Diversity of Forage Species in Oil Palm Plantation Area in Kolaka Regency

Natsir Sandiah[1*], Syamsuddin[1], Rahim Aka[1], La Ode Muh. Munadi[1]

[1]*Faculty of Animal Science, Halu Oleo University , Jl. H. E. A. Mokodompit, Kampus Hijau Bumi Tridharma Anduonohu, Kendari City, Southeast Sulawesi*
**Corresponding author. Email: natsir.sandiah@uho.ac.id*

ABSTRACT
The diversity of greenery species in oil palm plantations is a source of animal feed. The research aims to identify the type of forage as a source of animal feed in the area of oil palm plantations in Watubangga Subdistrict Kolaka Regency, conducted in April to June 2021 using survey methods and direct observations on oil palm plantation areas. Observation and measurement of forage type used quadrant 1 m x 1 m in the area of oil palm plantations aged 7 years. The results of forage identification were analysed using summed dominant ratio formula to see the relative density, relative frequency and important value of a forage type. Furthermore, it was analysed using the formula of livestock capacity. The identification results showed that out of the 24 types of forage in the oil palm plantation area there are 13 types that can be consumed by livestock with a capacity of 502.07 livestock units.

Keywords: *Forage Type, Palm oil, Kolaka.*

1. INTRODUCTION

A development of beef cattle has good prospects. As the population increases, the demand for meat and milk as a fulfillment of nutrition increases [1]. Efforts to realize food security, increasing meat production continues to be done by looking at the available resources [2]. Weeds are obstacle in the cultivation of oil palm crops [3]. Indonesia is a tropical region with a climate that supports the growth of plants and weeds [4], [5]. Palm oil plantation management is an investment and requires a large amount of manpower [6]. Good growth and production of oil palm crops requires intensive maintenance of crops, such as timely fertilization, as well as pest control, plant diseases, and weeds [7], [8].

Weeds are disruptive plants because they compete with staple crops in obtaining nutrients in the soil so as to reduce production by up to 20% [9]. The presence of weeds in oil palm plantations is basically undesirable because it results in a decrease in production in the competition of nutrients, water, sunlight, and living space, decreases the quality of production due to contaminated parts of weeds, releases allopathic compounds disrupting plant growth, becomes pests and disrupts the water system, in general the disruption of weeds is invisible but takes place slowly, so that the presence of weeds will increase the cost of farming because of the addition activities in the crop. The scramble for nutrients, water, sunlight, air, and weed growing space can compete strongly with the main plants. Weeds are different from pests of plant diseases, the impact of harm caused by weeds is not seen directly and runs slowly. But accumulatively the losses incurred are very large because the effect with the amount of production to be produced will decrease gradually.

Factors that affect the growth and productivity of palm oil are grouped into three factors, namely, environment, plant materials and technical cultural actions [10]. Protection of plants from pest and disease control is an aspect of technical measures that mostly affects growth and productivity [11]. Weed control is an effort to improve the competitiveness of staple crops and to weaken the competitiveness of weeds [12]. Weeds in oil palm plants such as *Mikania micrantha* can reduce the production of fresh fruit bunches by 20% [13]. The dynamics of weed populations in palm oil are influenced by environmental factors, technical culture, and thus determine the level of effectiveness in controlling activities [14], success of competing weeds,

harnessing the growing environment and giving rise to dominance over major crops [15]. Weed control is generally carried out by farmers including manual control, chemical control and technical cultural control [16]. Manual control of weeds uses hoe tools and so on, chemical control uses herbicides. Weed control is very expensive [17]. Types of weeds in oil palm plantations include *Clomolaena odorata, Mikania micrantha, melastoma malabactrium, Imperata cylindrica, Asystasia gangetica* and *lantana cemara* [18]. The life forms of weeds in palm oil plantations are the most numerous forms of herbs and shrubs [19].

Effort to control weeds in oil palm plantations is to implement an integrated agricultural system, where the weeds can be used as a source of animal feed. Oil palm plantations in Watubangga subdistrict have an area of 738 hectares divided into several age categories including 3 years, 7 years, 9 years, and 12 years to 20 years. Each age of palm oil has a diversity of types of weeds that can be used as a source of feed, but the focus of research on the age of palm 7 years, because at the age the palm is more diversity of forage species than the age of 3 years, 9 years to 20 years. Forage of livestock food in oil palm plantations is a potential development of beef cattle because the type of forage comes from the sidelines of plantation crops. Every day ruminants need more than 60% forage to be consumed, both fresh and dry. The farmers' community in Watubangga sub-district uses forage in the form of field grass, legumes, puzzles and some superior grass as animal feed in oil palm plantations. However, the main obstacle is that the production of forage produced in the area of oil palm plantations in Watubangga sub-district is not clearly known. Based on these thoughts, research was conducted that aims to analyze the diversity of forage types in oil palm plantations in Kolaka Regency.

2. MATERIALS AND METHODS

The research was conducted on seven-year-old oil palm plantation area in Watubangga Subdistrict, Kolaka Regency from April to June 2021. This study used survey method with direct observation on plantation location with research population of all 7 years old palm plantation area with a sample number of 200 quadrants using equipment assistance in the form of quadrant size 1 m X 1 m, GPS (*Global Positioning System*), digital camera, roll meter, tropical forage book, machete, scissors, large plastic, label paper, newspapers and stationery writing and materials used in the form of natural feed vegetation contained at the research site.

Calculations to analyze the vegetation of weeds that grow dominantly used *summed dominance ratio* that can describe the dominance of weeds in mastering the means of growing from the magnitude of absolute density (AD), absolute frequency (AF), relative density (RD), relative frequency (RF), and important value (IV). If the *summed dominance ratio* value of a weed was high, the dominance of the weed was high, on the contrary, if the *summed dominance ratio* value of a weed was low, the dominance was low. More details of *summed dominance ratio* formula are as follows [28].

1) Absolute Density

$$AD = \frac{\text{Number of One Type of Weed}}{\text{Area}}$$

2) Nisbi Density:

$$RD = \frac{\text{Absolute Density of One Type of Weed}}{\text{Total Absolute Density of All Types of Weeds}} \times 100$$

3) Absolute Frequency (AF) :

$$AF = \frac{\text{Number of tiles of one type}}{\text{Sum Of All Tiles}}$$

4) Nisbi Frequency (NF)

$$RF = \frac{\text{Absolute Frequency of One Type of Weed}}{\text{Total Absolute Frequency of All Types of Weeds}} \times 100$$

5) Important value (IV) :

Nisbi Density + Nisbi Frequency

6) *Summed Dominance Ratio* (SDR):

$$SDR = \frac{\text{Important Value}}{2}$$

After identifying the type of forage in the area of oil palm plantations, it was calculated the area of harvest for each type of forage so that it can be known the capacity of livestock for each type of forage rill. It was done to give a clear picture that the location of oil palm plantations in Watubangga Subdistrict has a potential to be an integrated beef cattle development area of oil palm plantations. The calculation of livestock capacity is determined by assuming one unit of cattle worth the weight of cattle ± 250 kg and the daily consumption of dry material is 2.5% of body weight. In addition, the value of *Proper Use Factor* (PUF) is also used as a correction factor in the determination of livestock carrying capacity. Summit value can be calculated with the following formula:

$$\text{Carrying Capacity} = \frac{\text{Dry Material Production (kg/year)}}{\text{Dry Material Needs of livestock units (kg/year)}}$$

3. RESULTS AND DISCUSSIONS

Oil palm plantations in Watubangga subdistrict at the age of 7 years give dominance of different forage both in quadrants 1 to 200. This is influenced by the intensity of rain sunlight and weather conditions that enter the plantation plants or soil surface as a means of growing forage, in addition the type of forage at the time of the implementation of the study grows evenly because it is influenced by the intensity of rain. The results showed that there are 24 types of forage that can be consumed or cannot be consumed by livestock, more clearly *summed dominance ratio* at the research site presented in Table 1.

The identification of forage species in oil palm plantation areas aged 7 years old has the dominant

Table 1. Summed Dominance Ratio Forage in oil palm plantation areas

NO	Forage Type	Summed Dominance Ratio					
		AD	ND	AF	NF	IV	SDR (%)
1	*Eleusine indica* (L.) Gaertn	98	11.72	80	9.57	21.29	10.65
2	*Axonopus compresus* (SW.) P. Beauv.	63	7.54	80	0.01	7.54	3.77
3	*Brachiaria mutica (Forsk.) Stapf*	42	5.02	60	0.60	5.62	2.81
4	*Imperata cylindrical*	22	2.63	60	0.31	0.00	2.95
5	*Ischaemum muticum (L.)*	30	3.59	60	0.43	4.02	2.01
6	*Cyrtococcum accrencens*	51	6.10	60	0.73	6.83	3.42
7	*Digitaria cilliaris*	63	7.54	80	0.90	8.44	4.22
8	*Ischaemum timorense kunth*	29	3.47	40	0.41	3.88	1.94
10	*Cyperus rotundus (L.)*	34	4.07	60	0.49	4.55	2.28
11	*Scleria sumatrensis*	21	2.51	60	0.30	2.81	1.41
12	*Cyperus distans*	7	0.84	20	0.10	0.94	0.47
13	*Cyperus kylingia*	33	3.95	80	0.47	4.42	2.21
14	*Davilia denticulate*	14	1.67	40	0.20	1.87	0.94
15	*Borreria latifolia*	29	3.47	60	0.41	3.88	1.94
16	*Stachytarpheta indica*	19	2.27	40	0.27	2.54	1.27
17	*Asplenium platyneuron*	6	0.72	20	0.09	0.80	0.40
18	*Ageratum conyzoides*	22	2.63	40	0.31	2.95	1.47
19	*Chromolaena odorata*	23	2.75	80	0.33	3.08	1.54
20	*Clidemia hirta*	27	3.23	20	0.39	3.62	1.81
21	*Mimosa pudica*	27	3.23	40	0.39	3.62	1.81
22	*Calopogonium mucunoides*	65	7.78	60	0.93	8.71	4.35
23	*Alysicarpus vaginalis (L.) DC.*	63	7.54	60	0.90	8.44	4.22
24	*Dismodium triflorum (L.) DC.*	38	4.55	80	0.54	5.09	2.54
TOTAL		826					61.09

Source: Research Data Analysis, 2021.
Information: Absolute density (AD), Absolute frequency (AF), Relative density (RD), Relative frequency (RF), and Important value (IV), SDR (*Summed Dominance Ratio*)

variation in different growing facilities. *Eleusine indica* (L.) Gaertn is a type of forage that dominates the area of oil palm plantations aged 7 years old with *Summed Dominance Ratio* 10.65%, while for plants in the form of *Axonopus compresus* (SW.) P. Beauv 3.77%, Brachiaria mutica (Forsk.) Stapf 2.81%, *Digitaria cilliaris* 4.22%, *Calopogonium mucunoides* 4.35%, and *Alysicarpus vaginalis* (L.) DC. 4.22%. Each type of plant or forage identification results in plantation area varies with a total *Summed Dominance Ratio* of 61.09%. Plant diversity in plantation areas ranges from 2 to 32 species, with the percentage of land cover of each species in the region ranging from 10% to 90% [20]. Vegetation in oil palm plantations aged 7, 10 and 14 years as many as 42 types for each age of palm plants include grasses, legumes and nail nails [21].

The diversity of forage species on oil palm plantations in Rambah Subdistrict, Rokan Hulu, is found 17 families and 40 species of weeds. Density values range from 0.01-14.15, relative density 1.1-70.38, frequency 0.08-1.00, relative frequency 0.59%- 7.10%, important value 0.59%-76.89% [22]. Based on palm oil plantation area, there are 39 types of weeds, the four dominant types of weeds are *Ottochloa nodosa*, *Paspalum conjugatum*, *Muccuna Bracteata*, and *Cyperus killingia* as the most dominant weeds with *summed dominance ratio* above 10% [23]. Based on the types of forage that have been identified, there are several types that can be consumed by livestock including *Elausine indica* (L) Gaertn, *Axonopus compresus (SW)* P. Beauv, *Braehiaria mutica (Forsk.) Stapf*, *Ischaemum muticum (L)*, *Cyrtococcum acerencens*, *Digitaria Cilliaris*, *Ischaemum timorense kunth*, *Imperata cylindrical*, *Cyperus rotundus L.*, *Cyperus kyllingia*, *Alysicarpus vaginalis (L.) DC.*,

Table 2. Area of Harvest forage Animal Feed by Type

No	Forage Type	*Summed Dominance Ratio* (%)	Area of Oil Palm Plantation (ha)	Forage harvesting area (ha)
1	*Elausine indica (L)* Gaertn	10.65	738	78.60
2	*Axonopus compresus (SW)* P. Beauv	3.77	738	27.82
3	*Braehiaria mutica (Forsk.)* Stapf	2.81	738	20.74
4	*Ischaemum muticum (L)*	2.34	738	17.25
5	*Cyrtococcum acerencens*	3.42	738	25.24
6	*Digitaria Cilliaris*	4.22	738	31.14
7	*Ischaemum timorense kunth*	1.94	738	14.32
8	*Imperata cylindrical*	2.95	738	21.77
9	*Cyperus rotundus L.*	2.28	738	16.83
10	*Cyperus kyllingia*	2.21	738	16.31
11	*Alysicarpus vaginalis (L.) DC.*	4.22	738	31.14
12	*Calopogonium mucunoides*	4.35	738	32.10
13	*Dismodium triflorum (L.) DC.*	2.12	738	15.68
Total		47.28		348.94

Source**:** Research Data Analysis, 2021.

Calopogonium mucunoides and *Dismodium triflorum (L.) DC.* Forage that can be consumed has a different area, so for in its use as a source of feed can be clearly known. The area of harvesting forage for animal feed at the research site is presented on Table 2.

The results of the identification and analysis of some forage are clearly seen that forage in the area of oil palm plantations aged 7 years has a difference, such as forage *Elausine indica* (L) Gaertn with *summed dominance ratio* of 10.65 has a harvest area of 78.60 hectares with an area of oil palm plantations of 738 hectares. This is also different from the forage type in the form of *Axonopus compresus* (SW) P. Beauv with *summed dominance ratio* of 3.77% which has a harvest area of 27.82 hectares. The difference between each species of plants is influenced by the intensity of light and the foothold of beef cattle in seeking feed in oil palm plantations. Overall, for the harvesting area of forage livestock food covers an area of 348.94 hectares with a *summed dominance ratio* of 47.28% of the total plantation area of 738 hectares.

The potential utilization of forage in between palm trees is an opportunity in tackling the lack of animal feed. The age of palm oil 7 years old provides a diverse source of forage so as to contribute to the management of weeds in plantation areas, to restore soil nutrients through livestock feces and as labor at the time of harvesting palm. The provision of animal feed has become a major issue in the development of livestock areas so that with the presence of oil palm plantations with different areas in each region is able to answer the challenge because basically oil palm plantations produce waste for animal feed and forage on the sidelines of plantation crops. However, some areas of oil palm plantations in Indonesia have not been managed to the maximum for cattle development areas. One of efforts to develop beef cattle in oil palm plantations is to calculate the carrying capacity of forage in the area. The carrying capacity in question is the capacity of forage bins to support the development of beef cattle in terms of the availability of feed sources of forage origin. The capacity of livestock at the research site is presented in Table 3.

Dry material needs cattle category children 602.25 kg/year/tail or 1.65 kg/tail/day, heifers 3.6 kg/tail/day of the year 1,314 kg/tail/year and adult cows 7.5 kg/tail/day or in a year 2737.5 kg/tail/year [24]. The carrying capacity of livestock for the forage type *Elausine indica* (L) Gaertn 78.60 which is multiplied by 30% produces a harvest area of 23,579 hectares with a livestock carrying capacity for each hectare of 1.35 units of cattle, so that overall, the forage type *Elausine indica* (L) Gaertn is able to accommodate as many as 106.43 units of livestock assuming natural grass as much as 70% and 30% is a type of grass that cannot be consumed by livestock.

Meanwhile, the production of dry materials for natural grass is 6178 kg/ha/year, so for every hectare of forage *Elausine indica* (L) Gaertn is able to produce 485,572 fresh grasses and produce 3706 dry materials

Table 3. Livestock Carrying Capacity

Forage Type	Area of hectares	Area Harvest	Grass Production (kg/ha/year)	Consumption (kg/head/year)	Carrying Capacity /ha	Total Carrying Capacity
Elausine indica (L) Gaertn	78.60	23.579	485.572	2,737.5	1.35	106.43
Axonopus compresus (SW) P. Beauv	27.82	8.347	171.888	2,737.5	1.35	37.67
Braehiaria mutica (Forsk.) Stapf	20.74	6.221	128.118	2,737.5	1.35	28.08
Ischaemum muticum (L)	17.25	5.174	106.557	2,737.5	1.35	23.35
Cyrtococcum acerencens	25.24	7.572	155.930	2,737.5	1.35	34.18
Digitaria Cilliaris	31.14	9.343	192.405	2,737.5	1.35	42.17
Ischaemum timorense kunth	14.32	4.295	88.452	2,737.5	1.35	19.39
Imperata cylindical	21.77	6.531	134.501	2,737.5	0.23	4.91
Cyperus rotundus L.	16.83	5.048	103.953	2,737.5	1.35	22.78
Cyperus kyllingia	16.31	4.893	100.762	2,737.5	1.35	22.08
Alysicarpus vaginalis (L.) DC.	31.14	9.343	192.405	2,737.5	1.35	42.17
Calopogonium mucunoides	32.10	9.631	198.332	2,737.5	1.35	43.47
Dismodium triflorum (L.) DC.	15.68	4.704	96.873	2,737.5	1.35	21.23
Total	348.94	104.682	487.610			447.93

Source**:** Research Data Analysis, 2021.

for every one hectare. The calculation of carrying capacity is a real number of the results of research conducted at the research site, overall, the carrying capacity of livestock for forage species at the research site amounted to 447.93 units of livestock.

The area of oil palm plantations in Seluma Regency found 53 types of lower plants in all palm oil stands consisting of 46 genera and 29 families with carrying capacity aged 2, 7, and 15 years respectively 2.01, 1.37, and 0.76 LU/hectare/year [25]. One hectare of palm oil land can accommodate 3,73 units of livestock with a total available land area of 5,519 hectares and can accommodate 20,585.87 units of livestock [26]. *Eleusine indica (L.)* Gaertn harvest area of 15.41 hectares with a carrying capacity of *28.98* units of cattle, *Axonopus compresus (SW.)* P. Beauv in oil palm plantations can accommodate 32.47 units of cattle, *Brachiaria mutica (Forsk.)* Stapf is able to accommodate 16.56 units of cattle, *Imperata cylindrical* 22.77 units of cattle, *Ischaemum muticum (L.)* 16.56 units of cattle, *Cyrtococcum accrencens* 60.02 units of cattle, *Digitaria cilliaris* 16.56 units of cattle, *Ischaemum timorense kunth* 49.68 units of cattle, *Cyperus rotundus L.* 28.98 units of cattle, *Cyperus kylingia* 26.91 units of cattle, *Alysicarpus vaginalis* 55.89 units of cattle and *Desmodium triflorum* 20.70 units of cattle [27]. The utilization of forage in oil palm plantation areas is not currently widely applied so that between the plantation and farmers have not been established cooperation, the plantations receive benefits from farmers by utilizing livestock as weed controllers as well as fertilizer producers and farmers receive benefits from the availability of forage in plantation areas.

4. CONCLUSION

Oil palm plantation as a location for the development of beef cattle is an area that has a potential which is the availability of forage animal feed. This study concluded that of the 24 types of forage that dominate oil palm plantations aged 7 years there are 13 types of forage that can be consumed by livestock. Summed Dominance Ratio for 24 types of forage amounted to 61.09% and Summed Dominance Ratio for 13 green species that can be consumed by livestock is 47.28% with a harvest area of 348.94 hectares of total oil palm plantation area of 738 hectares and the carrying capacity of livestock of the 13 types of forage is 447.93 units of livestock.

AUTHORS' CONTRIBUTIONS

Natsir Sandiah (2021) describes the state-of-the-art in a very simple way. Syamsuddin (2021) adjusts the writing according to the template. Rahim Aka (2021) processes research data. La Ode Muh Munadi (2021) Corrects sentences and translates into English

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