Journal of Tropical Crop Science Vol. 9 No. 1, February 2022
www.j-tropical-crops.com

Forage Potential of Plant Species Found in Various Ecosystems in Musi Banyuasin Regency, South Sumatera, Indonesia

Putri Irene Kanny[A,C], M.A. Chozin[B], Edi Santosa[B], Dwi Guntoro[B], Sofyan Zaman[B], Suwarto[B], Ani Kurniawati[B]

[A] Department Agronomy and Horticulture Graduate School, Faculty of Agriculture, IPB University. Jl Meranti, Kampus IPB Darmaga, Bogor 16680, West Java, Indonesia.
[B] Department Agronomy and Horticulture, Faculty of Agriculture, IPB University. Jl Meranti Kampus IPB Darmaga, Bogor 16680, West Java, Indonesia.
[C] Department of Agrotechnology, Gunadarma University. Jl. Margonda Raya No 100, Depok 16424, Indonesia.

*Corresponding author; email: ma_chozin@yahoo.com

Abstract

Forage is an important component in sustainable smallholder livestock. The purpose of the study was to identify the diversity of natural plant species in various ecosystems, as well as their potential as forage. Based on our surveys of palm oil plantation, rubber plantation and home gardens using quadrant method, we identified approximately 50 species comprising the natural vegetation of our study area. Out of 50, we identified 39 broad-leaved species, 9 grasses (Poaceae) species, and 2 sedges (Cyperaceae) species. The palm oil plantation had 29 species dominated by *Ottochloa nodosa* (11.92%) and *Asystasia gangetica* (11.40%); 25 species were found in the rubber plantation dominated by *Cynodon dactylon* (28.42%) and *Panicum repens* (9.20%); and home gardens contained 30 species dominated by *Eleusine indica* (13.39%) and *Ageratum conyzoides* (9.60%). Among the 29 species found in the palm oil plantation, 13 were observed to have low palatability scores and 16 species have high palatability scores. Based on their high palatability scores, the following species that can be utilized as forage for Balinese cattle: *Cyrtococcum acrescens*, *Eleusine indica*, *Centrosema pubescens*, *Paspalum conjugatum*, and *Sida rhombifolia*.

Keywords: Balinese cattle, feed palatability, smallholder plantations

Introduction

One of the keys to success in the field station of Sekolah Peternakan Rakyat of IPB University (IPB Farming School; SL-SPR-IPB) as a model for empowering smallholder cattle farming is the availability of sustainable feed, particularly during the extreme dry season, which is attributed to the impact of climate change (LPPM-IPB, 2015). The dry season may reduce the quality and quantity of animal feed. Thus, it affects the production and reproductive phase of cattle (Manu, 2013). The adequacy of feed during the dry season and the availability of land as a competitive provider of animal feed are strategies for developing smallholder livestock farming (Sandi et al., 2018; Purnomo et al., 2017).

The availability of forage in smallholder livestock areas may come from natural vegetation sources in plantation ecosystems, local feed production with intercropping patterns and crop-livestock systems, as well as from areas that have the potential to provide feed with plant cultivation (Ramdani et al., 2017; Diwyanto, 2008). The provision of forage for livestock in smallholder livestock areas is still using a partially managed feed supply and utilization system. Some of which are still sourced from local feed production derived from vegetation in the home gardens or vegetation under the ecosystem of oil palm and rubber plantations where the production is strongly influenced by the seasons.

According to Jehemat et al. (2018), to realize an increase and supply of sustainable feed in the production of smallholder cattle farming, an integrated system is needed to ensure low feed prices and ease in providing quality feed. Moreover, cattle fattening to stimulate an increase in cattle population, healthy cattle conditions, proper management, types of feed crop suitable for regional conditions and abundant feed that is not susceptible to climate change (Naikofi et al., 2019; Otampi et al., 2017). The aim of this study

was to obtain preliminary information on the diversity of natural plant species in various ecosystems, as well as their potential as forage based on feed palatability. This information is important as a first step towards developing the integration of food-feed crops and dynamic model-based sustainable feed logistic system within the oil palm ecosystem in smallholder livestock areas.

Material and Methods

Experimental Site

The study was carried out in the Sekolah Peternakan Rakyat area of Sungai Lilin, located in Cinta Damai Village, Sungai Lilin Sub-district, Musi Banyuasin Regency, South Sumatra Province, from September-December 2020. The laboratory study was conducted at The Research Center for Agricultural Technology (BPTP) in Indonesian Agency for Agricultural Research and Development, South Sumatra, Indonesia. The site had altitude 42 m above sea level (2°26'48.7"S 103°54'12.9"E) with rainfall 2000-2200 mm per year. The study sites were the ecosystems of smallholder oil palm plantations, smallholder rubber plantations, and home gardens.

Vegetation Analysis

Vegetation surveys involving oil palm plantations, rubber plantations, and home gardens were carried using 1 m x 1 m quadrants randomly placed, with a total of 12 plots in each observation area. The determination key of plantation plants and direct consultation with the botanist are used to identify plant vegetations. Observations were performed on 2 ha areas per experimental unit to determine the summed dominance ratio (SDR) and diversity index of plant vegetation. Data were analyzed by calculating density (K), relative density (KR), frequency (F), relative frequency (FR) (Kainde et al., 2011), Summed Dominance Ratio (SDR) (Mueller-Dombois and Ellenberg, 1974) and similarity index Bray-Curtis (Ludwig and Reynolds, 1988).

Qualitative Palatability

A qualitative palatability evaluation of cattle was done to 30 random respondents of cattle's farmers. Data collecting methods included direct observation, interviews, and a questionnaires list. Respondents were representatives from each hamlet in Cinta Damai Village who owns cattle for at least one year and collect forage for their cattle independently, members of the SPR at least one year, male or female, and aged 18 to 50 years. The determination of the score and degree of palatability was conducted using the modified method of Bergen and Bates (1984).

Plant Dry Weight Analysis

Dry weight analysis was conducted for plant samples identified by previously interviewed cattle's farmers. These samples were collected in foraging locations specified by the respondents. The feed samples included up to 10 species that were identified by cattle's farmers as favored by livestock. For each plant species, about 200 g samples were obtained. These sample were then replicated three times for a total of 30 experimental units, and placed in an oven at 80°C for 24 hours. Dry weight data were analyzed using SAS Software version 9.4. If the difference in dry weight between species was significant, the Tukey's Honestly Significant level of 5% was used to examine the differences between species.

Result and Discussion

Vegetation Survey

The availability of animal feed is a determining factor in the development of livestock. Feed is the component that contributes the most to livestock production costs (60-70%) and has a direct effect on livestock production, productivity and health. Based on our vegetation surveys in locations where cattle's farmers usually take their cattle for forage, places, such as oil palm plantations, rubber plantations, and home gardens ecosystems showed high species diversity (Table 1). Among the three, home garden ecosystems showed the highest diversity with 30 species identified, followed by oil palm plantations aged 2 years with 29 species of plants, and rubber plantations came last with 25 species of plants observed. The difference in diversity could be due to different ecosystem characters and the different adaptability of plants. Several studies show that in oil palm plantations, there are usually 17 to 56 plant species found (Suryana et al., 2019; Ramdani et al., 2017; Adriadi et al., 2012). Rubber plantations were shown to have 20 to 29 plant species in some studies (Novalinda et al., 2014; Sari and Rahayu, 2013), while the plant species recorded from home gardens ranged from 13 to 61 (Antoh et al., 2019; Feriatin 2017; Andriansyah et al., 2015).

The species with wide adaptation, such as *Asystasia gangetica*, *Ageratum conyzoides, Borreria laevis*, *Paspalum cunjugatum*, and *Cyperus rotundus* L., can grow in palm oil and rubber plantations, and home gardens at a high frequency value or a faster rate. *Phyllanthus niruri* was rarely found in all three locations.

Perennial weeds, such as *Imperata cylindrica*, *Hyptis brevipes*, *Lantana camara*, *Ludwigia peruviana*, and *Andropogon aciculatus,* were only found in poorly maintained smallholder rubber plantations.

Dominant Plant Species in Various Ecosystems

In the 2-year-old oil palm ecosystems studied, the dominant plant species included *Ottochloa nodosa*, *Asystasia gangetica*, and *Mucuna bracteata*, with SDR values of 11.92%, 11.4%, and 8.96%, respectively. The first species is classified as a grasses (Poaceae) while the last two are classified as the broad-leaved species. The species of vegetation that grow on oil palm plantations are natural vegetations or are intentionally planted as legume cover crop (LCC) on plasma plantations. Plasma plantations are smallholdings that have been maintained and managed by enterprises since they were planted to produce (Syahza and Asmit, 2018). Private oil palm plant company such as PT. Hindoli Plantation and Factory of Cargill's company located closed to the people's cattle livestock has a naturally plant growth condition. *Mucuna* included in the LCC is weed-controlling and erosion-prevention plant that grows swiftly to cover the soil. *Asystasia* is a common highly adaptable weed in plantations in various habitats that can grow quickly and thrive in 90% of shady place

Table 1. Distribution of various plant species in the oil palm, rubber plantations and home garden in Cinta Damai Village, Sungai Lilin Sub-district, Musi Banyuasin Regency

No	Species	Oil palm	Rubber	Home gardens	No	Species	Oil palm	Rubber	Home gardens
	Broad-leaved					**Broad-leaved**			
1	*Ageratum conyzoides*	√	√	√	28	*Mimulus spp.*		√	
2	*Asystasia gangetica*	√	√	√	29	*Mimosa pudica*	√		√
3	*Borreria laevis*	√	√	√	30	*Mucuna bracteata*	√		√
4	*Borreria latifolia*	√	√		31	*Nephrolepis bisserata*		√	
5	*Calyptocarpus vialis*			√	32	*Nephrolepis cordifolia*		√	
6	*Centrosema pubescens*	√		√	33	*Passiflora edulis*	√		
7	*Chromolaena odorata*	√			34	*Phyllanthus niruri*	√	√	√
8	*Clidemia hirta*		√		35	*Physalis angulata*	√		√
9	*Cleome rutidosperma*	√	√		36	*Sauropus androgynus*		√	
10	*Commelina diffusa*			√	37	*Sida rhombifolia*	√	√	√
11	*Cyanthillium cinereum*			√	38	*Stachytarpheta indica*	√		√
12	*Davallia denticulata*		√		39	*Urtica dioica*			√
13	*Diodia sarmentosa*	√				**Grasses (Poaceae)**			
14	*Dicranopteris linearis*		√		1	*Ottochloa nodosa*	√	√	
15	*Elephantopus scaber*			√	2	*Paspalum conjugatum*	√	√	√
16	*Euphorbia heterophylla*			√	3	*Cyrtococcum acrescens*	√		
17	*Euphorbia hirta*	√		√	4	*Agrostis stolonifera*	√	√	
18	*Hedyotis corymbosa*	√		√	5	*Axonopus compressus*	√	√	√
19	*Hyptis brevipes*	√		√	6	*Cynodon dactylon*		√	√
20	*Imperata cylindrica*			√	7	*Panicum repens*		√	
21	*Lantana camara*			√	8	*Eleusine indica*			√
22	*Ludwigia octovalvis*			√	9	*Andropogon aciculatus*			√
23	*Ludwigia peruviana*			√		**Sedges (Cyperaceae)**			
24	*Lycopodium cernuum*		√		1	*Cyperus kyllingia*	√	√	
25	*Lygodium flexuosum*	√	√		2	*Cyperus rotundus*	√	√	√
26	*Melastoma affine*		√	√		Total species	29	25	30
27	*Mikania micrantha*	√							

Note √ = *found*

(Asbur et al., 2016).

Based on the SDR value, the dominant vegetation species in rubber plantations were *Cynodon dactylon* (28.42%) and *Panicum repens* (9.20%) which are classified as grasses (Poaceae). According to its distribution, *Cynodon dactylon* was found in rubber plantations and home gardens, while *Panicum repens* was only found in rubber plantations (Table 1). Grasses, such as *Cynodon dactylon* and *Panicum repens* are often used as animal feed (Kumalasari et al., 2020; Umami et al., 2016). The greatest number of species was observed in the home gardens vegetation near the settlement area (Table 1). *Eleusine indica* (13.39%) and *Ageratum conyzoides* (9.60%) were the leading species in open area situation (Table 2). *Eleusine indica* was often found in the open and widely used for livestock feed material (Syarifuddin, 2011). Extracts from *Ageratum* are extensively used in animal feed diets (Hapsari et al., 2018; Melani et al., 2018). Efforts to improve the quality and quantity of plant species, including genetic diversity, historical data, advantages, and plant adaptability to the local environment are all considered (Maretta et al., 2020).

Botanical Composition and Similarity Index

The results of the vegetation analysis showed that the botanical composition in the various survey locations was heterogeneous (Table 3). Vegetation under 2-year old unproductive oil palm plantations consisted of 22 species (76%) of broad-leaved plants and dicotyledons, 5 species of grasses (Poaceae) (17%) and 2 species of sedges (Cyperaceae) (7%). Furthermore, the rubber plantation ecosystem that has reproduced had relatively lower composition of broad-leaved species vegetation, yet it had 6 species of grasses (24%). The most dominant vegetation species were found in the home gardens ecosystem, with 30 species. The similarity indices or community coefficients for oil palm plantations, rubber plantations and home gardens were 29.81%, 28.97% and 31.56%, respectively (Table 3). According to Nurjaman et al. (2017), the composition of vegetation that has a similarity value of <50% indicates that there are differences in the species of community constituents, however, it is possible to have similar species.

Table 2. Average value of the Summed Dominance Ratio (SDR) of vegetation species in the ecosystem of oil palm plantations, rubber plantations and house yards in Cinta Damai Village, Sungai Lilin Sub-district, Musi Banyuasin Regency

No.	Species	SDR (%)		
		Oil palm plantations	Rubber plantations	Home gardens
	Broad-leaved			
1	*Asystasia gangetica*	11.40	5.87	-
2	*Sida rhombifolia*	-	5.52	7.80
3	*Cleome rutidosperma*	7.99	-	-
4	*Borerria latifolia*	5.25	-	-
5	*Euphorbia hirta*	-	-	-
6	*Centosema pubescens*	7.75	-	6.10
7	*Mucuna bracteata*	8.96	-	-
8	*Clidemia hirta*	-	6.52	-
9	*Ageratum conyzoides*	-	-	9.60
	Grasses (Poaceae)			
1	*Ottochloa nodosa*	11.92	-	-
2	*Cynodon dactylon*	-	28.42	-
3	*Panicum repens*	-	9.20	-
4	*Eleusine indica*	-	-	13.39
5	*Paspalum conjugatum*	-	-	5.84
	Sedges (Cyperaceae)			
1	*Cyperus rotundus*	5.54		6.22
	Other species	*	*	*

Note: - not found or has a DR value < 5% *Various other species with SDR value < 5% each. SDR is the dominance of weed species in a community is expressed as a percentage.

Table 3. Vegetation similarity index in oil palm plantations, rubber plantations and home gardens in Cinta Damai village, Sungai Lilin Sub-district, Musi Banyuasin Regency

Species group	Oil Palm plantations	Rubber plantations	The Home gardens
Broad-leaved	22 (76%)	17 (68%)	24 (80%)
Grasses (Poaceae)	5 (17%)	6 (24%)	5 (17%)
Sedge (Cyperaceae)	2 (7%)	2 (8%)	1 (3%)
Total	29 (100%)	25 (100%)	30 (100%)
Index of Similarity (%)	29.81	28.97	31.56

Note: Numbers in brackets indicate the percentage of the number of species in one ecosystem

Potential of Natural Vegetation As Cattle Feed

The results of this study indicate that the degree of palatability for cattle to the species of vegetation varied starting from the species of feed that was not preferred to the species of feed that was highly preferred. The distribution of vegetation species based on the palatability evaluation is presented in Figure 1. The preferred and highly preferred vegetation species (16 species) were more numerous than those that were less and disliked (13 species). Some vegetation species disliked by cattle with scores lower than 2.0 were *Mikania micrantha*, *Phyllanthus niruri*, and *Saurous androgynus*. According to respondents, the forage has several characteristics disliked by Balinese cattle, such as a sharp aroma, tough stems. Balinese cattle tend to like young forage which has not yet flowered. According to Saking and Qomariyah (2017), the low score of palatability evaluation of forage can be caused by a sharp aroma of the forage itself.

A total of 29 vegetation species were found in oil palm plantations, where three species were highly preferred with a score of 4.0, namely *Asystasia gangetica*, *Eleusine indica*, and *Cyrtococcum acrescens* (Table 4). *Eleusine indica* and *Cyrtococcum acrescens* are classified as grasses (Poaceae). The other 13 species were species that are preferred and have the potential to be used as forage for cattle (Table 4). *Cyrtococcum patens* and *Cyrtococcum acrescens* are species found in the oil palm-cattle integration area and are highly preferred feed for cattle but are very rarely found (Rostini et al., 2020). According to the findings of other studies, forages such as *Centrosema pubescens* and *Sida rhombifolia* were among the preferred feed alternatives for cattle (Pasaribu and Pratiwi, 2014; Zulfiani et al., 2013).

Potential of Several Plant Species as Cattle Feed

The dry matter composition of species of plants favored by animals from oil palm farms varied, according to the findings of our study. The highest dry weight biomass content was obtained from *Mimosa pudica* (38.6g), *Sida rhombifolia* from the broad-leaved group, and *Cyrtococcum acrescens* (30.4g) from the grass group (Table 5). Although widely preferred, *Asystasia gangetica* obtained low dry matter of 18.8g (Table 4). Susetyo (1980) stated that a desirable dry matter content for livestock feed material is 15–30%. These findings reveal that grasses in people's livestock regions has high dry matter content, but the availability largely depends on the seasonal condition. Reduced livestock feed

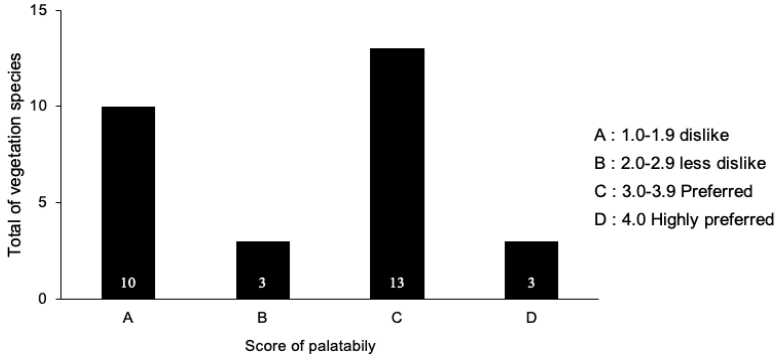

Figure 1. The number of plant species in oil palm plantation ecosystem that are preferred or not preferred (based on palatability) by cattle in Sungai Lilin Sub-district, Musi Banyuasin Regency

Table 4. Vegetation species preferred by cattle based on cattle's farmers assessments in Cinta Damai village, Sungai Lilin Sub-district, Musi Banyuasin Regency

No	Species	The Average score
	Broad-leaved	
1	*Asystasia gangetica*	4.0 (0.0)
2	*Centrosema pubescens*	3.9 (0.4)
3	*Mucuna bracteata*	3.9 (0.4)
4	*Mimosa pudica*	3.8 (0.4)
5	*Sida rhombifolia*	3.7 (0.4)
6	*Borerria latifolia*	3.7 (0.5)
7	*Leucaena glauca*	3.7 (0.9)
	Grasses (Poaceae)	
1	*Eleusine indica*	4.0 (0.0)
2	*Cyrtococcum acrescens*	4.0 (0.0)
3	*Paspalum conjugatum*	3.8 (0.6)
4	*Axonopus compressus*	3.6 (0.8)
5	*Cynodon dactylon*	3.1 (0.9)
6	*Agrostis stolonifera*	3.1 (1.3)
7	*Panicum repens*	3.1 (1.2)
	Sedges (Cyperaceae)	
1	*Cyperus rotundus*	3.7 (0.5)
2	*Cyperus kyllinga*	3.1 (1.3)

Note: Values in brackets indicate the standard deviation

Table 5. The dry weight of species found in the oil palm plantation favored by Balinese cattle in Cinta Damai Village, Sungai Lilin Sub-district, Musi Banyuasin Regency

No.	Species	Dry Weight (g)
	Broad-leaved	
1	*Mimosa pudica*	38.6 a
2	*Sida rhombifolia*	34.1 b
3	*Centrosema pubescens*	27.9 cd
4	*Asystasia gangetica*	18.8 e
5	*Borreria latifolia*	13.8 f
6	*Mucuna bracteata*	25.7 b
	Grasses (Poaceae)	
1	*Eleusine indica*	20.1 e
2	*Paspalum conjugatum*	21.3 e
3	*Cyrtococcum acrescens*	30.4 bc
	Sedges (Cyperaceae)	
1	*Cyperus rotundus*	25.5 d

Note: Numbers in the column followed by letters are not significantly different at 5% level based on the Tukey's test.

material forage during the dry season can adversely affect the livestock production. Dry season may cause mature cattle's weight to drop by 25%, or 0.15-0.27 kg per day, followed by the increased calf mortality (Bamualim, 2011). Consequently, the drought-tolerant or adaptive plant species assistance, such as sorghum, hanjeli, or other species of cereals in people's livestock lands are required during the dry season (Sutrisna et al., 2013; Qosim and Nurmala, 2011). According to local government data, natural vegetation studies have been carried out on oil palm plantations. Data collection activities from various locations in all ecosystems could provide various alternatives of animal feeds to breeders.

Conclusion

The smallholder livestock area, located in Cinta Damai Village, Sungai Lilin Sub-District, Musi Banyuasin Regency, South Sumatra Province, Indonesia, has 50 species of natural vegetation consisting of 39 species of broad-leaved plants, 9 species of grasses (Poaceae) and 2 species of sedges (Cyperaceae). The ecosystems commonly used by breeders to collect forage were smallholder oil palm plantations, smallholder rubber plantations and home gardens which usually contain 29, 25 and 30 species of potential forage plants, respectively. Among the 29 species found in oil palm plantations, 13 of them were disliked, and 16 were classified as preferred and highly preferred by Balinese cattle. The following species might be used as feed crops for Balinese cattle due to their high palatability scores; *Cyrtococcum acrescens, Eleusine indica, Centrosema pubescens, Paspalum conjugatum,* and *Sida rhombifolia*

Acknowledgement

The authors thank the Ministry of Research and Technology/BRIN for funding this research project under the PTUPT scheme in 2019-2020 (contract number: 4211/IT3.L1/PN/2020), Mr. Wagiman and other SPR Guardians of Maju Bersama, Sungai Lilin, for their assistance throughout this study.

References

Adriadi, A., Chairul., and Solfiyeni. (2012). Vegetation analysis of weed in palm oil plantation (*Elaeis quineensis* Jacq.) in Kilangan, Muaro Bulian, Batang Hari. *Journal Biologi Universitas Andalas* **1**, 108-115. DOI: https://doi.org/10.25077/jbioua.1.2.%25p.2012

Andriansyah, S.N., Lovadi, I., and Linda, R. (2015). The diversity of crop in the village Antibar, Mempawah Timur, Mempawah. *Protobiont* **4**, 226-235.

Antoh, A.A., Arifin, N.H.S., Chozin, M.A., and Arifin, H.S. (2019). Short Communication: Agriculture biodiversity and economic productivity of the yards in Arguni Bawah, Kaimana District, West Papua Province, Indonesia. *Biodiversitas* **20**, 1020-1026.

Asbur, Y., Yahya, S., Murtilaksono., Sudradjat., and Sutarta, E.S. (2016). The roles *Asystasia gangetica* (L.) Anderson and ridge terrace in reducing soil erosion and nutrient losses in oil palm plantation in South Lampung, Indonesia. *Journal of Tropical Crop Science* **3**, 49-55.

Bamualim, A.M. (2011). Development of beef cattle feed technology in semi-arid area of Nusa Tenggara. *Pengembangan Inovasi Pertanian* **4**, 175-188.

Bergen, W.G., and Bates, D.B. (1984). Ionophores: their effect on production efficiency and mode of action. *Journal Animal Science* **58**, 1465-1483.

Diwyanto, K. (2008). Local resource ultilization and technological innovations in support the development of the beef cettle in Indonesia. *Pengembangan Inovasi Pertanian* **1**, 173−188.

Feriatin. (2017). The diversity of garden plants and their utilization for supporting food security the sub district of South Wakorumba. *Jurnal Ilmu Pertanian Indonesia* **22**, 99-107. DOI**:** https://doi.org/10.18343/jipi.22.2.99

Jehemat, A., Kantur, D., and Ranta, F. (2018). Agricultural waste capacity on the availability of fodder in the application of any system of farming base plants and integrated cattle in the village Fatuknutu, Amabi Oefeto, Kupang. *Partner* **23**, 601-610.

Hapsari, N.S., Harjanti, D.W., and Muktiani, A. (2018). Fermentability of feed supplemented with Ageratum conyzoides leaves and Zingiber officinale extracts on in vitro dairy cow. *Journal Agripet* **18**, 1-9.

Kainde, R.P., Ratag, S.P., Tasirin, J.S., and Faryanti, D. (2011). Vegetation analysis of the Mount Tumpa protection forest. *Eugenia* **17**, 1-11.

[LPPM-IPB] Lembaga Penelitian dan Pengabdian kepada Masyarakat-Institut Pertanian Bogor. (2015). Guide book: Sekolah Peternakan Rakyat (SPR-1111). LPPM-IPB Bogor, Indonesia.

Ludwig, J.A., and Reynolds, J.F. (1988) Statistical Ecology. John Wiley and Sons, New York.

Manu, A.E. (2013). Productivity of West Timor Sabana shadower. *Pastura* **3**, 25-29.

Maretta, D., Sobir., Helianti, I., Purwono., and Santosa, E. (2020). Genetic diversity in eddoe taro (*Colocasia esculenta* var. antiquorum) from Indonesia based on morphological and nutritional characteristics. *Biodiversitas* **21**, 3525-3533.

Melani, A., Harjanti, D.W., and Muktiani, A. (2018). Evaluation of *Ageratum conyzoides* and *Zingiber officinale* leaf extracts on nutrient digestibility in dairy cows. *Agromedia* **13**, 106-113.

Mueller-Dombois, D., and Ellenberg, H. (1974). "Aims and Methods of Vegetation Ecology". Wiley and Sons, New York.

Naikofi, I., Wijayanto, N., and Fuah, A.M. (2019). Silvopastur carrying capacity of in sub-district of North Timor Taraah District Nusa Tenggara Timur. *Jurnal Ilmu Produksi Teknologi Hasil Peternakan* **7**, 62-66. DOI: https://doi.org/10.29244/jipthp.7.2.62-66

Novalinda, R., Syam, Z., and Solfiyeni. (2014). Vegetation analysis of weeds at rubber plantation (*Hevea brasiliensis* Mull.Arg.) at Batang Kapas, Pesisir Selatan. *Jurnal Bio Universitas Andalas* **3**, 129-134.

Nurjaman, D., Kusmoro, J., and Santoso, P. (2017). Comparison of vegetation structure and composition of Rajamantri and Batumeja areas in Pananjung Pangandaran nature reserve, West Java. *Jurnal Biodjati* **2**, 167-179. DOI: https://doi.org/10.15575/biodjati.v2i2.1304 [August 22, 2021]

Otampi, R.S., Elly, F.H., Manese, M.A., and Lenzun, G.D. (2017). Influence of feed price and labor wage to profit of cattle farming in Wineru Village East Likupang Sub District North Minahasa Regency. *Zootec* **37**, 483-495.

Pasaribu, Y., and Pratiwi, I.I. (2014). Cart content of *Centrosema pubescens* dan *Capologonium mucunoides* in Wasur village. *Agricola* **4**, 33-40.

Ramdani, D., Abdullah, L., and Kumalasari, N.R. (2017). Analysis of local forage potential under ruminant - palm plantation integration system in Mandau District, Bengkalis Regency of Riau Province. *Buletin Makanan Ternak* **104**, 1-8.

Rostini, T., Djaya, S., and Adawiyah, R. (2020). Analysis of forage for livestock in integrated and non-integrated cow and palm plantation. *Jurnal Sains Peternakan Indonesia* **15**, 155-161. DOI: https://doi.org/10.31186/jspi.id.15.2.155-161 [August 22, 2021]

Saking, N., and Qomariyah, N. (2017). Identification of local forages supports beef cattle productivity in South Sulawesi. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner. Bogor, 08-09 August 2017. DOI: https://dx.doi.org/10.14334/Pros.Semnas.TPV-2017-p.558-565 [August 22, 2021]

Sandi, S., Desiarni, M., and Asmak. (2018). Beef cattle feed management in people's farms in Sejaro Sakti Village, Indralaya District, Ogan Ilir. *Jurnal Peternakan Sriwijaya* **7**, 21-29. DOI: https://doi.org/10.33230/JPS.7. 1.2018.7080 [August 20, 2021]

Sari, H.F.M., and Rahayu, S.S.B. (2013). Types of weeds found in rubber plantations (*Hevea brasiliensis* Roxb.) Rimbo Datar Village, District 50, city of West Sumatra. *Jurnal Ilmiah Biologi: Biogenesis* **1**, 28-32. DOI: https://doi.org/10.24252/bio.v1i1.444 [August 20, 2021]

Suryana., Chozin, M.A., and Guntoro, D. (2019). Species identification for cover crop on mature oil palm plantation. *Jurnal Agronomi Indonesia* **47**, 305-311. DOI: https://doi.org/10.24831/jai.v47i3.26980 [August 20, 2021]

Susetyo, S. (1980). "Natural Pastures". Departemen Ilmu Makanan Ternak, Fakultas Peternakan, IPB Bogor, Indonesia.

Sutrisna, N., Sunandar, N., and Zubair, A. (2013). Test adaptation several *Sorghum bicolor* L. on dryland in Ciamis, West Java. *Jurnal Lahan Suboptimal* **2**, 137-143.

Syahza, A., and Asmit B. (2018). Regional economic empowerment through oil palm economic

institutional development. *Management of Environmental* 30, 1477-7835. DOI: https://doi.org/10.1108/MEQ-02-2018-0036 [January 17, 2022].

Syarifuddin, H. (2011). Forage structure and composition under oil palm plantation. *Agrinak* **1**, 25-30.

Umami, N., Damayanti, E., Utomo, R., Suhartanto,B., Yusiati, L.M., Kustantinah., Hanim, C., Bachruddin, Z., and Muhlisin. (2016). Potential and production of forgive feed at Banyusoco agricultural land, Playen, Gunung Kidul *In* Prosiding Simposium Nasional Penelitian dan Pengembangan Peternakan Tropika 2016. Yogyakarta, 3 November 2016. https://repository.ugm.ac.id/273142/ [August 20, 2021]

Qosim, W.A., and Nurmala, T. (2011). Exploration, identification, and analysis of germplasm diversity of hanjeli (*Coix lacryma* jobi L.) as a source of fatty food ingredients in West Java. *Pangan* **2**, 365-376. DOI: https://doi.org/10.33964/jp.v20i4.181.

Zulfiani., Yuniati. E., and Pitopang, R. (2013). Ethnobotany study of the Kaili Tara tribe in Binangga Village, Parigi Tengah District, Parigi Moutong Regency, Central Sulawesi. *Jurnal Biocelebes* **7**, 67-74.