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Vegetation analysis of non-tidal swampland in South Sumatra, Indonesia and its carrying capacity for Pampangan buffalo pasture

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Abstract. *Muhakka, Suwignyo RA, Budianta D, Yakup. 2019. Vegetation analysis of non-tidal swampland in South Sumatra, Indonesia and its carrying capacity for Pampangan buffalo pasture. Biodiversitas 20: 1077-1086.* In Indonesia, non-tidal swampland area is 13.27 million ha, only 4 million ha has been developed with details of 2.6 million ha that managed by the public and the private sector and 1.3 million ha with government assistance. This study aims to analyze vegetation structure of non-tidal swampland in Pulau Layang Village, Ogan Komering Ilir District, South Sumatra, Indonesia and Rambutan Village, Banyuasin District, South Sumatra, Indonesia and to examine its carrying capacity for Pampangan buffalo pasture. Methods used were by the combination of direct observation, survey using plot sampling with total 50 observation plots, and measurements to determine forage production using Halls method. The results show that there 19 forage species were in two studied areas which are potential as Pampangan buffalo feed. Species with the highest Important Value Index were Purun tikus (*Eleocharis .dulcis*) with 89.71% and Kumpai padi (*Oryza. rufipogon*) with 54.08%. The production of fresh forage and dry matter in the wet season in Pulau Layang was 6.90 tons ha^{-1} $year^{-1}$ and 1.27 tons ha^{-1} $year^{-1}$, respectively, whereas in Rambutan they were 3.68 tons ha^{-1} $year^{-1}$ and 0.91 tons ha^{-1} $year^{-1}$, respectively. The production of fresh forage and dry matter in the dry season in Pulau Layang was 4.86 tons ha^{-1} $year^{-1}$ and 0.99 tons ha^{-1} $year^{-1}$, respectively, while in Rambutan they were 2.52 tons ha^{-1} $year^{-1}$ and 0,71 tons ha^{-1} $year^{-1}$, respectively. The pasture carrying capacity in Pulau Layang in the wet season was 3.66 AU (Animal Unit) ha^{-1} $year^{-1}$ and in the dry season, it was 2.85 AU ha^{-1} $year^{-1}$, while in Rambutan Village it was 2.61 AU ha^{-1} $year^{-1}$ and 2.04 AU ha^{-1} $year^{-1}$, respectively. There were six species of forage with high production, namely Kumpai tembaga (*Hymenachne acutigluma)* Kumpai padi *(Oryza rupifogon)*, Kumpai minyak *(Hymenachne amplexicaulis)*, Are bolong *(Polygonum barbatum L)*, Bento rayap *(Leersia hexandra)* and Purun tikus *(Eleocharis dulcis)*. It is estimated that there still can be added buffalo cattle as much as 0.31 AU ha^{-1} $year^{-1}$ in Pulau Layang Village so 155 buffaloes and 0.59 AU ha^{-1} $year^{-1}$ in Rambutan Village.709 buffaloes

Keywords: Pampangan buffalo, vegetation analysis, carrying capacity, pasture, non-tidal swampland

INTRODUCTION

Non-tidal swampland is often considered as suboptimal land despite its availability is very extensive in Indonesia. The total extent of non-tidal swampland is about 13.27 million ha, consisting of 3.0 million ha of deep swampland, 6.07 million ha of swampland with medium deep and 4.20 million ha of shallow swampland, and is distributed in Sumatra, Kalimantan, and Papua. Nonetheless, there is only 4 million ha of them have been developed with public and private sectors manage 2.60 million ha while 1.3 million ha are developed by government assistance (BPS 2010; Mulyani and Sarwani 2013). At provincial level, non-tidal swampland in South Sumatra covers the most extensive area in Sumatra, reaching 2.98 million ha but only 298,189 ha that has been developed (BPS 2014).

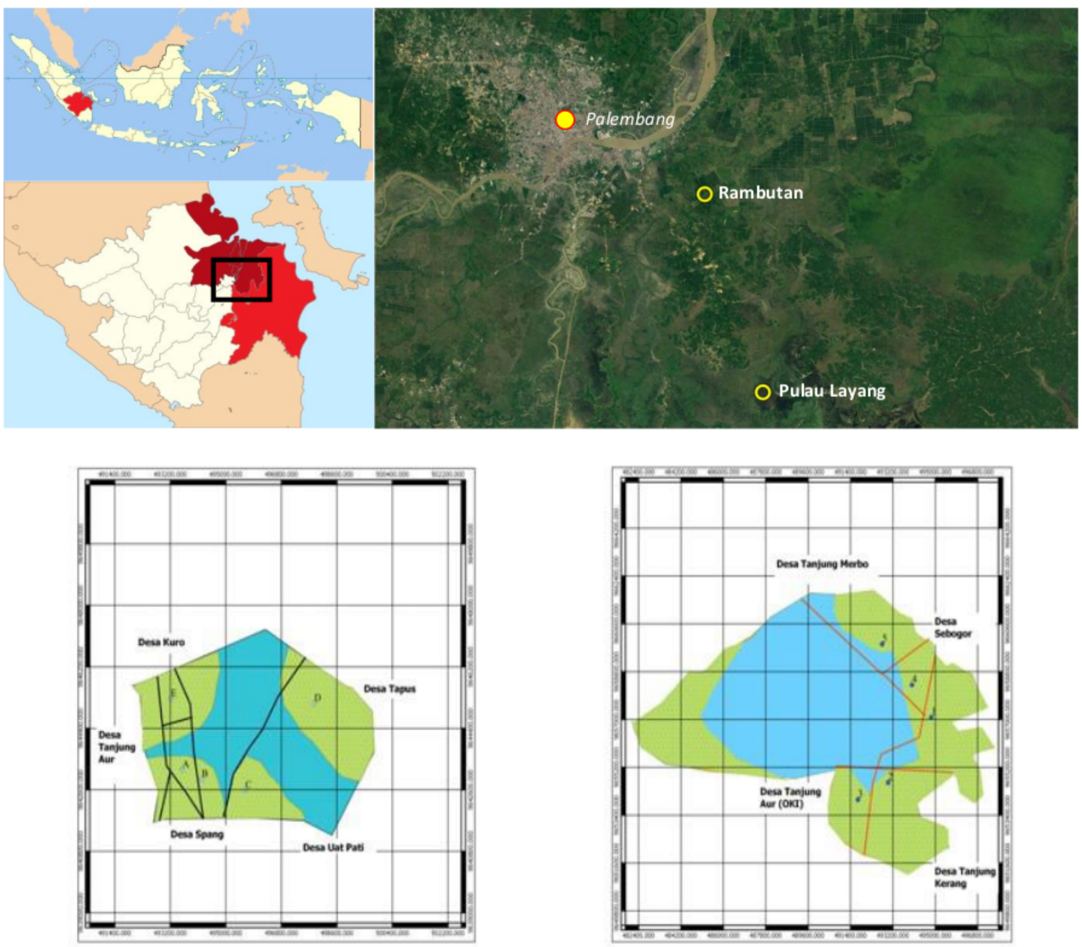
Pampangan buffalo is potential germplasm of South Sumatra Province which is widely found and extensively farmed in Pulau Layang Village, Ogan Komering Ilir District and Rambutan Village, Banyuasin District (Muhakka et al. 2013). In addition to being farmed for their meat, the buffalo also produce milk to be processed into traditional food named *Gulo Puan*. Buffalo population in South Sumatra in 2014 was 33,369 buffaloes, decreasing 4.29% than that in 2012 with 34,866 buffaloes (South Sumatra Province Animal Husbandry Office 2014). There are three factors causing the decline in the buffalo livestock population, namely: (i) fluctuated availability of natural forage, (ii) low quality of nutritional forage of lowland swamp, and (iii) decreasing extent of grazing pasture land (BPTP South Sumatra 2011). The low productivity of the buffaloes in term of growth and milk production is caused by the consumed rations could not meet the needs for food substances which characterized by low protein content, high crude fiber, and low digestibility. However, the buffaloes have several advantages and their productivity can be enhanced especially through food and genetic improvement (Talib et al. 2014). The buffaloes have advantages compared to cows in which they can survive particularly when available feed has low quality (Diwyanto and Handiwirawan 2006; Yasin 2013).

One strategy that can be done to maintain and improve the level of productivity of Pampangan buffalo is by studying their forage in lowland swamp by analyzing the vegetation and carrying capacity of pasture. Studies on vegetation analysis and pasture carrying capacity up to date are only limited to dry land areas, such as in Wulan Gitrang Sub-district, East Flores which show carrying capacity of 0.42 $AU.ha^{-1}.year^{-1}$ on coffee plantation and 0.38 $AU.ha^{-1}.year^{-1}$ on grassland (Kleden et al. 2015). Another study investigating carrying capacity of livestock forage during preproduction of rubber (juvenile plants) is 0.14 $AU.\ ha^{-1}.year^{-1}$, while during rubber production (mature plants) can only accommodate 0.06 $AU.\ ha^{-1}.year^{-1}$ (Pramana et al. 2015).

This study aims to analyze vegetation structure of non-tidal swampland in South Sumatra and examine its carrying capacity for Pampangan buffalo pasture.

MATERIALS AND METHODS

This research was carried out in Pulau Layang Village, Pampangan Sub-district, Ogan Komering Ilir District, South Sumatra and Rambutan Village, Rambutan Sub-district, Banyuasin District, South Sumatra from April to September 2017. The methods used were the combination of survey, measurements, and direct observations on samples of swampland commonly used as pasture by farmers. Data of livestock population were collected from related agencies and institutions.



A B

Figure 1. Research location in South Sumatra, Indonesia. A. Pulau Layang Village, Pampangan Sub-district, Ogan Komering Ilir District, South Sumatra. B. Rambutan Village, Rambutan Sub-district, Banyuasin District, South Sumatra

Field data were collected using direct observations and measurements including forage vegetation species, amount of production, forage quality (natural grasses and legumes), and soil fertility. Purposive sampling was conducted by making quadratic plots with size of 1x1m each plot and with total number of plots was 50 (Kleden et al. 2015). In each observation plot, the name and individual number of forage species were recorded. The plant specimens were collected and labeled with each species was photographed with digital camera. The collected specimens from each plot were separated according to each species and dried to calculate the dominant value. Dominant value is a value that more important than other values. . The unknown species was collected for herbaria, being treated with 70% alcohol, oven-dried, and identified the plant is identified by employing a botanist and using reference book.

Vegetation analysis

The collected data were analyzed quantitatively (Utami et al. 2007) as follows:

Density

Density is the number of individual of a species per area extent and formulated as follows:

$$\text{Density} = \frac{\text{Number of individual of a species}}{\text{Total extent of sample plots}}$$

Relative density

Relative density is the density of a species as a percent of total plant density and formulated as follows:

$$\text{Relative density} = \frac{\text{Density of a species}}{\text{Density of all species}} \times 100\%$$

Frequency

Frequency is the number of sample plots having a species in a given total number of sample plots and formulated as follows:

$$\text{Frequency} = \frac{\text{Number of plots having a species}}{\text{Number of all observed plots}}$$

Relative frequency

Relative Frequency is the frequency of a species as a percent of total frequency of all species and formulated as follows:

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100\%$$

Important Value Index (IVI)

This value indicates the dominance of a species in a particular area and formulated as follows:

IVI = Relative Density + Relative Frequency

Forage production

Measurement on forage production adopted the *Halls* method (Kleden et al. 2015) using a 1m x 1m quadratic frame (Sutaryo 2009). A total of 50 observation points were done in grazing area of swampland ~~lowland~~ that frequently used by farmers/ranchers. The squared frame for each observation point was randomly placed. The average forage production was calculated using the following formula:

$$X = \sum xi/n$$

Where:
X : The existing average of forage biomass production
∑xi: The amount of forage biomass production at each observation
n : The amount of observation

Pasture carrying capacity

The carrying capacity is the ability of pasture areas or grass farming to accommodate a number of livestock so that the need for grass for one-year-animal feed is sufficient. Calculating forage carrying capacity of swamp lowland forage is based on the amount of forage supplied on pasture for livestock needs for one year which is stated in Animal Unit (AU) per hectare. The carrying capacity was calculated for each species of forage. The calculation adopted formula developed by Purnomo (2006).

$$\text{Carrying capacity} = \frac{\text{Cumulative production x proper use factor (\%)}}{\text{Animal needs (kg DM/AU/day) x 360 days}}$$

$$\text{Cumulative Forage Production} = [(hk/ik \times pk) + (hp/ip \times pp) + (hh/ih \times ph)]$$

Where:
hk : Number of days in the dry season (90 days)
hp : Number of days in the transition season (120 days)
hh : Number of days in the wet season (150 days)
ik : Cutting intervals in the dry season (50 days)
ip : Cutting intervals in the transition season (30 days)
ih : Cutting intervals in the wet season (40 days)
pk : Biomass production in the dry season
pp : Biomass production in the transition season
ph : Biomass production in the wet season
puf: Proper use factor 68%.
kt : Animal need 6,25 kg dry matter $AU^{-1}day^{-1}$

Data analysis

Carrying capacity was analyzed by comparing forage production to the number of livestock available which result in a ratio that informs the number of buffaloes that could be developed in the study area. Three possible ratios are: (i) AUp/AUt < 1 means the number of livestock grazing in swampland is greater than the amount of feed available; (ii) AUp/AUt =1 means there is a balance between the amount of forage available and the number of livestock; (iii) AUp/AUt > 1 means the number of livestock is less than the amount of food available in the pasture. AU is animal unit equivalents with AUp and AUt are animal units for feed and animal unit for livestock, respectively (Kleden et al. 2015).

RESULTS AND DISCUSSION

Forage species

In the research areas, there were 19 forage species potential to be used as Pampangan buffalo feed, covering 17 grass species (Gramineae) and 2 legume species (Leguminosae) (Table 1).

Analysis of forage vegetation

The results of vegetation analysis of forage species at Pampangan buffalo pastures in swamp lowland during wet and dry seasons in Pulau Layang Village and Rambutan Village are presented in Tables 2 and 3, respectively.

Forage production

The average production of fresh forage vegetation of swamp lowland at two study locations was 6.90 $tons.ha^{-1}.year^{-1}$ in Pulau Layang Village, Pampangan Sub-district, Ogan Komering Ilir District (Table 4) and 3.68 $tons.ha^{-1}.year^{-1}$ in Rambutan Village, Rambutan Sub-district, Banyuasin District (Table 5).

Table 1. Forage species in the studied areas of Pampangan buffalo pasture in non-tidal swampland of South Sumatra, Indonesia

Latin name	Local name	Village		Remarks
		P	R	
Catharanthus roseus	Tapak dara	+	-	NDP
Cyperus cephalotes	Apit-apit	+	-	NDP
Cyperus digitatus	Kasuran	-	+	NDP
Digitaria fuscescens	Pasiran/Kerak maling	+	+	DP
Eichhornia crassipes	Eceng gondok	+	-	NDP
Eleocharis dulcis	Purun tikus	+	+	DP
Hymenachne acutigluma	Kumpai tembaga	+	+	DP
Hymenachne amplexicaulis	Kumpai minyak	+	+	DP
Hymenachne sp.	Kumpai merah	+	-	NDP
Ipomoea aquatica	Kangkung merah	+	-	NDP
Leersia hexandra	Bento rayap	+	+	DP
Ludwigia hyssopifolia	Cecengkehan	+	-	ND
Neptunia oleracea	Kemon air	+	-	NDP
Nymphaea lotus	Telepuk Gajah	+	-	NDP
Nymphaea odorata	Telepuk Padi	+	-	NDP
Oryza rufipogon	Kumpai padi	+	+	DP
Polygonum barbatum	Are bolong	+	-	DNP
Rhynchospora corymbosa	Berondong	-	+	ND
Sesbania exasperata	Mutiara	-	+	NDP

Note: P: Pulau Layang Village, R: Rambutan Village, DP: Dominant, Palatable, DNP: Dominant, Not Palatable, NDP: Not Dominant, Palatable ND : Not Dominant, Not Palatable means forages that is not liked by buffaloes to eat swampland. +: Present,-: Absent. Dominand means a type of forages that always appears in sampling and have high production.

Table 2. Density, relative density, frequency, relative frequency, and important value index of forage species at Pampangan buffalo pasture during wet and dry seasons in Pulau Layang Village, Pampangan Sub-district, Ogan Komering Ilir District, South Sumatra, Indonesia

Latin name	Wet season					Dry season				
	D	RD (%)	F	RF (%)	IVI (%)	D	RD (%)	F	RF (%)	IVI (%)
Catharanthus roseus	0.08	2.50	0.06	3.65	6.15	-	-	-	-	-
Cyperus cephalotes	-	-	-	-	-	0.16	8.42	0.12	9.52	17.94
Digitaria fuscescens	-	-	-	-	-	0.16	8.42	0.12	9.52	17.94
Eichhornia crassipes	0.48	15.00	0.20	12.19	27.19	0.18	9.47	0.08	6.34	15.82
Eleocharis dulcis	0.16	5.00	0.14	8.53	13.53	-	-	-	-	-
Hymenachne acutigluma	0.22	6.87	0.12	7.31	14.19	0.12	6.31	0.12	9.52	15.84
Hymenachne amplexicaulis	0.20	6.25	0.10	6.09	12.34	0.14	7.36	0.08	6.34	13.71
Hymenachne sp.	0.46	14.37	0.18	10.97	25.35	0.20	10.52	0.12	9.52	20.05
Ipomoea aquatica	0.04	1.25	0.04	2.43	3.68	-	-	-	-	-
Leersia hexandra	0.06	1.87	0.04	2.43	4.31	0.12	6.31	0.10	7.93	14.25
Ludwigia hyssopifolia	0.18	5.62	0.06	3.65	9.28	0.16	8.42	0.08	6.34	14.77
Neptunia oleracea	0.56	17.50	0.32	19.51	37.01	0.38	20.00	0.24	19.04	39.04
Nymphaea lotus	0.02	0.62	0.02	1.22	1.84	-	-	-	-	-
Nymphaea odorata	0.02	0.62	0.02	1.22	1.84	-	-	-	-	-
Oryza rufipogon	0.18	5.62	0.08	4.87	10.50	-	-	-	-	-
Polygonum barbatum	0.54	16.87	0.26	15.85	32.72	0.28	14.73	0.20	15.87	30.61
Total	3.2	100	1.64	100	200	1.90	100	1.26	100	200

Note: D = Density, RD = Relative Density, F = Frequency, RF = Relative Frequency, IVI = Important Value Index

Table 3. Density, Relative Density, Frequency, Relative Frequency, and Important Value Index of forage species at Pampangan buffalo pasture during wet and dry seasons in Rambutan Village, Rambutan Sub-district, Banyuasin District, South Sumatra, Indonesia

Latin name	Wet season					Dry season				
	D	RD (%)	F	RF (%)	IVI (%)	D	RD (%)	F	RF (%)	IVI (%)
Cyperus digitatus	0.88	18.03	0.30	14.85	32.88	0.12	5.31	0.06	4.34	9.65[4]
Digitaria fuscescens	1.10	22.54	0.40	19.80	42.34	0.40	1.77	0.22	15.94	17.71[3]
Eleocharis dulcis	1.68	34.42	0.74	36.63	71.06	1.00	44.24	0.62	44.92	89.17[1]
Hymenachne acutigluma	0.04	0.82	0.02	0.99	1.81	0.02	0.88	0.02	1.44	2.33[8]
Hymenachne amplexicaulis	0.04	0.82	0.02	0.99	1.81	0.04	1.77	0.02	1.44	3.21[7]
Leersia hexandra	0.06	1.23	0.04	1.98	3.21	0.04	1.77	0.04	2.89	4.65[5]
Oryza rufipogon	0.80	16.39	0.40	19.80	36.19	0.60	26.54	0.38	27.53	54.08[2]
Rhynchospora corymbosa	0.08	1.63	0.04	1.98	3.61	0.04	1.77	0.02	1.44	3.21[6]
Sesbania exasperata	0.20	4.09	0.06	2.97	7.06	-	-	-	-	-
Total	4.88	100	2.02	100	200	2.26	100	1.38	100	200

Note: D = Density, RD = Relative Density, F = Frequency, RF = Relative Frequency, IVI = Important Value Index

Table 4. Fresh weight production (FWP), dry matter production (DMP), and forage carrying capacity (CC) of swamp lowland in wet and dry seasons in Pulau Layang Village, Ogan Komering Ilir.

Latin name	Wet season			Dry season		
	FWP (kg)	DMP (kg)	CC (AU.ha^{-1}. year^{-1})	FWP (kg)	DMP (kg)	CC (AU.ha^{-1}. year^{-1})
Catharanthus roseus	7,530	977.40	2.82	-	-	-
Cyperus cephalotes	-	-	-	4,580	1,145.00[4]	3.30
Digitaria fuscescens	-	-	-	2,420	537.97[10]	1.55
Eichhornia crassipes	5,940	1,097.70	3.17	4,700	830.49[6]	2.40
Eleocharis dulcis	12,640	2,664.50	7.69	-	-	-
Hymenachne acutigluma	6,700	1,352.70	3.90	7,480	1,632.54[1]	4.71
Hymenachne amplexicaulis	6,650	790.00	2.28	5,990	729.58[8]	2.11
Hymenachne sp.	7,040	1,151.70	3.32	5,720	975.83[5]	2.82
Ipomoea aquatica	4,020	604.60	1.75	-	-	-
Leersia hexandra	4,740	1,232.40	3.56	5,290	1,385.45[2]	4.00
Ludwigia hyssopifolia	1,980	346.90	1.00	4,290	777.35[7]	2.24
Neptunia oleracea	1,910	394.80	1.14	2,870	607.01[9]	1.75
Nymphaea lotus	9,800	1,983.50	5.72	-	-	-
Nymphaea odorata	7,500	1,286.30	3.71	-	-	-
Oryza rufipogon	12,960	2,225.20	6.42	-	-	-
Polygonum barbatum	7,180	1,651.40	4.77	5,290	1,244.74[3]	3.59
Average	6,899	1,268.51	3.66	4,863	986.60	2.85

Table 5. Fresh weight production (FWP), dry matter production (DMP), and forage carrying capacity (CC) of swamp lowland in wet and dry seasons in Rambutan Village, Banyuasin.

Latin name	Wet season			Dry season		
	FWP (kg)	DMP (kg)	CC (AU.ha^{-1}. year^{-1})	FWP (kg)	DMP (kg)	CC (AU.ha^{-1}. year^{-1})
Cyperus digitatus	2,590	248.90	0.72	240	28.61	0.08
Digitaria fuscescens	790	108.00	0.31	1,100	152.79	0.44
Eleocharis dulcis	4,370	921.20	2.66	1,700	376.21	1.09
Hymenachne acutigluma	8,540	3,139.30	9.06	5,900	2,181.82	6.29
Hymenachne amplexicaulis	4,860	577.40	1.67	3,200	489.28	1.41
Oryza rufipogon	4,690	1,462.80	4.22	4,420	1,421.03	4.10
Rhynchospora corymbosa	1,510	441.80	1.28	250	77.88	0.22
Sesbania exasperata	1,360	111.50	0.32	-	-	-
Average	3,676.67	905.52	2.61	2,523.75	705.66	2.04

Pasture carrying capacity

The carrying capacity of swamp lowland for Pampangan buffalo pasture in Pulau Layang Village was 3.66 AU.ha^{-1}.year^{-1} during the wet season and 2.85 AU.ha^{-1}.year^{-1} in the dry season (Table 4). The carrying capacity of swamp lowland for Pampangan buffalo pasture in Rambutan Village was 2.61 AU.ha^{-1}.year^{-1} in the wet season and 2.04 AU.ha^{-1}.year^{-1} in the dry season (Table 5).

Discussion

Diversity of forage species

There are dominant and palatable forage vegetation species in swamp lowland having potential as buffalo feed, namely Kumpai padi grass (*O. rufipogon),* Kumpai tembaga *(H. acutigluma),* and Kumpai minyak *(H. amplexicaulis)*, not dominant and palatable such as Kumpai merah *(Hymenachne* sp) and Kemon air *(N. oleracea)*; dominant and non palatable grass species (buffalo doesn't like it) namely Are bolong (*P. barbatum).* Yet, this grass species would be eaten by the buffaloes if there were no other forage species to be eaten (Table 1). The results of this study are different from the results of research conducted by other people before, the fundamental difference is the existence of differences in internal factors (forage vegetation) and external factors (environment). This research was carried out on swampland while research carried out by others was mostly on dry land or on tidal land. With the difference in place of study, the number, types of forage vegetation that are available will also be different. Besides that, there is also a difference in the production of forages and the carrying capacity of pasture. The renewal of this research is that there is currently no discussion about the analysis of vegetation and the carrying capacity of pasture grazing on swampland.

Ali et al. (2012) conducted a study on swampland vegetation and found 25 species in Pampangan sub-district, while Rohaeni et al. (2005) found 24 species in South Kalimantan, and Camarao and Rodrigues Filho (2001) only found 7 species in Brazil. In Gowa District, there were 15 species found on natural grasslands consisting of 12 species classified as palatable forage (7 kinds of grass and 5 legumes) and 3 non palatable species, all of them are native species (Rinduwati et al. 2016). Based on the number of species encountered (15 species), it can be said that the natural pasture in Gowa District is quite good. Other studies show high diversity of forage species: 33 species in Sota village in Merauke, consisting of 61% grass, 3% legume and other plants 36% (Praptiwi et al. 2017); 22 forage species in Pakistan (Abdullah et al. 2017), 40 forage species consisting of 82-87% forage grass, 1% legume and forage consumable by livestock, and 12-17% those not edible by livestock in West Papua (Yoku et al. 2015). In Tobelo Sub-district, forage pasture consisted of 58.33% grass, 25% legume, and 16.67% other forage (Matulessy and Kastanja 2013; Eoh 2014). Species diversity is influenced by season in which the wet season increases the availability of water needed by plants for growth, especially the grass species, resulting in higher diversity (Kumalasari and Sunardi 2015).

Analysis of forage vegetation

In Pulau Layang Village, during the wet season, species with the highest Important Value Index (IVI) were Kemon air (*N. oleracea*) having 37.01% Important Value Index, followed by 32.72% Are bolong (*P. barbatum* L) and 27.19% Eceng gondok (*E. crassipes*), while the lowest value was Telepuk padi (*N. odorata* Aiton) and Telepuk gajah (*N. lotus*) which was 1.84% each. During the dry season, the highest IVI were Kemon air (*N. oleracea*) with 39.04%, followed by Are bolong (*P. barbatum* L*)* 30.61% and Kumpai merah (*Hymenachne* sp.) 20.05%, while the lowest value was Kumpai padi *(O. rufipogon)* with 13.71% (Table 2).

In Rambutan Village, during the wet season, species with the highest Important Value Index (IVI) were Purun tikus *(E. dulcis)* with 71.06%, Kerak maling *(D. fuscescens)* 42.34%, and Kumpai padi *(O. rufipogon)* 36.19%. The lowest values were Kumpai tembaga *(H. acutigluma)* and Kumpai minyak *(H. amplexicaulis)* 1.81% each. In the dry season, the highest IVI were Purun tikus *(E. dulcis)* 89.71%, Kumpai padi *(O. rufipogon)* 54.08%, and Kerak maling *(D. fuscescens)* 17.71%. The lowest value was Kumpai tembaga *(H. acutigluma)* 2.33% (Table 3).

The results also showed that there was a difference in the species richness between the wet and dry seasons. In Pulau Layang Village in the wet season there were 14 forage species and in the dry season, there were only 10 forage species. While Apit-apit *(C. cephalotes* Vahl*)* and Kerak maling *(D. fuscescens)* were not found in the wet season, Purun tikus (*E. dulcis*), Kumpai padi (*O. rufipogon*), Tapak darah (*C. roseus* L. Don*)*, Kangkung merah (*I. aquatica* Forsk*)*, and Telepuk padi (*N. odorata* Aiton) were not found in the dry season. In Rambutan Village, in wet season there were 9 forage species, while in the dry season there were only 8 species. In the dry season there was no legume Mutiara *(S. exasperate),* indicating that this species could not bear the drought and as a result, it would die in the dry season. These results suggest that there are some species that tolerant to water while some others were not. On the other hand, some species are tolerant to drought, while some others are not.

The Important Value Index (IVI) differences among species might be caused by the competition of each species in obtaining soil nutrients and sunlight, as well as climatic factors of the wet and dry seasons as also stated by Parmadi et al. (2016). In addition, there are other influencing factors namely vegetation density. The variation in species diversity and composition indicates that even though a research location has the same age, yet the environmental conditions could result in different vegetation (Syarifuddin 2011). In Pulau Layang Village, species having the highest IVI were Kemon air and Are bolong (37.01 and 32.73%) while in Rambutan Village were Purun tikus, Kerak maling and Kumpai padi (71.06%, 42.34%, and 36.19%), indicating that they are the most dominant species among other. A species is considered to be dominant in an area if it has IVI of more than 20% of all species and co-dominant if the percentage ranges from 10% to 20% (Suveltri et al. 2014).

The highest species density of forage vegetation in swamp ecosystem might have resulted from its adaptation and development ability in accordance with environment. This strengthens the study conducted by Oktaviani et al. (2015) that plants with the highest density can adapt to the environment to grow and reproduce under the conditions of low pH in water and soil. In contrast, plants with the lowest density might be caused by the unsuitable environmental factors for the plants to grow and breed, particularly in the acidic water and soil (Samin et al. 2016).

Forage production

The production of fresh forage at pastures in Pulau Layang Village in the wet season was 6.899 kg ha^{-1} year^{-1} and the production of the dry matter was 1,268.51 kg ha^{-1}year^{-1}, while in the dry season the production of fresh forage was 4,863 kg ha^{-1} year^{-1} and the dry matter production was 986.60 kg ha^{-1} year^{-1} (Table 4). This result is higher than those conducted in Canada (Omokanye et al. 2018) and in Timor Tengah Selatan District (Se'u et al. 2015) stating that the average fresh production of pasture in Gowa District in the wet season was 5,350 kg ha^{-1} year^{-1} and in the dry season was 1,390 kg ha^{-1} year^{-1} (Rinduwati et al. 2016). But the results of this study were lower than the study by Abdullah et al. (2017) in Pakistan who reported that forage production was 8,029.1 kg ha^{-1} year^{-1} in the wet season and 5,422.9 kg ha^{-1} year^{-1} in the dry season. The forage production of pasture in Sabana Timur Barat on the average ranged from 0.61 to 4.33 tons ha^{-1} year^{-1} (Manu 2013).

The lowest production usually occurs at the peak of dry season in October and the highest occurs in April (Manu 2013; Damry 2009). The forage production of *Pennisetum purpuphoides* was 70.4 ton ha^{-1}year^{-1}, *Setaria sphasielata* 44.8 tons ha^{-1}year^{-1}, *Brachiaria sp* 44.7 tons ha^{-1}year^{-1}, *Pennisetum purpureum* 44.6 tons ha^{-1}year^{-1}, and *Panicum maximum* 15,6 tons ha^{-1}year^{-1} (Jarmani and Haryanto 2015). The different amounts of production might have resulted from the differences in vegetation species, types of pasture, and methods used. There are various methods for estimating forage production, but many are inaccurate when applied to certain animal feed plant species. Therefore, it is very important to understand the limitations of technique used to measure forage production (Edvan et al. 2016; Badgery et al. 2017).

In Pulau Layang Village, there were 5 forage species having high fresh production in the wet season, namely Kumpai padi (*O. rufipogon*) with 12,960 kg ha^{-1} year^{-1}, followed by Purun tikus (*E. dulcis*), Telepuk gajah (*N. lotus*), Are bolong (*P. barbatum* L) and Telepuk padi (*N. odorata* Aiton), and the lowest one was Kemon air (*N. olerancia*) with 1,910 kg ha^{-1} year^{-1}. In the dry season the highest fresh production was Kumpai tembaga (*H. acutigluma*) with 7,480 kg ha^{-1} year^{-1}, followed by Kumpai minyak (*H. amplexicaulis*), Kumpai merah (*Hymenachne* sp.), Are bolong *(P. barbatum* L) and Bento rayap *(L. hexandra)*, and the lowest one was Kemon air (*N. oleracea*) with only 2.870 kg ha^{-1} year^{-1}. The highest dry matter production in the wet season was Purun tikus (*E. dulcis*) with 2,664.5 kg ha^{-1} year^{-1}, followed by Kumpai padi *(O. rufipogon*), Telepuk gajah *(N. lotus),* Are bolong *(P. barbatum* L*),* and Kumpai tembaga *(H. acutigluma),* and the lowest was Cecengkehan *(L. hyssopifolia)*. In the dry season the highest dry matter production was Kumpai tembaga (*H. acutigluma*) with 7.480 kg ha^{-1} year^{-1}, followed by Bento rayap *(L. hexandra),* Are bolong *(P. barbatum* L*),* Apit-apit (*C. cephalotes* Vahl*)* and Kumpai merah *(Hymenachne* sp.*)*, and the lowest was Kerak maling (*D. fuscescens*) with 2,420 kg ha^{-1} year^{-1} (Table 4).

In Rambutan Village, the production of fresh forage during the wet season was 3,676.67 kg ha^{-1} year^{-1} and the dry matter production was 905.52 kg ha^{-1} year^{-1} whereas in the dry season the fresh produce was 2,523.75 kg ha^{-1} year^{-1} and the dry matter production was 705.66 kg ha^{-1} year^{-1} (Table 5). These results were higher than those of the study conducted by Purwantari et al. (2015) and Praptiwi et al. (2017) who reported that the average availability of forage on palm oil plantation was 1,455.5 kg ha^{-1} year^{-1}. The forage production during preproduction of rubber plantation was 732.90 kg ha^{-1} year^{-1} and at the time of production, it was only 317.83 kg ha^{-1}year^{-1} (Pramana et al. 2015).

In Rambutan Village, during the wet season there were 5 forage species having the highest fresh and dry matter production, namely Kumpai tembaga *(H. acutigluma)* producing 8,540 kg ha^{-1} year^{-1} and 3,139.3 kg ha^{-1}year^{-1} respectively, followed by Kumpai padi (*O. rufipogon*), Bento rayap *(L. hexandra),* Purun tikus (*E. dulcis*), and Kumpai minyak (*H. amplexicaulis*), and the lowest one was Kerak maling (*D. fuscescens*) with 790 kg ha^{-1} year^{-1} and 108.0 kg ha^{-1} year^{-1}, respectively. In the dry season, the highest fresh and dry matter production was Kumpai tembaga *(H. acutigluma)* of 5,900 kg ha^{-1} year^{-1} and 2,181.82 kg ha^{-1} year^{-1}, followed by Kumpai padi *(O. rufipogon)*, Bento rayap *(L. hexandra),* Kumpai minyak *(H. amplexicaulis),* and Purun tikus *(E. dulcis)*, and the lowest one was Kasuran *(C. digitatus)* with 240 kg ha^{-1} year^{-1} and 11.92 kg ha^{-1} year^{-1}, respectively (Table 5). The results of this study were still higher than those conducted by Rostini et al. (2014) stating that the highest fresh forage production of grass *Hymenachne amplexicaulis* Haes was 1,032 kg DM ha^{-1} harvest^{-1} in the high tide season and 518.3 kg DM ha^{-1} harvest^{-1} in the low tide season, where the dry matter production ranged from 43.8 to 1.032 kg DM ha^{-1} harvest^{-1} in the high tide season and from 38.5 to 752.8 kg DM ha^{-1} year^{-1} harvest^{-1} in the low tide season.

The higher production of forage in Pampangan Sub-district compared to that in Rambutan Sub-district might be caused by higher soil fertility of the pasture area in Pampangan. The result of soil analysis showed that the C-Organic, N-total, and P-available in Pampangan (Bray I) were higher than those in Rambutan which might be related to the fact that most pasture in Pulau Layang Village (Pampangan) are rice fields which are always given fertilizer. This differs with pasture in Rambutan Village which is only used for grazing without any use of fertilizer. The provision of manure and bioslury fertilizer can increase the production and forage quality of 4.75 tons and 4.36 tons, respectively (Suarna and Budiasa 2016; Jeffery et al. 2018).

Pasture carrying capacity

In Pulau Layang Village, the carrying capacity for Pampangan buffaloes pasture on the swamp lowland in the wet season was 3.66 AU ha^{-1} year^{-1} and 2.85 AU ha^{-1} year^{-1} during the dry season (Table 4). In Rambutan Village, the carrying capacity for Pampangan buffalo pasture in the wet season was 2.61 AU ha^{-1} year^{-1} and in the dry season was 2.04 AU ha^{-1} year^{-1} (Table 5). The results of this study correspond to study conducted by Rostini et al. (2014) which found the carrying capacity of swamp lowland in South Kalimantan was 2.91 AU ha^{-1} year^{-1}.

These results were higher than in grassland in South Central Timor District with only 0.24-0.63 AU ha^{-1} year^{-1} (Seu et al. 2015), in natural pastures of Gowa District with 0.88 AU ha^{-1} year^{-1} (Rinduwati et al. 2016), in pasture in Poso District with 0.63 AU ha^{-1} year^{-1} (Damry 2009; Daru et al. 2014), in Kelei and Didiri villages of Poso Districts with 0.96 and 1.12 AU ha^{-1} year^{-1} (Karti et al. 2015), However, these results were lower than the study conducted by Muhajirin et al. (2017) stating that the carrying capacity of Padang Mengatas BPTU was 5 AU ha^{-1} year^{-1} in the wet season and 3.18 AU ha^{-1} year^{-1} in the dry season. Even, Abdullah et al. (2017) reported very high carrying capacity of forage in Pakistan with 24 AU ha^{-1} year^{-1} and 16 AU ha^{-1} year^{-1} in the wet and dry seasons, respectively.

There is a decrease in dry material produced during the dry season because the water condition in swamp lowland is reduced. Decrease in swamp water level resulted in the decrease of photosynthesis which affects the production of the dry matter. Water is the main ingredient needed in photosynthesis. The disruption of metabolic processes in plants will affect plant production. Plant dry weight depicts the accumulation of organic compounds that are successfully synthesized by the plants from inorganic compounds, especially water and CO_2 (Lakitan 1995). Water shortages will have a negative effect on plant growth resulting in decreased production (Jun-Feng et al. 2010; Taiz and Zeiger 2002).

The high carrying capacity is related to the high forage production, forage management and selection of good species. Management and strategy to increase forage production require innovative facilitation and training to stockbreeders and farmers to increase their knowledge. These efforts should be supported by government and private companies develop programs regarding the importance of forage in increasing ruminant livestock production (Nigus 2017; Omokanye et al. 2018).

In Pulau Layang Village, in a pasture condition assumed to have one forage species, the highest carrying capacity in the wet season was Purun tikus *(E. dulcis)* with 7.69 AU ha^{-1} year^{-1}, followed by Kumpai padi *(O. rufipogon)* with 6.42 AU ha^{-1}year^{-1}, Telepuk gajah *(N. lotus)* with 5.72 AU ha^{-1} year^{-1}, Are bolong *(P. barbatum* L*)* with 4.77 AU ha^{-1} year^{-1} and Kumpai tembaga *(H. acutigluma)* with 3.90 AU ha^{-1} year^{-1}, respectively, and the lowest was Cecengkehan *(L. hyssopifolia)* with 1.00 AU ha^{-1} year^{-1}. In the dry season, the highest carrying capacity was Kumpai tembaga *(H. acutigluma)* with 4.71 AU ha^{-1} year^{-1}, followed by Bento rayap *(L. hexandra)* with 4.00 AU ha^{-1} year^{-1}, Are bolong *(P. barbatum* L) with 3.59 AU ha^{-1} year^{-1}, Apit-apit *(C. cephalotes* Vahl*)* with 3.30 AU ha^{-1} year^{-1} and Kumpai merah *(Hymenachne sp.)* with 2.82 AU ha^{-1} year^{-1}, whereas the lowest was Kerak maling *(D. fuscescens)* with 1.55 AU ha^{-1} year^{-1} (Table 4).

In Rambutan Village, assuming that the pasture had one forage species, the highest carrying capacity in the wet season was Kumpai tembaga *(H. acutigluma)* with 9.06 AU ha^{-1} year^{-1}, followed by Kumpai padi *(O. rufipogon)* with 4.22 AU ha^{-1} year^{-1}, Bento rayap *(L. hexandra)* with 3.29 AU ha^{-1} year^{-1}, Purun tikus *(E. dulcis)* 2.66 with AU ha^{-1} year^{-1}, and Kumpai minyak *(H. amplexicaulis)* with 1.67 AU ha^{-1} year^{-1}, while the lowest was Kerak maling *(D. fuscescens)* with 0.31 AU ha^{-1} year^{-1}. During the dry season the highest carrying capacity was Kumpai tembaga *(H. acutigluma)* with 6.29 AU ha^{-1} year^{-1}, followed by Kumpai padi *(O. rufipogon)* with 4.10 AU ha^{-1} year^{-1}, Bento rayap *(L. hexandra)* with 2.65 AU ha^{-1} year^{-1}, Kumpai minyak *(H. amplexicaulis)* with 1.41 AU ha^{-1} year^{-1}, and Purun tikus *(E. dulcis)* with 1.09 AU ha^{-1} year^{-1}, while the lowest was Kasuran *(C. digitatus)* with 0.08 AU ha^{-1} year^{-1} (Table 5). These results indicate that the carrying capacity is very influential with the type of feed plan. In addition, another important thing is cattle grazing system in which livestock grazing must be regulated to avoid over-grazing as the amount of grazing livestock depends on the carrying capacity of the pasture (Salendu and Elly 2014; Cheng et al. 2017; Hashemi 2017).

The results of this study indicated that forage availability is still sufficient to meet feed requirements for Pampangan buffaloes. The population of Pampangan buffaloes in Pulau Layang Village was 487 buffaloes with a grazing area of 500 ha and average carrying capacity of 3.14 AU ha^{-1} year^{-1}. While the number of Pampangan buffaloes of Rambutan Village was 1.735 buffaloes with a pasture area of 1,203 ha and average carrying capacity of 2.45 AU ha^{-1} year^{-1}. It is estimated that there still can be added buffalo cattle as much as 0.31 AU ha^{-1} year^{-1} in Pulau Layang Village so 155 buffaloes and 0.59 AU ha^{-1} year^{-1} in Rambutan Village 709 buffaloes

In conclusion, there were 19 forage species to have the potential as feeding source of Pampangan buffaloes in South Sumatra. The importance of species indicated by IVI is strongly influenced by grazing locations and seasons. The most important species were Kemon air *(N. oleracea)* and Are bolong *(P. barbatum* L*)* in Pulau Layang Village and Purun tikus *(E. dulcis)*, Kerak maling *(D. fuscescens)*, and Kumpai padi *(O. rufipogon)* in Rambutan Village. In Pulau Layang Village, the fresh forage and dry matter production in the wet season were 6.90 and 1.27 tons ha^{-1} year^{-1}, while in Rambutan Village they were 3.68 tons ha^{-1} year^{-1} and 0.91 ton ha^{-1} year^{-1}, respectively. The fresh forage production and dry matter production in the dry season in Pulau Layang Village were 4.86 and 0.99 tons ha^{-1} year^{-1}, while in Rambutan Village were 2.52 tons ha^{-1} year^{-1} and 0.71 tons ha^{-1} year^{-1}, respectively. On the average the carrying capacity of the swamp lowland pasture in South Sumatra was 2.79 AU.ha^{-1}.year^{-1}. As such, forage availability is still sufficient to meet the need for animal feed, and it is estimated the areas can be added buffalo cattle of 0.31 AU ha^{-1} year^{-1} in Pulau Layang Village and 0.59 AU ha^{-1} year^{-1} in Rambutan Village.

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REFERENCES

Abdullah, M., Rafay, M., Sial, N., F. Rasheed, F., Nawaz M.F., Nouman, W., Ahmad, I., Ruby, T and Khalil, S. 2017. Determination of forage productivity, carrying capacity and palatability of browse vegetation in arid rangelands of Cholistan Desert (Pakistan). Appl Ecol Environ Res 15 (4): 623-637.

Ali AIM, Sandi S, Muhakka, Riswandi. 2012. The quality of forage feed of the swampy lowland of Pampangan buffalo pasture. Prosiding InSINAS 2012. 307-312.

Badgery WB, Millar GD, Broadfoot K, Michalk DL, Cranney P, Mitchell D, Van de Ven R. 2017. Increased production and cover in a variable native pasture following intensive grazing management. Anim Prod Sci 57: 1812-1823.

BPS [Central Statistics Agency]. 2010. Swamp lowland Area of Indonesia. Directorate General of Food, Ministry of Agriculture and Central Statistics Agency Jakarta.

BPS [Central Statistics Agency]. 2014. South Sumatra in Figure 2015. Central Statistics Agency of South Sumatra Province, Palembang.

Camarao AP, Rodrigues Filho JA. 2001. Botanical composition of the available forage and the diet of water buffalo grazing native pastures of the medium Amazon region, Brazil. Buffalo J 3: 307-316.

Center for Agricultural Technology Assessment in South Sumatra. 2011. Pampangan buffalo as South Sumatra's Nutfah plasm. Center for Agricultural Technology Assessment in South Sumatra, Palembang.

Cheng D, Peili S, Xianzhou Z, Ning Z, Xi C, Shoubao G, Wanrui Z. 2017. The rangeland livestock carrying capacity and stocking rate in the Kailash Sacred Landscape in China. J Resour Ecol 8 (6): 551-558.

Damry. 2009. Production and content of forage nutrition of natural pasture of North Lore Subdistrict of Poso District. Jurnal Agroland 16 (4): 296-300. [Indonesian]

Daru TP, Suhardi, Yusuf R., Wibowo A, Pujowati P. 2012. Carrying capacity of feed forage on the ruminants development in West Kutai District. Jurnal Teknologi Pertanian 8 (1): 30-36. [Indonesian]

Daru TP, Yulianti A, Widodo E. 2014. Forage potential of palmoil plantation as beef cattle feed in Kutai Kartanegara District. Media Sains 7: 79-86. [Indonesian]

Delima M, Karim A, Yunus M. 2015. Study of feed forage production potency on existing areas potential to increase ruminant livestock population in Aceh Besar District. Jurnal Agripet 15 (1): 33-40. [Indonesian]

Dwyanto K, Handiwirawan E. 2006. Strategy of buffalo cattle development: network and distribution aspects. Pros. National Workshop of Buffalo Cattle Business to Support the Beef Adequacy Program. Sumbawa, 4-5 August 2006. Center for Animal Husbandry Research and Development in cooperation with the Directorate of Nursery, Director General of Animal Husbandry of West Nusa Tenggara Province, Mataram. [Indonesian]

Edvan RL, Bezerra LR, Marques CAT, Carneiro MSS, Oliveira RL, Ferreira RR. 2016. Methods for estimating forage mass in pastures in a tropical climate. Revista de Ciências Agrárias 39 (1): 36-45.

Eoh M. 2014. Carrying capacity and composition of feed substance of buffalo pasture of Pulau Moa. Agrinimal 4 (2): 77-82.

Hashemi N. 2017. Recognizing the potential of sustainable use of pasture resources in South Khorasan Province with approach of carrying capacity. Environ Ecosyst Sci 1 (2): 9-12.

Jarmani SN, Haryanto B. 2015. Improving productivity of animal feed forage to support buffalo pasture capacity of Kampar District of Riau (A suggestion of thought). Jurnal Pastura 4 (2): 95-99. [Indonesian]

Jefferya RP, Simpsona RJ, Lambersc H, Orcharda S, Kidda DR, Halingb RE, Ryana MH. 2018. Contrasting communities of arbuscular-forming root symbionts change external critical phosphorus requirements of some annual pasture legumes. Appl Soil Ecol. DOI: 10.1016/j.apsoil.

Jung-Feng S, Guo MX, Lian, JR, Xiaobin P, Guo WY, Ping CX. 2010. Gene expression profile of response to water stress at the jointing stage in wheat. Agric Sci China 9 (3): 323-330.

Karti PDMH, Abdullah L, Prihantoro I. 2015. Exploration and productivity of pastures of East Pamona Subdistrict of Poso District of Mid Sulawesi. Jurnal Pastura 4 (2): 91-94. [Indonesian]

Kleden MM., Ratu MRD, Randu MDS. 2015. Feed forage carrying capacity in coffee plantation areas and natural pasture of East Flores District of East Nusa Tenggara. Jurnal Zootek 35 (2): 340-350. [Indonesian]

Kumalasari NR, Sunardi. 2015. Variety of feed forage potential vegetation in rice field areas of different height conditions. Jurnal Pastura 4 (2): 59-61. [Indonesian]

Lakitan B. 1995. Plant Physiology and Plant Development. Raja Grafindo Persada, Jakarta. [Indonesian]

Manu AE. 2013. Productivity of sabana pasture of West Timor. Jurnal Pastura 3 (1): 25-29.

Muhajirin, Despal, Khalil. 2017. Pemenuhan kebutuhan nutrien sapi potong bibit yang digembalakan Fulfilling the nutrient needs of grazed nursery beef cattle of Padang Mengatas. Buletin Makanan Ternak 104 (1): 9-20. [Indonesian]

Muhakka, Riswandi, Ali AIM. 2013. Morphological and reproductive characteristics of Pampangan Buffaloes of South Sumatra Province. Jurnal Sain Peternakan Indonesia 8 (8): 89-106. [Indonesian]

Mulyani A, Sarwani M. 2013. Characteristics and potential of sub-optimal land for agricultural development. Jurnal Sumberdaya Lahan 7 (1): 47-55. [Indonesian]

Oktaviani SI, Santri DJ, Dayat E. 2015. Diversity of swamp vegetation of Tanjung Lago Subdistrict. Jurnal Lahan Suboptimal 4 (2): 133-148. [Indonesian]

Omokanye A, Yoder C, Sreekumar L, Vihvelin L, Benoit M. 2018. Forage production and Economic performance of pasture rejuvenation methods in Northern Alberta, Canada. Suit Agric Res 7 (2): 94-110.

Parmadi JC EH, Dewiyanti I, Karina S. 2016. Important value index of mangrove vegetation in Kuala Idi area, East Aceh District. Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah 1 (1): 82-95.

Praptiwi II, Susanti DS, Damayanti AT, Mangera Y. 2017. The potential of various vegetation species as animal feed forage in the pasture of Sota Village of Merauke District. Agricola 7 (1): 15-24. [Indonesian]

Purnomo J. 2006. Animal Feed Forage in Indonesia. Jakarta. [Indonesian]Agricultural Research and Development Agency of the Ministry of Agriculture

Purwantari ND, Tiesnamurti B, Adinata Y. 2015. Availability of forage sources in palm oil plantations for cattle grazing. Watazoa 25 (1): 47-54.

Rinduwati., Hasan S, Syamsu JA, Useng D. 2016. Carrying capacity and botanical diversity of pastoral range in Gowa Regency. Intl J Sci: Basic Appl Res 29 (3) : 105-111.

Rohaeni ES, Darmawan A, Qomariah R, Hamdan A, Subhan A. 2005. Inventory and characterization of swamp buffaloes as germplasm. [Research Report]. Center for Agricultural Technology Assessment in South Kalimantan, Banjarbaru. [Indonesian]

Rostini T, Abdullah L, Wiryawan KG, Karti PDMH. 2014. Production and nutrition potency of swamp local forage in South Kalimantan as ruminant feed. Glob J Anim Sci Livestock Prod Anim Breed 2 (2): 107-113.

Salendu AHS, Elly FH. 2014. Potential development of forage for cattle under the coconut trees in Lolayan Subdistrict of Bolaang Mongondow District. Jurnal Pastura 4 (1): 7-10. [Indonesian]

Samin AN, Chairul, Mukhtar E. 2016. Analysis of coastal vegetation in tourist area of Pasir Jambak, Kota Padang. Jurnal Biocelebes 10 (2): 32-42. [Indonesian]

Se'u VE, Kartib PDMH, Abdullah L. 2015. Botanical composition, grass production, and carrying capacity of pasture in Timor Tengah Selatan District. Media Peternakan 38 (3):176-182. [Indonesian]

South Sumatra Province Animal Husbandry Office. 2014. South Sumatra Animal Husbandry Statistics in 2014. South Sumatra Province Animal Husbandry Office, Palembang.

Suarna IW, Budiasa IKM. 2016. Effect of organic fertilizers on the production and quality of mixed pasture on the dry land of Sebudi Karangase Village. Majalah Ilmiah Peternakan 19 (3): 125-128.

Sutaryo D. 2009. Calculation of Biomass. An Introduction to the Study of Carbon and Carbon Trading. Wetlands International Indonesia Programme, Bogor.

Suveltri B, Syam Z, Solfiyeni. 2014. Analysis of weed vegetation in plantations of maize (*Zea mays* L.) on maximum tillage in District of Lima Puluh Kota. Jurnal Biologi Universitas Andalas (J Bio UA) 3 (2): 103-108. [Indonesian]

Syarifuddin H. 2011. Composition and Structure of animal feed forage under the trees of palm oil plantation. Agrinak 1 (1): 25-30.

Taiz L, Zeiger E. 2002. Plant Physiology. 3 rd ed. Sinauer, New York.

Thalib C, Herawati T, Hastono. 2014. Strategy of increasing buffalo productivity through the improvement of feed and genetics. Wartazoa 24 (2): 83-96.

Yasin S. 2013. Eating behavior of ruminants as phenology bioindicators and dynamics of pasture. Jurnal Pastura 3 (1) : 1-4. [Indonesian]

Yoku O, Supriyantono A, Widayati T, Sumpe I. 2014. Production of natural pasture and potency of Balinese cow development in supporting the meat adequacy program in West Papua. Jurnal Pastura 3 (2): 102-105. [Indonesian]

Yoku O, Supriyantono A, Widayati T, Sumpe I. 2015. Composition of botany and distribution of local forage species of natural pasture in West Papua. Jurnal Pastura 4 (2): 62-65. [Indonesian]

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