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Herbaceous Plant Community Structure Around The Waste Ponds of PT. KSL in Betung District, Banyuasin Regency, South Sumatra

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ABSTRACT

PT. KSL was a company in the palm oil processing and the palm nursery inLubuk Karet of Betung District, Banyuasin Regency, South Sumatra which had the ponds to accommodate the residualwaste water of the treatments. Around the edges of the ponds there were a lot of the herbaceous plants that were cleared routinely. The clearing land would affect the community structure of the herbaceous plants. Thus, this research aimed to determine the herbaceous plant community structure around the company's waste ponds. The research method used was purposive sampling with 15 observation plots which was each measuring 2m x 2m. The herbaceous plant community structure was analyzed using Shannon-Wiener diversity index and importance values by counting the number of species and individuals of each species. The result research showed that the diversity of the herbaceous plants around the waste ponds was low (1.16 to 1.75), except the plot 8 which had a very low diversity index (0,90). The highest importance value in the herbaceous community was *Asystasia gangetica* (37.24%). It showed that *Asystasia gangetica* was the herbaceous plant that dominated. The dominating species meant having the wider range than the other species to the environmental factors.

Keywords :community structure, herbaceous, palm, Banyuasin, South Sumatra

INTRODUCTION

PT KSL was a company in the crude palm oil (CPO) processing and the palm nursery, which was located in Lubuk Karet of Betung District, Banyuasin Regency, South Sumatra. This company had the eight ponds to accommodate the residualwaste water of the palm oil processing. Around the edges of the ponds there were a lot of the herbaceous plants. The herbaceous plants that were around the ponds always throve, although they were cleared every 3 months. The herbaceous plants were the constituent plants in the ecosystem that were smaller than shrubs dan trees, had the wet stem, were not woody plants, and spread in the individual groups or the solitary on the variety of habitats [(11)].

The herbaceous plants that grew around the edges of the ponds were cleared by the excavator or pulled by hand to keep cleanliness around the ponds. The clearing land would affect on the community structure of the herbaceous plants. The herbaceous plants had a function as ground cover that played a role in preventing the raindrops fell to the ground directly, so it would prevent the loss of topsoil (humus) by water. Moreover, the herbaceous plants also could improve the composition or the structure of the soil with their roots [(10)].

The issue that appeared was why the herbaceous plants around the ponds need to be cleared whereas the herbaceous plants had a good function for the soil. To answer this issue, it would require the study with the aim to determine the herbaceous plant community structure around the Company's waste ponds for the crude palm oil processing and the palm nurseryin Lubuk Karet of Betung District, Banyuasin Regency, South Sumatra.

METHODS

The study of the herbaceous plant community structure around the Company's waste ponds for the crude palm oil processing and the palm nursery was a survey research that was descriptive quantitative, conducted in November 2015. The sampling of the herbaceous plants was done by purposive sampling based on the extent of the herbaceous plants around the waste ponds using the quadrat method. The standard of the quadrat used for the herbaceous plants was 2m x 2m by 15 observation plots of a total area of 6,066 m^2. The parameters used in obtaining the herbaceous data were

the number of species and the number of individuals of each species were found at the observation plots. These parameters were used to determine the diversity and the importance value of the herbaceous plants.

The herbaceous plant diversity was calculated using Shannon-Wiener diversity index by the following equation [3]. The value of the species diversity index according to Shannon-Wiener was defined in Table 1.

H' =

Description:
H' = species diversity index
s = number of species
pi = proportion of individuals of species i in community

TABLE 1. Definition of Species Diversity Index According to Shannor-Wiener

Species Diversity (H')	Level of Diversity
> 4	Very high
3,1 – 4	High
2,1 – 3	Moderate
1,1 – 2	Low
0 – 1	Very low

The importance value was the quantitative parameter that could be used to describe the dominance of the species in a vegetation (a plants community). The importance value index (IVI) for the herbaceous plants was the sum of the relative density (RD) and the relative frequency (RF) with the following formula [2].

IVI-i = RD-i + RF-i

D-i =

DR-i =

F-i =

RF-i =

RESULT AND DISCUSSION

The herbaceous plant community structure around the Company's waste ponds for the crude palm oil processing and the palm nursery was described in the diversity and the importance value of the herbaceous plants.

The Herbaceous Plant Diversity Around The Company's Waste Ponds

The species diversity described the total number of the proportion of a species relative to the total number of the existing individuals. The greater the number of the species with well-balanced proportions, the higher the diversity shown. That concept was called the heterogeneity. The high heterogeneity in a community was when there were many species and the individual number of the species nearly as abundant in number. One measurement of the concept of the heterogeneity was to use the Shannon-Wiener diversity index [3].

The herbaceous diversity that was performed in 15 observation plots around the Company's waste ponds was calculated using Shannon-Wiener index that can be shown in Figure 1 below.

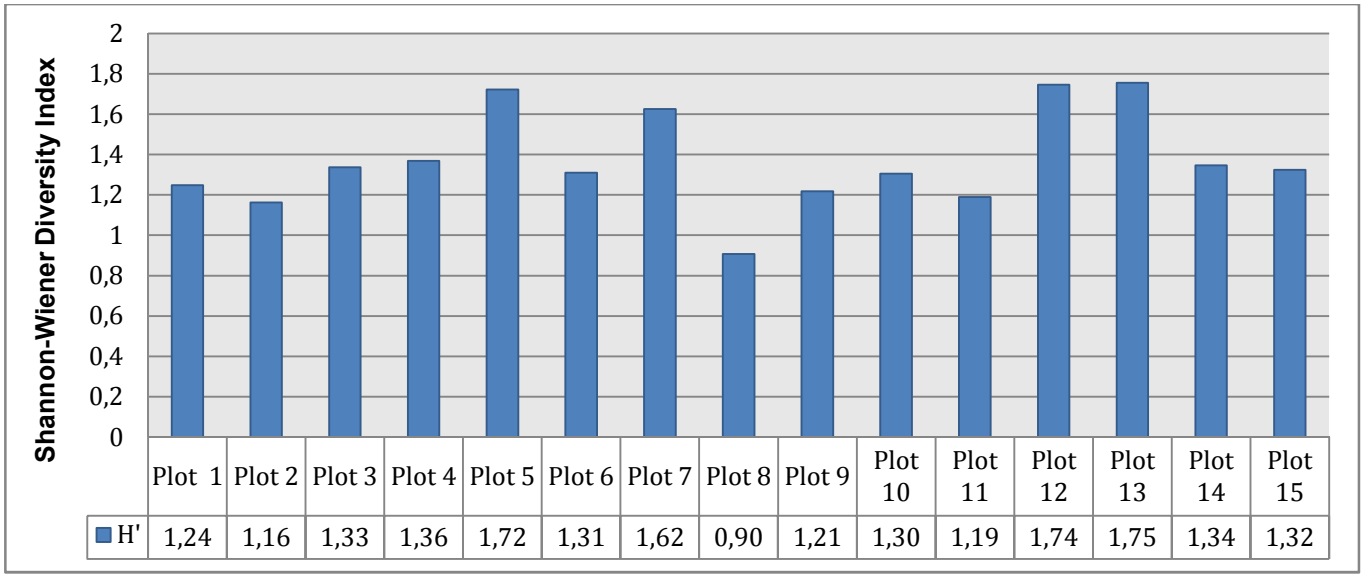

FIGURE 1. The herbaceous diversity at the observation plots around the Company's waste ponds

The diversity index was used to determine the effects of the disturbance to the environment or to determine the stability of the plant communities in an area. Figure 1 above showed that the herbaceous diversity at the observation plots was low (1.16 to 1.75), except the plot 8 which had a very low diversity index (0.90). The low value of the diversity index indicated that the community was not yet stable and there were the high ecological pressures, both from the biotic factors (the competition among the individual plants) or the abiotic factors (10). The high ecological pressures caused not all kinds of plants could survive in an environment. This was supported by the encountered dominant and codominant species to have the significant value which did not differ much (Table 3) (8).

Another factor that affected the level of the species diversity in the community was due to the human activities, such as the clearing land. The clearing land around the waste ponds that was often done by The Company (PT KSL) caused the low diversity relatively. The clearing land caused the land to be empty of the various species of the herbaceous plants. Because the herbaceous plants had the strong competitiveness and the high adaptability, the herbaceous plants were able to grow and form the herbaceous community in the empty place (11). Generally, in the new community had the low diversity relatively.

The Importance of The Herbaceous Plants Around The Company's Waste Ponds

Based on all observation plots around the Company's waste ponds, there were the obtained herbaceous plants that were included in 12 families and 19 species (Table 2). One species most often found of 19 species of the herbaceous plants that were found around the waste ponds was Asytasia gangetica L. with 218 individuals. While the species with the smallest individual number was Synedrella nodiflora L. with 2 individuals.

Based on Table 2, *Asystasia gangetica* L. was the species most often found the Company's waste ponds, while *Synedrella nodiflora* L. was the found species rarely. If the calculation based on the importance value of the herbaceous plants, *Asytasia gangetica* L. also had the highest importance and *Synedrella nodiflora* L. was the lowest than the other herbaceous plants. It could be shown from the importance value index in Table 3.

TABLE 2. The Herbaceous Plant at The Observation Plots Around The Company's Waste Ponds

No.	Species Name	Lokal Name	Family	Number of Individual
1	*Phyllanthus urinaria* L.	Meniran	Phyllanthaceae	129
2	*Amaranthus gracilis* L.	Bayam	Amaranthaceae	7
3	*Cyperus rotundus* L.	Rumput Teki	Cyperaceae	7
4	*Physalis angulata* L.	Cipluan	Solanaceae	5
5	*Mimosa pudica* L.	Putri Malu	Fabaceae	7
6	*Eclipta alba* L.	Urang Aring	Asteraceae	48
7	*Ageratum conyzoides* L.	Bandotan	Asteraceae	7
8	*Euphorbia hirta* L.	Patikan Kebo	Euphorbiaceae	35
9	*Amaranthus hybridus* L.	Bayam	Amaranthaceae	162
10	*Cleome rutidosperma* DC.	Maman Ungu	Capparaceae	135
11	*Blumea lacera* L.	Sembung	Asteraceae	3
12	*Borreria latifolia* (Audl.) K. Schum	Kentangan	Rubiaceae	8
13	*Portulaca oleraceae* L.	Krokot	Portulacaceae	36
14	*Hedyotis corymbosa* L.	Rumput Mutiara	Rubiaceae	10
15	*Synedrella nodiflora* L.	Jotang Kuda	Asteraceae	2
16	*Asytasia gangetica* L.	Rumput Israel	Acanthaceae	218
17	*Passiflora foetida* L.	Rambusa	Passifloraceae	7
18	*Mikania scandens* L.	Mikania	Asteraceae	65
19	*Vernonia cinerea* L.	Sawi Langit	Asteraceae	7
			Species Individual Total	2550
			Species Total	19

(Source: Primer Data, 2015)

TABLE 3. The Importance Value Index of The Herbaceous Plants Around The Company's Waste Ponds

No.	Species Name	RD (%)	RF (%)	IVI (%)
1	*Asytasia gangetica* L.	23,75	13,49	37,24
2	*Amaranthus hybridus* L.	17,65	12,31	29,96
3	*Cleome rutidosperma* DC.	14,71	13,49	28,20
4	*Phyllanthus urinaria* L.	14,05	13,49	27,54
5	*Eclipta alba* L.	5,23	6,75	11,98
6	*Mikania scandens* L.	7,08	4,50	11,58
7	*Euphorbia hirta* L.	3,81	5,62	9,43
8	*Physalis angulata* L.	0,54	3,37	3,91
9	*Portulaca oleraceae* L.	3,92	4,55	8,47
10	*Amaranthus gracilis* L.	2,94	3,37	6,31
11	*Vernonia cinerea* L.	0,74	3,37	4,11
12	*Cyperus rotundus* L.	0,76	3,37	4,13
13	*Borreria latifolia* (Aubl.) K.Schum	0,87	2,25	3,12
14	*Mimosa pudica* L.	0,76	2,19	2,95
15	*Ageratum conyzoides* L.	0,76	2,19	2,95
16	*Blumea lacera* L.	0,33	2,19	2,52
17	*Hedyotis corymbosa* L.	1,11	1,18	2,29
18	*Passiflora foetida* L.	0,76	1,12	1,88
19	*Synedrella nodiflora* L.	0,22	1,18	1,40
Total		100	100	200

Description:
RD (%) : Relative Density
RF (%) : Relative Frequency
IVI (%) : Importance Value Index

The importance value index showed the role of a species in the community [1; 6]. Table 3 showed that the herbaceous plant with the highest importance value was *Asystasia gangetica* L. (37.24%). It showed that *A. gangetica* L. was a dominating herbaceous. Instead of the species that had the smallest role and contribution with the lowest importance value was *Synedrella nodiflora* L.

Based on Table 3, *Amaranthus hybridus* L., *Cleome rutidosperma* DC. and*Phyllanthus urinary* L. were the codominant species that had the high importance values in the herbaceous community. The codominant species were the species that held the important role in the community after *Asystasia gangetica* L. The presence of the dominant species and the codominant species were the species that occupied the most of the research sites, so they showed that they had the ability to adapt to the existing environmental conditions.

The species with the high importance value was the species with k-strategy that could inhibit the growth and the spread of the other species [8]. The dominant species controlled the reproduction and continued existence of the community [1]. The dominant species appeared as the result of the competition in the ecosystem and had the strong growth, so that it became the more powerful species than the other species [2]. The dominating species meant having the wider range limitation than the other species to the environmental factors. The wide tolerance range of the environmental factors caused the species would have the large distribution [3].

Asystasia gangetica L., the dominant species, was the herbaceous plant that could grow up to 0.5 m tall or creep up over the others and form the thick undergrowth. The cross-section of *A. gangetica*'s stem was rectangular, fragile, segmented, and hairy randomly distributed. Each segment could form the new roots when it came in contact with the soil in enough moisture [9]. The soil around the Company's waste ponds was the clay soil with pH 6-7 (based on the laboratory test results). The clay had the silky texture and the pore space dominated by the small pores, so the most of the pores were filled by water and were able to keep the plant nutrient [4].

Besides the soil factor, the shade factor (the presence of the large plants such as trees) also affected the herbaceous, such as *A. gangetica* L. [5]. There was no or very few shade at the study site (around the Company's waste ponds) led to the high intensity of the sunlight coming into the ground. It caused the air temperature became higher, at 34-37^{o}C. The abundant sunshine (the open area) would trigger the growth and development of *A. gangetica* L., so it would lead to the

production of flowers and seeds more [7; 9]. The growth and the development of *A. gangetica* L. as the dominant herbaceous was followed by the growth and the development of the codominant herbaceous species.

The Presence of The Herbaceous Plants

The herbaceous plants had the function in the soil and water conservation because they had some benefits that supported the ground. The herbaceous plants could increase the infiltration because their roots would enlarge the granulation and the soil porosity. Moreover, their roots also affected the microorganisms activity which resulted in increasing the soil porosity and increasing the soil absorption to absorb the rainwater. Furthermore, the water came in through the infiltration was stored because it was held by the ground cover vegetation or the plant debris i.e. the leaves having the dense cover, so it could press the evaporation [4]. Moreover, the presence of the herbaceous plants also could reduce the damage of the soil aggregates from the falling raindrops to the ground.

Asystasia gangetica L. was a herbaceous plant that dominated the research sites. *A. gangetica* L. was a herbaceous plant that became the important weed that had been widespread in the plantations, especially in the palm plantations since the 1970s. The dominance of *A. gangetica* L. in the palm plantations was related to the use of glyphosate widely and continuously. *A. gangetica* L. originated in Africa and had spread widely in Southeast Asia, China, Australia, Papua New Guinea, and the Pacific Islands. In Australia, the invasion of *A. gangetica* L. had caused the heavy damage to the ecosystems. Reportedly, *A. gangetica* L.began to cause the problems in the palm plantations in Sumatra by the end of year 2000 [9]. Therefore, PT. KSL, a company in the palm oil processing and the palm nursery inLubuk Karet of Betung District, Banyuasin Regency, South Sumatra, did the cleaning of the herbaceous plants that were dominated by *A. gangetica* L. around the waste ponds that thrived routinely. It was very unfortunate for indeed the herbaceous plants had the function in the soil and the water conservation.

CONCLUSION

The herbaceous plant community structure around the waste ponds of PT. KSL, a company in the palm oil processing and the palm nursery in Betung District, Banyuasin Regency, South Sumatra, consisted of 12 families and 19 species. The diversity of the herbaceous plants at the observation plots was low (1.16 to 1.75), except the plot 8 had a very low diversity (0.90). The dominating herbaceous plant was *Asystasia gangetica* L. with the highest importance value (37.24%), which can grow up to 0.5 m or creep up over the others, form a thick undergrowth, and has a good tolerance to the environmental factors, so it can be a weed in the oil palm plantation. Then the company needed to clear it routinely.

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