Oil Palm Plantation and Plant Species Diversity in Kolaka District, Indonesia

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Abstract: - Knowledge of the types of plant species in the world continues to progress even though there are still many plant species whose types and benefits are not yet known. These plant species concentrate in an area both in residential areas, pastures, agricultural land, and plantation land. The research aims to identify plant species in mature oil palm plantation areas in Kolaka Regency by selecting Watubangga and Tanggetada subdistricts as survey locations and has been carried out from January to August 2022 by dividing the mature oil palm area into 3 villages in each subdistrict as research samples. The results of the survey and identification were analyzed using the *summed dominance ratio* formula to determine the level of dominance of plant species in controlling growth facilities. The findings of plant species in mature oil palm plantation areas in Watubangga Subdistrict, Polenga Village (highest-*Cyperus rotundus* L. 3.0738%, lowest-*Solanum torvum* Sw. 1.8637%), Kastura Village (highest-*Brachiaria miliformis* 4.1470%, lowest-*Euphorbia hirta* L 1.5057%), Kukutio Village (highest-*Pennisetum purpureum* Schumach 3.8447%, lowest-*Chromolaena odorata* (L.) King. 1.6317%). Tanggetada Subdistrict, Pundaipa Village (highest-*Asystasia coromandeliana* Ness 3.8541%, lowest-*Cyrtococcum acrescens* 1.4968%), Tinggo Village (highest-*Imperata cylindrica* (L.) P. Beauv. 4.9256%, lowest-*Chromolaena odorata* (L.) King 1.6079%), Oneeha Village (highest-*Pennisetum purpureum* Schumach, 3.8447%, lowest-*Chromolaena odorata* (L.) King. 1.6317%). This finding can be concluded that each area of mature oil palm plantations has several different and varied plant species and there are invasive plants that can eliminate native plants such as *Chromolaena odorata* (L.) King. and *Imperata cylindrica* (L.) P. Beauv.

Key-Words: - Summed Dominance Ratio, Plants, Oil Palm Plantation, Kolaka

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1 Introduction

Massive and structured forest clearing in various parts of the world causes damage to various ecosystems to be used as industrial areas, housing, agriculture, mining, and plantations. The extent of the oil palm plantation area has an impact on environmental damage and the extinction of plant species ecosystems. The damage certainly has implications for the growth and development of a plant ecosystem as well as what happened in Southeast Sulawesi Province. Oil palm plantations in Southeast Sulawesi Province in 2022 were recorded at 75.921 hectares spread across Konawe, North Konawe, East Kolaka, and Kolaka Regency.

Kolaka Regency was formerly known by the people of Southeast Sulawesi as the land of orchids (Wonua Sorume), a district that will be famous for its diversity of beautiful orchid plants, unique birds, and unique animals (Anoa) Southeast Sulawesi is now starting to experience extinction because since 2004 private plantations that were given a permit to manage a forest area of 31.291 hectares, began to penetrate the forest and establish a plantation industry. This fact gives a shocking effect to plant species found in forest areas and of course, will slowly experience extinction due to massive land clearing on a large scale by oil palm plantations.

The massive opening of oil palm plantation areas in Kolaka Regency also has an impact on Watubangga Subdistrict with an area of 5.748 ha and Tanggetada District 7.748 ha, which of course eliminates some plant species in the area and requires efforts to preserve plant species [1], predict and assess the risk of extinction [2], especially plant species in the lowlands [3], and the need to identify plant species that are starting to experience extinction [4].

Identifying plant species in oil palm plantations has benefits both theoretically and practically because through this study it will be known with certainty the types of plants that can live in oil palm plantations become a basic frame of reference for further research in saving natural plant species that are threatened with extinction. As a result of the invasion of oil palm plantations. Previous research has given many examples to identify plant species in various areas that are threatened with extinction, such as in the Scottish mountains [5], Hungarian prairie [6], South Africa [7], Chile and Peru [8], and Ethiopia [9].

Identification of plant species in oil palm plantation areas in particular has not been widely carried out in Kolaka Regency. Previous research on plant species in oil palm areas was mixed plant species in oil palm plantations [10], conservation of biodiversity in oil palm plantation areas [11],[12] loss of plant species in oil palm areas [13]. The results of the research on plant species found in oil palm plantation areas have been previously mentioned there are no studies that specifically examine the *summed dominance ratio* of plant species in oil palm plantation areas. *Summed dominance ratio* is the richness of a plant species [14], able to dominate and dominate other plant species [15], and shows the index of the dominance of plant species in controlling the means of growth.

2 Methods

The survey and identification of plant species in the oil palm plantation area were carried out in Kolaka Regency by selecting two sub-districts as research locations, namely Watubangga District and Tanggetada District, each sub-district selected three villages as research samples based on the criteria for land area and productivity of mature oil palm plantations. The tools used when measuring plant species using questionnaires, tropical plant books, digital cameras, machetes, plastic samples, paper labels, writing tools, and research materials are plant species found in oil palm plantation areas that have been produced.

Points were taken for each plant species using a transect system measuring 50×50 m^2 (Fig.1) plant sampling used the transect method, where the researchers first determined two points as the center of the transect line with a length of 50 m with a transect line thickness of 1 cm, and made transect segments with a length of 1 m and walked along the transect line to identify plant species, record, and compare using tropical plant books, and the internet. The sample points for each village are 50 points with a total of 300 transects.

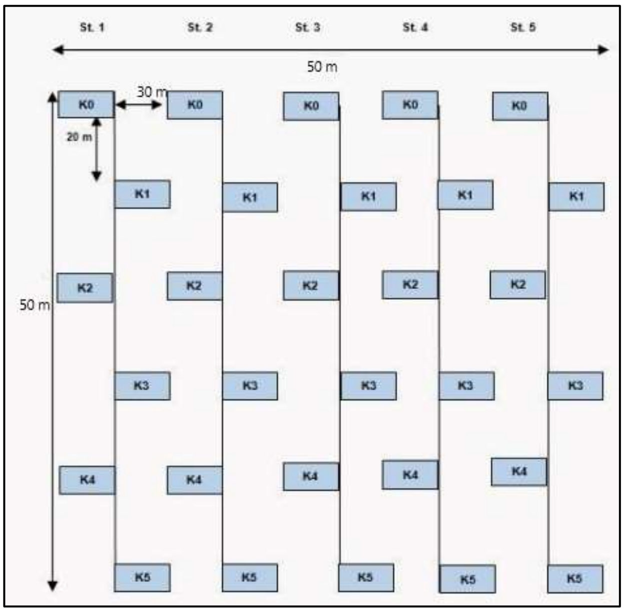

Fig. 1: Research Transect Design

Analyzing plant species in oil palm plantation areas using summed dominance ratio [25],[26],[27].

Absolute Density:

$$AD = \frac{\text{Total species}}{\text{An area}}$$

Relative Density:

$$RT = \frac{\text{Absolute density}}{\text{Total kerapatan mutlak}} \times 100$$

Absolute Frequency:

$$AD = \frac{\text{Number of plant species}}{\text{Total of all plants}}$$

Relative Frequency

$$RF = \frac{\text{Absolute frequency}}{\text{Total absolute frequency}} \times 100$$

Important Score:

RT + RF

Summed Dominance Ratio:

$$SDR = \frac{IS}{2}$$

3 Results and Discussion

The *summed Dominance Ratio* in the study was divided into six village areas according to the research locations in Watubangga and Tanggetada districts. The *summed dominant ratio* is specifically used as a parameter to see the level of dominance of a plant species in an area. Plant species that have a higher ratio value than other plant species, the more these plants can be concluded as plants that can control the growing media, and vice versa if the

Summed dominant ratio value is lower, the plant species is getting lower in controlling the growing media.

The basic understanding of the *summed dominance ratio* will certainly provide an understanding and description of the diversity of plant species in the oil palm plantation area in Kolaka Regency. The results of the identification of plant species in the oil palm area resulted in (Fig. 2, Fig. 2A) Polenga Village with the lowest *summed dominance ratio* value found in the *Solanum torvum* Sw species from the Solanaceae family of 1.8637% and the highest *summed dominance ratio* was found in the species *Cyperus rotundus* L. family Cyperaceae with a value of 3.0738%.

Fig. 2: Oil Palm Plantation Area

Fig. 2A: Oil Palm Plantation Area

Oil palm plantations in Kastura Village, Watubangga District (Table 1), had the highest *summed dominance ratio* found in the plant species *Brachiaria miliformis* from the *Poaceae* family with a value of 4.1470% and the lowest plant species *Euphorbia hirta* L. from the *Dennsteadtiaceae* family with a value of 1.5057%. As a result of the sum of the dominance of the species, these plants are more numerous than other types of species. Oil palm development areas generally have fairly shady canopies so that light intensity cannot penetrate the soil surface directly and of course will affect plant species. Asteraceae is a plant species that is resistant to high levels of shade, this can be seen from the results of observations made during research in Kolaka Regency.

Table 1. Summed Dominance Ratio Watubangga District

Family	Species	SDR (%) Polenga	SDR (%) Kastura	SDR (%) Kukutio
Acanthaceae	*Asystasia coromandeliana* Ness.	2.2666	2.9480	3.2809
	Mikania micrantha Kunt.	2.3897	2.5401	2.9222
Adiantaceae	*Taenitis blechnoides* (Willd.) Sw.	2.7247	1.6655	1.7725
Aspleniaceae	*Asplenium macrophyllum* Sw.	2.1120	1.9771	3.2165
	Asplenium nidus L.	2.4064	2.1416	2.1694
	Asplenium platyneuron (L.)	2.5759	1.6491	2.3946
Asteraceae	*Ageratum conyzoides* L.	2.5077	3.6333	1.6377
	Chromolaena odorata (L.) King	2.0010	2.5119	1.6317
Cyperaceae	*Cyperus distans* L.f.	2.5831	3.5816	1.6800
	Cyperus rotundus L.	3.0738	2.2262	1.6719
	Cyperus kylingia	2.5685	2.5236	2.2900
	Scleria sumatrensis Retz.	2.5805	2.1651	2.8458
Dennsteadtiaceae	*Nephrolepis bisserrata*	2.3739	2.4978	2.8921
	Euphorbia hirta L.	1.9940	1.5057	2.9303
Euphorbiaceae	*Phyllanthus amarus* Schumach. & Thonn	2.0470	2.5354	3.3815
Gleicheniaceae	*Gleichenia liniaris*	2.9950	3.0984	1.7845
Lycopodiaceae	*Licopodium cernuum*	2.1805	2.1228	2.5273
Malvaceae	*Urena lobata* L.	2.6686	3.0326	1.9233
Melastomataceae	*Clidemia hirta* (L.) D.Don	2.6280	2.5283	1.6538
Mimosaceae	*Mimosa pudica* L.	2.4447	2.2779	3.0288
Poaceae	*Axonopus compressus* (Sw.) P.Beauv.	2.3748	1.8207	2.7392
	Brachiaria miliformis	2.6183	4.1470	2.7633
	Brachiaria mutica (Forssk.) Stapf	2.9115	2.2286	2.3162
	Cynodon dactylon (L.) Pers.	2.3241	2.2662	2.1754
	Cyrtococcum acrescens	2.2317	1.6021	2.1151
	Chrysopogon aciculatus (Retz.) Trin.	2.0441	2.5683	2.2518
	Digitaria cilliaris	2.0309	2.6130	2.2599
	Imperata cylindrica (L.) P.Beauv.	2.4473	3.1972	2.8961
	Ischaemum timorense Kunth.	2.3938	1.5997	2.9906
	Panicum brevifolium (Link) Kunth.	2.5774	2.2944	2.2237
	Panicum maximum (Jacq.)	2.1428	1.5527	1.7323
	Panisetum polystachyon	2.1989	1.5245	2.2498
	Pennisetum purpureum Schumach.	2.2418	2.2239	3.8447
Polypodiaceae	*Davalia denticulata*	2.4617	3.0726	1.8147
	Goniophlebium persicifolium	2.3509	2.5095	2.8237
	Phymatodes sp.	2.3814	3.5251	1.6780
	Phymatopteris triloba (Houtt.) Pic.Serm.	2.5005	2.6717	2.9102
Rubiaceae	*Borreria latifolia* (Aubl.) K.Schum.	2.1270	1.6162	2.3805
Solanaceae	*Solanum torvum* Sw.	1.8637	2.7611	2.2719
Verbenaceae	*Stachytarpheta indica* (L.) Vahl.	2.2047	1.7008	2.4650
Leguminaceae	*Calopogonium mucunoides* Desv.	2.0142	1.5833	2.7734
	Alysicarpus vaginalis (L.) DC.	2.0634	2.1110	2.3403
	Desmodium triflorum (L.) DC.	1.9699	2.0523	2.8438

Plant species and their diversity can be directly affected by the level of light intensity because in general plants need light to live normally. The diversity of plant species is affected by water, minerals, and light [16], which can increase plant productivity [17], with different levels of wealth and equity [18]. Kukutio Village, Watubangga District, had the highest *summed dominance ratio* found in the plant species *Pennisetum purpureum* Schumach (Fig. 3, Fig. 3A) with a *summed dominance ratio* of 3.8447%, and the lowest was in the species *Chromolaena odorata* (L.) King (Fig. 4, Fig. 4A) with a *summed dominance ratio* of 1.6317%. *Chromolaena odorata* (L.) King is an invasive plant containing bioactive compounds [19], able to survive in dry areas [20], and resistant to climate change [21].

The increase in the number of plant species depends on the conditions in which the plant is located, on the other hand, plants are largely influenced by temperature conditions, the environment, and the activities of other living things. Plant species can grow and develop properly if there are no disturbances that hinder growth, wealth, or evenness.


Fig. 3: *Pennisetum purpureum* Schumach.


Fig. 3A: *Pennisetum purpureum* Schumach.


Fig. 4: *Chromolaena odorata* (L.) King.

The formation of various plant patterns in the species structure is a dynamic process and has a close relationship with environmental conditions because in general, if there are elements that are not by plant needs, it will inhibit microbial growth.


Fig. 4A: *Chromolaena odorata* (L.) King.

Table 2. Summed Dominance Ratio Tanggetada District

Family	Species	SDR (%) Pundaipa	SDR (%) Tinggo	SDR (%) Onetha
Acanthaceae	*Asystasia coromandeliana* Nees.	3.8541	1.8488	3.2809
	Mikania micrantha Kunt.	3.1215	2.9685	2.9222
Adiantaceae	*Taenitis blechnoides* (Willd.) Sw.	2.6707	3.0881	1.7725
Aspleniaceae	*Asplenium macrophyllum* Sw.	1.6001	1.7257	3.2165
	Asplenium nidus L.	1.7317	2.5130	2.1694
	Asplenium platyneuron (L.)	1.9319	2.3703	2.3946
Asteraceae	*Ageratum conyzoides* L.	2.2450	2.0200	1.6377
	Chromolaena odorata (L.) King	2.3045	1.6079	1.6317
Cyperaceae	*Cyperus distans* L.f.	1.6346	2.3578	1.6800
	Cyperus rotundus L.	2.0508	1.7150	1.6719
	Cyperus kylingia	2.3608	2.3792	2.2900
	Scleria sumatrensis Retz.	3.2936	2.3739	2.8458
Dennstaedtiaceae	*Nephrolepis bisserrata*	3.3344	1.9201	2.8921
	Euphorbia hirta L.	3.1748	2.9989	2.9303
Euphorbiaceae	*Phyllanthus amarus* Schumach. & Thonn	2.4047	2.4220	3.3815
Gleicheniaceae	*Gleichenia liniaris*	2.6488	2.4042	1.7845
Lycopodiaceae	*Licopodium cernuum*	2.2324	1.7953	2.5273
Malvaceae	*Urena lobata* L.	2.3702	1.8184	1.9233
Melastomataceae	*Clidemia hirta* (L.) D.Don	1.5751	2.0058	1.6538
Mimosaceae	*Mimosa pudica* L.	3.3250	2.4952	3.0288
Poaceae	*Axonopus compressus* (Sw.) P.Beauv.	1.9194	2.4773	2.7392
	Brachiaria milliformis	2.0102	1.7828	2.7633
	Brachiaria mutica (Forssk.) Stapf	3.2185	1.8648	2.3162
	Cynodon dactylon (L.) Pers.	2.7146	1.7828	2.1754
	Cyrtococcum acrescens	1.4968	2.9793	2.1151
	Chrysopogon aciculatus (Retz.) Trin.	1.6565	1.7221	2.2518
	Digitaria cilliaris	3.3751	2.9364	2.2599
	Imperata cylindrica (L.) P.Beauv.	3.1403	4.9256	2.8961
	Ischaemum timorense Kunth.	2.9712	2.4524	2.9906
	Panicum brevifolium (Link) Kunth.	2.5580	2.9917	2.2237
	Panicum maximum (Jacq.)	3.0088	4.1418	1.7323
	Panisetum polystachyon	1.5375	2.4524	2.2498
	Pennisetum purpureum Schumach.	2.6707	2.4256	3.8447
Polypodiaceae	*Davalia denticulata*	2.5080	1.6632	1.8147
	Goniophlebium persicifolium	2.3671	1.7899	2.8237
	Phymatodes sp.	2.0165	3.6631	1.6780
	Phymatopteris triloba (Houtt.) Pic.Serm.	1.8630	3.1362	2.9102
Rubiaceae	*Borreria latifolia* (Aubl.) K.Schum.	1.5970	1.7846	2.3805
Solanaceae	*Solanum torvum* Sw.	2.2199	1.7739	2.2719
Verbenaceae	*Stachytarpheta indica* (L.) Vahl.	1.8881	2.9489	2.4650
Leguminaceae	*Calopogonium mucunoides* Desv.	2.5486	3.4794	2.7734
	Alysicarpus vaginalis (L.) DC.	1.6659	1.8952	2.3403
	Desmodium triflorum (L.) DC.	1.8349	3.1023	2.8438

The *summed dominance ratio* in Tanggetada sub-district (Table 2) is not much different from the *summed dominance ratio* in Watubangga sub-district. This is influenced by the intensity of land clearing carried out by plantation workers. The highest *summed dominance ratio* of plant species in Pundaipa Village was *Asystasia coromandelana* Ness. from the family *Acanthaceae* (3,8541%) and the lowest plant species *Cyrtococcum acrescens* (1,4968%), although they have differences, these species grow evenly. The dominant plant species in Tinggo Village is *Imperata cylindrica* (L.) P. Beauv. (Fig. 5, Fig. 5A) from the family *Poaceae* (4.9256%) and the lowest is *Chromolaena odorata* (L.) King from family *Asteraceae* (1.6079%).

Fig. 5: *Imperata cylindrica* (L.) P. Beauv.

Fig. 5A: *Imperata cylindrica* (L.) P. Beauv.

Imperata cylindrica (L.) P. Beauv. is a problem plant that can control the means of growth [22], threaten other plant ecosystems [23], and can be found on all continents except Antarctica [24]. Oneeha village has the highest plant species, *Pennisetum purpureum* Schumach (3.8447%), and the lowest is *Chromolaena odorata* (L.) King. of the *Asteraceae* species (1,6317%).

Vegetative homogeneity is the type of vegetation found under oil palm stands or other growing areas. Plant uniformity can have a soil and water conversion effect because plants have a uniform root system to create dense clusters and are resistant to soil erosion, protect the soil from rain and surface runoff also play a role in increasing soil organic matter. Differences in the structure and composition of each layer of vegetation are closely related to environmental conditions. Environmental factors that will affect the continuity of growth are altitude, altitude will affect species richness, structure, and composition of vegetation, soil conditions, temperature, and light and water intensity.

4 Conclusion

The findings of plant species in the oil palm plantation area showed that the Watubangga sub-district has different diversity and there are invasive plants that cause the loss of native species in the oil palm plantation area, namely *Chromolaena odorata* (L.) King. and *Imperata cylindrica* (L.) P. Beauv. however, there are also plant species that can be used directly as animal feed, such as the *Pennisetum purpureum* Schumach plant which is found in almoust all observation points. This study is expected to provide an overview of the diversity of plant species in the oil palm plantation area and can be used as initial data for further research in the future.

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