Vegetation analysis of ground covers on Sidoarjo mud impacted land

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Abstract. The study aims to explore the vegetation stucture and the dominance of cover plant type on Sidoarjo muddy farming field, East Java. This research is descriptive through vegetation analysis with line inert method to obtain Important Value Index (IVI). Result show that vegetation structure of 11 types of ground cover plants on mud-affected land was dominated by *Panicumsp, Panicum maximum,* and*Arthraxonsp*with 29.60, 17.70, and 16.84 of IVI respectively. Then, they are following by species that have lower IVI such as: *Cynodondactylon* (Linn.) Prest, *Spigelia anthelmia* L., *Mimosa pudica*, *Cyperus rotundus, Imperata cylindrica, D. aegyptium (*Linn.*)* P. Beauv. *Desmidium sp,* and *A. villosa* Willd.

1. Introduction

The mudslides of Sidoarjo (*Lusi*) that occurred several times since the first eruption on 27 May 2006 have destroyed rice fields, residential areas, industrial estates and public facilities showing the severity of damage caused by natural phenomena [1]. Agricultural land couldn't be used for cultivation not only on permanently exposed land, but also on most of the land that has been exposed by Lusi mud [2]. The high levels of various minerals on the surface of mud-exposed soil [3] make the land unfeasible for farming because of contamination threat in plant products [4, 5]. In agricultural land that ever been exposed had an opportunity to be restored and become a viable agricultural cultivation land. It's done by applying bioremediation which utilize the bioremediator plants [6]. Various wild plants had a potential being utilized as bioremediation agents. The ability of various types of vegetation in the former mud field of Sidoarjo indicates its ability to overcome the stress of heavy metals and various other harmful compounds. Hence, we need to collect and keep those various types of vegetation that is able to grow well on the former land exposed by *Lusi* mud. This study aim to explore the vegetation stucture, the dominace and the reproduction of cover land plant on the agricultural former land affected by *Lusi* mud.

2. Experimental Method

The object of this study is an area that ever being exposed by *Lusi* at 2006. It located in: (i) Gempolsari village, a former citizen settlement area; (ii) a former agricultural land in Gempolsari village (Porong district); (iii) a former agricultural land in Sentul village (Tanggulangin district); and (iv) a former agricultural land in Kuaron village (Tanggulangin district). Those place have +4 meters asl of elevation, average temperature 25-34^{0}C and average air relative humidity 48-87%. Vegetation analysis on undergrowth or ground cover vegetation was used Intersep Line Method with size 1 m x 1 m, then there is a 5 m long plane divided into several equal points of distance (in this case the interval is 1 m) so that the 5 m line is divided into 5 intervals. Determination of plot sampling was conducted randomly following public road access [7]. All the plants that passed the intercept line either above/attached or under the line were observed and measured. We recorded all the number of plants of each species that we're found, the length of the canopy/leaf parallel to the intercept line and the maximum width of the leaves perpendicular to the intercept line. Next is determined the relative density (Kr), relative frequency (Fr), relative dominance (Dr), important value index (IVI) of all vegetation found [7]. Determination of unknown vegetation type was determined by Purwodadi Botanical Garden - LIPI, Pasuruan, East Java. The size of the uniformity of a given plant species is expressed in terms of the frequency of the plot number that is filled by a species over the whole plot. The frequency (F) and relative frequency (Fr) are expressed in percent (%) determined by using the formulas (1) and (2).

$$\mathrm{F} = \frac{\text{Number of plot that a species plant found}}{\text{Total number of plot}} \tag{1}$$

$$\mathrm{F}_r = \frac{\text{A species frequency}}{\text{Total frequency of all species}} \tag{2}$$

The density (K) is known by counting the number of individuals per species per unit of standing area while the relative density (Kr) is a density ratio of a species with 100% density of all types calculated respectively by the formulas (3) and (4).

$$\mathrm{K} = \frac{\text{number of individu}}{\text{sample area}} \tag{3}$$

$$\mathrm{K_r} = \frac{\text{density of one species}}{\text{density of all sepcies}} \tag{4}$$

The dominance (D) of a species against others within pasture stand is stated based on the width of the base plane against the area of the sample plot; relative dominance (Dr) is calculated by dividing the dominance of a type with all types multiplied by 100%. Both are determined by using formulas (5) and (6).

$$\mathrm{D} = \frac{\text{base plane number of a species}}{\text{are a of sample plane}} \tag{5}$$

$$\mathrm{D_r} = \frac{\text{base plane number of a species}}{\text{area of sample plane}} \times 100\% \tag{6}$$

Relative density (Kr), relative frequency (Fr), and relative dominance (Dr) of each plant are summed to obtain an important value (IV) and after averaging an important value index (IVI) (formula (7)). IVI is used to establish the dominance of a species against others, it can also be used to describe the ecological position of a species within the community.

$$\mathrm{IVI} = {}^{1}\!/_{3}\,(\mathrm{K_r} + \mathrm{F_r} + \mathrm{D_r}) \tag{7}$$

3. Results and Discussion

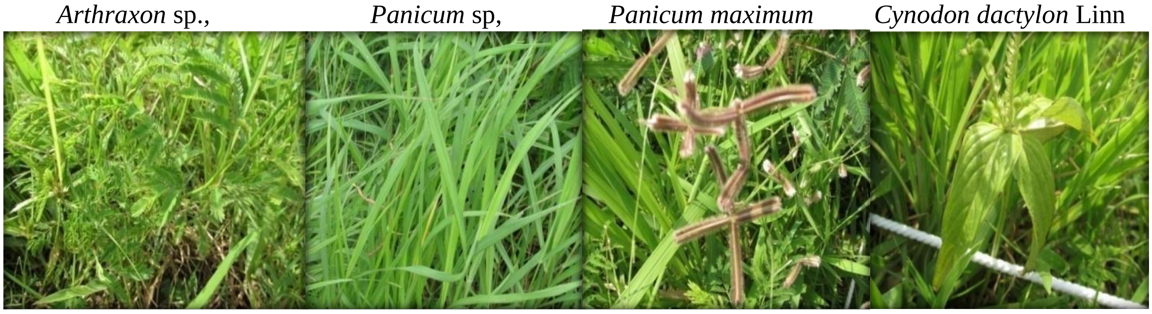
Based on the sample plotsobservations, a list of plant species scattered on the land that was once exposed to theLusi slurry as shown in **Table 1**.

Table 1. The number of individual ground cover plants observed

No	Species	Plot				Total
		1	2	3	4	
1	*Arthraxonsp.*	85	-	-	-	85
2	*Cynodon dactylon*Linn.	14	-	-	-	14
3	*Spigeliaanthelmia L*	4				4
4	*Mimosa pudica*	9	-	-	-	9
5	*Cyperusrotundus*	4	-	15	-	19
6	*Imperata cylindrical*	8	-	-	20	28
7	*D. aegyptium*Linn.	11	-	-	-	11
8	*Panicum sp.*	-	106	86	-	192
9	*Panicum maximum*	-	-	-	99	99
10	*Desmidium sp.*	-	-	-	1	1
11	*A .villosa*Willd.	-	-	-	1	1
	Number of individu					463

The morphology of 11 types of wild plants found in the former land exposed to Lusi mud can be seen in **Figure 1**.

Arthraxon sp., *Panicum* sp, *Panicum maximum* *Cynodon dactylon* Linn



A. villosa Willd *Imperatacylindrical* *D. Aegyptium* Linn *Spigelia anthelmia*

Cyperus rotundus *Mimosa pudica* *Desmidium* sp.

Figure 1. Types of vegetation in former land exposed to *Lusi*

From the eleven kinds of vegetation found it is known that eight species are grassroots (Graminae): *Arthraxon* sp., *Panicum* sp., *P. maximum*, *C. dactylon*, *A. villosa*, *I. cylindrica*, *D. aegyptium*, and *C rotundus*. The other three types of broadleaf are: *S. anthelmia*, *M. pudica*, and *Desmidium* sp., *Panicum* sp. has the largest INP of 29,000 so it can be said to be the dominant type even though the frequency of finding is not the highest, but the same is compared with *C. rotundus* and *I. cylindrica* (**Table 2**).

Table 2. Relative density (Kr), relaive frequency (Fr), relative dominance (Dr) and important value index (IVI) of vegetation

No	Species Name	FJ	KJ	DJ	Fr	Kr	Dr	IV	IVI
1	*Arthraxonsp*	0,25	17,0	0,0696	7,1429	18,3585	25,0270	50,5284	16,8428
2	*Cynodon dactylon*Linn)	0,25	2,8	0,0034	7,1429	3,0238	1,2226	11,3892	3,7964
3	*Spigeliaanthelmia*L.	0,25	0,8	0,0046	7,1429	0,8639	1,6541	9,6609	3,2203
4	*Mimosa pudica*	0,25	1,8	0,0015	7,1429	1,9438	0,5394	9,6261	3,2087
5	*Cyperusrotundus*	0,5	3,8	0,0085	14,2857	4,1037	3,0565	21,4458	7,1486
6	*Imperata cylindrical*	0,5	5,6	0,011	14,2857	6,0475	3,9554	24,2886	8,0962
7	*Digitaria. aegyptium*Linn.	0,25	2,2	0,003	7,1429	2,3758	1,0787	10,5974	3,5325
8	*Panicum sp.*	0,5	38,4	0,0919	14,2857	41,4687	33,0457	88,8001	29,6000
9	*Panicum maximum*	0,25	19,8	0,0684	7,1429	21,3823	24,5955	53,1206	17,7069
10	*Desmidium sp.*	0,25	0,2	0,016	7,1429	0,2160	5,7533	13,1122	4,3707
11	*A .villosawilld.*	0,25	0,2	0,0002	7,1429	0,2160	0,0719	7,4308	2,4769
	JumlahIndividu	3,5	92,6	0,2781	100	100	100	300	100

Based on the IVI, the vegetation types are grouped into fully role, enough to play a role, lack of role, and no role (**Table 3**).

Table 3. The cover land plants groups based on IVI

Group	IVI range (%)	Number of species	Species name
Fully role	20-30	1	*Panicum sp.*
Enough to play role	15-20	2	*P. maximum dan Arthraxonsp*
Lack of role	5-15	2	*Imperata cylindrical, Cyperusrotundus, Desmidium*sp.
No role	<5	6	*Cynodon dactylon, Digitaria. Aegyptium, Spigeliaanthelmia, Mimosapudica,* dan*A .villosa .*

The Table 3 shows that most substantial cover plants is *Panicum* sp. (IVI 29.60), *Panicum maximum* (IVI 17.71) and *Arthraxon* sp. (IVI 16.84) are quite important type, *Imperata cylindrical*, *C. dactylon* (Linn.) Prest, *Spigelia anthelmia* L, *Mimosa pudica*, *Cyperus rotundus*, *Imperata cylindrica*, *D. aegyptium* (Linn.) P. Beauv, *Desmidium* sp., have minor role, and *A. villosa* willd has no role. The difference is suspected because of differences in the ability to compete in the absorption of nutrients and obtain solar radiation that will cause differences in structure and diameter of growth. As shown in Table 3 that *M. pudica* and *Desmidium sp*. belonging to a growing group that is not and has little role in vegetation structure, but its existence can not be ignored. The presence of legumes in wild vegetation shows the potential for nitrogen fixation through the formation of bacterial nodules that can support important ecosystem functions [8]. Nitrogen fixation by this type of legume plays an important role in improving soil fertility [9]. Therefore, there is potential to encourage the spatial development of legumes in all areas affected by *Lusi* mud. In the long term, the existence of legume species has the economic potential of the area and becomes a buffer for the threat of ecological decline [10]. The area affected by *Lusi* is similar to other areas in Sidoarjo regency including areas with high rainfall [2, 11]. The amount of rainfall provides better opportunities for seasonal vegetation such as grasses that provide vegetation physiognomy characteristics [12, 13, 14]. All vegetation in the observation plot appears to grow normally even though its habitat is exposed to the mud toxic material [15]. Plants use adaptive mechanisms that translocate metals through xylem and then accumulate, sequestrate, or detoxify metals so that their growth can be maintained [6].

4. Conclusion

The vegetation structure of plant that cover the land affected by Sidoarjo mud consists of 11 species dominated by *Panicum* sp., *Panicum maximum*, and *Arthraxon* sp. with IVI 29.60, 17.70, and 16.84 followed by plant species with INI below it respectively: *Cynodon dactylon* (Linn) Prest, *Spigelia anthelmia* L., *Mimosa pudica*, *Cyperus rotundus*, *Imperata cylindrica*, *D. aegyptium* (Linn.), *Desmidium* sp., and *A. villosa* willd.

5. References

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