12	13,19
5	*Chromolaena odorata*	3,85	3,85	10,58	*Coffea* sp.	5,43	6,12	11,56
6	*Impatiens* sp.	0,48	1,92	10,10	*Homalanthus populneus**)	6,52	4,08	10,60
7	*Cyrtandra* sp.	17,31	19,23	9,13	*Stemonurus secundiflorus**)	6,52	4,08	10,60
8	*Elatostema reticulatum*	0,48	1,92	8,17	*Cinnamomum burmannii**)	3,80	6,12	9,93
9	*Centella asiatica*	0,96	3,85	7,69	*Gleichenia linearis*	3,26	4,08	7,34
10	*Angiopteris* sp.	0,48	1,92	5,29	*Angiopteris* sp.	2,72	4,08	6,80
11	*Kylinga brevifolia*	0,48	1,92	4,81	*Eurya acuminata**)	1,63	4,08	5,71
12	*Schefflera actinophylla**)	0,48	1,92	4,81	*Globba pendula*	1,63	4,08	5,71
13	*Cassia tora*	0,96	1,92	3,37	*Hornstedtia schypifera*	1,09	4,08	5,17
14	*Sida rhombifolia*	0,96	3,85	2,88	*Artocarpus heterophyllus**)	0,54	2,04	2,58
15	*Ageratum conyzoides*	4,81	5,77	2,40	*Cyrtandra* sp.	0,54	2,04	2,58
16	*Areca cathecu**)	0,48	1,92	2,40	*Macaranga triloba**)	0,54	2,04	2,58
17	*Biden pilosa*	0,48	1,92	2,40	*Vernonia amygdalina*	0,54	2,04	2,58
18	*Cinnamomum burmannii**)	0,48	1,92	2,40				
19	*Hornstedtia schypifera*	1,44	3,85	2,40				
20	*Molineria capitulata*	6,73	9,62	2,40				
21	*Nephrolepis* sp.	3,37	5,77	2,40				
22	*Piper* sp*)	0,48	1,92	2,40				
23	*Rubus moluccanus*	7,21	5,77	2,40				
24	*Schima wallichii**)	0,48	1,92	2,40				

This species has the most dominant influence on changes in environmental conditions and the existence of other species in the area because the Important Value Index (INP) shows the role of the species in an area [9] This opinion is also supported by the statement of Sofyan (1991) that species that have an index The highest importance value among other species is called the dominant species. It states that the high ability of the species to adapt to the environment and can compete with other species [10].

Furthermore, the results of the analysis of the vegetation at the study site, data on the number of species, importance, and the index of vegetation diversity in the pole strata, are presented in Table 2.

Table 2. Strata Vegetation Structure Poles in the Research Site

No	Nagari Surian					Nagari Talang Babungo				
	Jenis	KR	FR	DR	INP	Jenis	KR	FR	DR	INP
1	*Cinnamomum burmannii*	66,67	50,00	63,64	180,30	*Macaranga triloba*	30,77	30	31,08	91,85
2	*Homalanthus populneus*	33,33	50,00	36,36	119,70	*Cinnamomum burmannii*	15,38	10	16,00	41,38
3						*Stemonurus secundiflorus*	15,38	10	15,38	40,77
4						*Homalanthus populneus*	15,38	10	13,54	38,92
5						*Ficus* sp.	7,69	20	7,08	34,77
6						*Coffea* sp.	7,69	10	8,92	26,62
7						*Magnolia* sp.	7,69	10	8,00	25,69

Based on the data in Table 2, it can be shown that the pole group at the study site is dominated by *Cinnamomum burmanii* (180.30%) and *Macaranga triloba* (91.85%). Meanwhile, the species with the lowest index value was found in *Magnolia* sp. (25.69%). *Cinnamomum burmanii* is a species that is commonly found in both research sites and this species is not a protected plant.

The results of the analysis of vegetation at the research site, obtained data on the number of species, important values, and the index of vegetation diversity of tree strata, are presented in Table 3. Vegetation Structure and Composition in Nagari Surian in 10 plots in Nagari Surian, Pantai Cermin District studied, found a total of 24 tree species belonging to 18 tribes (families).

The Important Value Index (INP) in the tree strata that dominates the study site is *Sterculia foetida* with an important value (36.23%) and *Artocarpus heterophyllus* with an IVI of 48.52%. Ecologically, the two species above play the most important role in determining the dynamics of the species in the forest area, *Artocarpus heterophyllus* economically has an important role as a source of income for the local community.

Furthermore, the results of the calculation of the plant diversity index at the study site are classified as moderate because the criteria for the plant diversity index reach 2.12 or $1 \leq H' \leq 3$, so it is categorized into the medium level.

This situation occurs due to variations in different environmental factors. According to Kartasapoetra (1992), environmental factors that greatly influence vegetation include altitude, air humidity, air temperature and the intensity of sunlight. These environmental factors affect the distribution of plant species and their growth [12].

Table 3. Strata Vegetation Structure Trees in the Research Site

No	Nagari Surian					Nagari Talang Babungo				
	Jenis	KR	FR	DR	INP	Jenis	KR	FR	DR	INP
1	*Sterculia foetida*	8,70	9,52	18,01	36,23	*Artocarpus heterophyllus*	12,82	7,69	28,01	48,52
2	*Xylopia malayana*	13,04	14,29	3,10	30,43	*Stemonurus secundiflorus*	15,38	11,54	14,66	41,58
3	*Homalanthus populneus*	8,70	9,52	0,33	18,55	*Cinnamomum burmannii*	12,82	11,54	4,27	28,63
4	*Schima walichii*	4,35	4,76	4,61	13,71	*Homalanthus populneus*	10,26	7,69	3,68	21,63
5	*Artocarpus altilis*	4,35	4,76	3,56	12,67	*Lithocarpus* sp.	5,13	3,85	12,35	21,33
6	*Baccaurea racemosa*	4,35	4,76	2,33	11,44	*Sterculia* sp.	5,13	7,69	7,14	19,96
7	*Eucalyptus* sp.	4,35	4,76	1,91	11,02	*Clausena excavate*	5,13	7,69	4,23	17,05
8	*Lansium domesticum*	4,35	4,76	1,22	10,33	*Eurya acuminata*	5,13	7,69	1,45	14,27
9	*Litsea* sp.	4,35	4,76	0,97	10,08	*Eleocarpus stipularis*	2,56	3,85	7,36	13,77
10	*Litsea angulata*	4,35	4,76	0,82	9,93	*Litsea angulata*	7,69	3,85	1,98	13,52
11	*Parastemori urophylluma*	4,35	4,76	0,29	9,40	*Baccaurea* sp.	2,56	3,85	4,27	10,68
12	*Mallotus paniculatus*	4,35	4,76	0,20	9,31	*Ficus padana*	2,56	3,85	2,77	9,18
13						*Macaranga triloba*	2,56	3,85	2,30	8,71
14						*Saurauia bracteosa*	2,56	3,85	2,05	8,46
15						*Coffea robustus*	2,56	3,85	1,82	8,23
16						*Coffea* sp.	2,56	3,85	1,01	7,42
17						*Macropanax* sp	2,56	3,85	0,65	7,06

Mawazin and Subiakto (2013), stated that the higher the value of The higher the stability of the forest vegetation community. Based on these results, it can be assumed that *Bilongkiang* prefers to grow in forest conditions with moderate levels of diversity (Table 4) [11].

Table 4. Plant Diversity Index Values at Both Research Sites

Lokasi	**Habit**	**Indeks keanekaragaman (H′)**	**Keterangan**
Surian	Pohon	2,28	Sedang
	Sapling	0,64	Rendah
	Semai	2,29	Sedang
Talang Babungo	Pohon	2,61	Sedang
	Sapling	1,82	Rendah
	Semai	1,92	Rendah

IV. Conclusion

From the research results obtained 33 families consisting of 53 species with a total number of 79 individuals spread over two research locations which are divided into understorey plants/*seedlings*, poles and trees. It is known that the research location is dominated by *Artocarpus heterophyllus* , namely 48.52%, the vegetation level of *Macaranga triloba* is 91.85% and the understorey is dominated by *Zingiber bracteolatum* by 57.91%. In the quantitative analysis conducted on the vegetation at the research site in Solok Regency, the results of the calculation of the diversity index were 2.12, which means that the species diversity in the study area was moderate.

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References

[1] Kuehny J. 2001. Potted ornamental ginger. In: Hodson T, Dolce J, Kleckler A, Olvera A, editors. Greenhouse Product News. New York: Great American Media Services. p. 30–2.

[2] Jolliffe, I.T. Principal Component Analysis. Edisi kedua. Springer-Verlag. New York. 2002.

[3] Hendro, GM. Adji, TB. Setiawan, NA. 2012. Penggunaan Metodologi Analisis Komponen Utama (PCA) untuk Mereduksi Faktor-Faktor yang Mempengaruhi Penyakit Jantung Koroner. Seminar Nasional "*Science, Engineering and Technology*".

[4] Ter braak, C. 1986. Canonical Correspondence Analysis: A New Eigenvector Technique for Multivariate Direct Gradient Analysis. *Ecology.* 67 (5). Pp 1167-1179.

[5] Johnson dan Wichern. Applied Multivariate Statistical Analysis. Edisi keenam. Pearson Prentice Hall. 2007.

[6] Kimmins, J.P. 1987. Forest Ecology. Macmillan Publishing Co. New York.

[7] Nirwani Z. 2010. Keanekaragaman tumbuhan bawah yang berpotensi sebagai tanaman obat di Hutan Taman Nasional Gunung Leuser Sub Seksi Bukit Lawang [skripsi]. Fakultas Kehutanan Universitas Negeri Sumatera Utara.

[8] Hilwan I, Mulyana D, Pananjung WD. 2013. Keanekaraaman jenis tumbuhan bawah pada Tegakan Sengon Buto (Enterolobium cyclocarpum Griseb.) dan Trembesi (Samanea saman Merr.) di Lahan Pasca Tambang Batubara PT Kitadin, Embalut, Kutai Kartanagara Kalimantan Timur. Jurnal Silvikultur Tropika, 4(1):610.

[9] Abdiyani S. 2008. Keanekaragaman jenis tumbuhan bawah berkhasiat obat di Dataran Tinggi Dieng. Jurnal Penelitian Hutan dan Konservasi Alam. 1 (5):7992.

[10] Sofyan MZ. 1991. Analisis vegetasi pohon di Hutan Saloguma [skripsi]. Padang: Fakultas Matematika dan Ilmu Pengetaguan Alam Universitas Andalas.

[11] Mawazin, Subiakto, A. 2013. Keanekaragaman dan Komposisi Jenis Permudaan Alam Hutan Rawa Gambut Bekas Tebangan di Riau. Indonesian Forest Rehabilitation Journal. 1(1):59-73.

[12] Kartasapoetra. 1992. Budidaya Tanaman Berkhasiat Obat. Jakarta: Rineka Cipta.