Seasonal grass production and carrying capacity of buffalo grazing area in Paminggir, South Kalimantan

Abstract. The population and performance of Kalimantan swamp buffalo are declining. Diminishing grazing area and pasture biomass availability, especially in the rainy season, contribute to inadequate buffalo feed consumption. This study was conducted to investigate the seasonal productivity of palatable native grasses and to estimate the carrying capacity of the swamp grazing area. One year of observation indicated that kumpai banta and sumpilang had higher dry matter production in the deep-water season, whereas kumpai minyak was in the shallow-water season, and padi hiyang had similar production in both seasons. Dry matter production in the deep-water season was higher than in the shallow-water season (5.18 vs 4.61 ton DM/ha/month) as well as for the carrying capacity of swamp grazing area (15.5 vs 13.6 AU/season). It is concluded that the swamp grazing area in the Paminggir sub-district could carry higher than the existing buffalo population.

Keywords: Carrying capacity, Seasonal production, Swamp buffalo, Swamp grazing area

1. Introduction

Kalimantan swamp buffalo (*Bubalus bubalus carabanensis*) is one of the Indonesian swamp buffalo breeds that are widely distributed in South, Central and East Kalimantan Provinces. This swamp buffalo breed mainly raises in a non-tidal swamp area, even though a significant population of it can be found in hilly and forest areas of Kalimantan [1]. The swamp buffaloes are mainly used for agricultural labour, as a meat source and also kept as additional income for farmers [2]. Local swamp buffalo population and their productivity become more important since shortages in red meat sources urge Government to look at swamp buffalo as a potential red meat producer, especially in certain areas in which cattle farming is not feasible. In recent years, the volume of imported buffalo meat has been steadily increasing to reach 80,000 tonnes in 2021 [3].

However, the Indonesian swamp buffalo population kept on decreasing over the decade, including the Kalimantan buffalo in South Kalimantan province which declines 63%; from 44,603 heads in 2009 to only 16,556 in 2019 [4]. This decline is suspected due to calve rearing management and reproductive issues [5] and also due to the decrease in feed resources and grazing areas [6].

The previous study reported that there was a decrease in the area for buffalo grazing due to the change in land allocation to the residential, paddy field and oil palm plantations. Other research reported there are declines in the availability and productivity of native grasses species that are palatable for buffalo.

These resulted in high mortality of buffalo calves due to lack of feed, especially in the deep water season [5]. In addition [1] stated that the buffalo's body weight decreased even though the physical measurements were not significantly different from the previous report, where this was suspected because of a lack of feed intake and nutrition.

However, there is no data available for seasonal swamp grass production to estimate the carrying capacity of grazing areas for swamp buffalo in South Kalimantan. Therefore, this study was conducted to observe seasonal dry matter production in the swamp grazing area in Paminggir Sub-district, Hulu Sungai Utara District, South Kalimantan Province. Paminggir is a sub-district which has the highest population of Kalimantan swamp buffalo in South Kalimantan province and experienced a decline in buffalo population.

2. Methods

The study was conducted in Paminggir Sub District, Hulu Sungai Utara District, South Kalimantan Province, Indonesia. A sampling plot of 0.25 ha was placed in the buffalo grazing area, marked and surrounded by wood fencing thus the buffalo was unable to reach the grass inside the sampling plot. There are 7 villages in the Paminggir sub-district whereas three sampling plots were established in the buffalo grazing area of each village. Thus, there were 21 sampling plots established for the study. Buffalo farmers were interviewed to collect information on grazing practices, grass availability and fluctuation among seasons.

Grass production was measured once a month for 12 months (one year of observation). In every observation, grass species were recorded and weighed. According to local people knowledge, months were categorized into two seasons, namely shallow-water season (July, August, September, October and November) and deep-water season (December, January, February, March, April, May and June). The dry matter of the grass sample of each observation was determined in the laboratory according to the AOAC procedure.

Data were analysed to calculate seasonal dry matter production and its carrying capacity. The Swamp area carrying capacity was calculated as follows:

$$Carrying\ Capacity = \frac{Cumulative\ DM\ production \times proper\ use\ factor\ (\%)}{Animal\ needs(kg\ DM\ /\ AU\ /\ days) \times days\ in\ a\ season}$$

where:

DM	: dry matter
Proper use factor	: 68%
AU (buffalo BW)	: 300 kg
DM need/day	: 2.5% BW

3. Results

3.1 Seasonal Native Grass Production

The results showed that there are only 4 palatable grass species found in the sampling plots, namely Kumpai banta (*Paspalum sp*), sumpilang (*Cynodon dactylon*), Padi hiyang (*Oryza rofipogon*) and Kumpai minyak (*Hymenachne amplexicaulis*). Previous research stated that these four species of native grass are swamp grasses that have a high frequency of presence and are palatable by swamp buffalo [7]. Seasonal production from these grasses is presented in Figure 1 while the fluctuation of production over the season is presented in Figure 2.

This study indicated that there is a fluctuation in the production of palatable grasses for buffalo, whereas there are grass species that have higher dry matter production in the deep-water season than in the shallow-water season, namely Kumpai banta and Sumpilang. However, there are palatable grass species that have similar dry matter production in both seasons (Padi hiyang) or decrease during the deep-water season (Kumpai minyak).

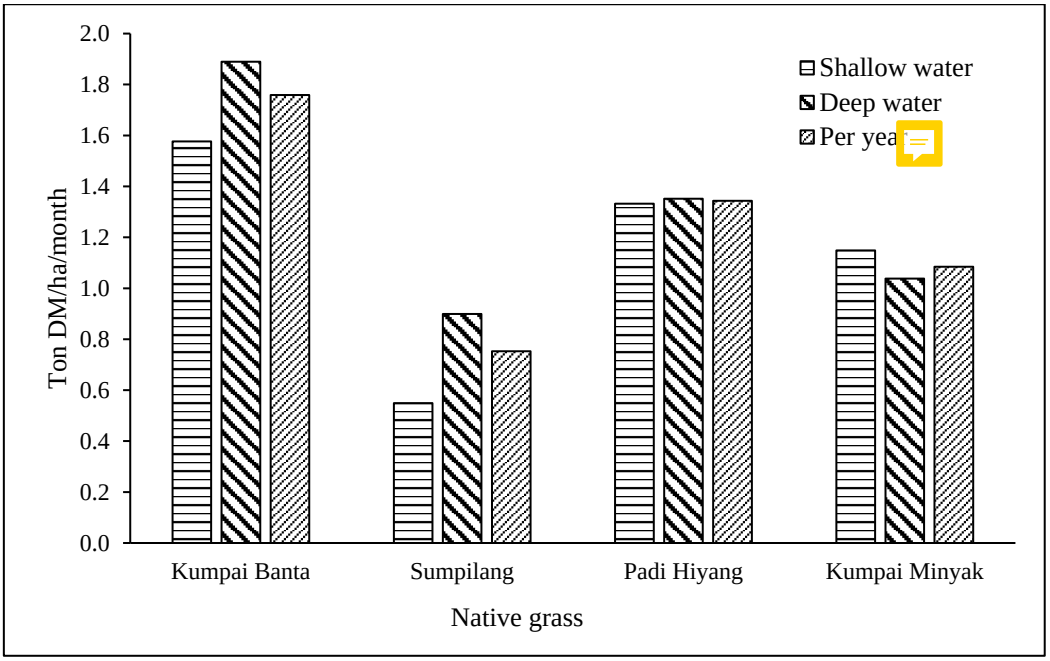

Figure 1. Seasonal production of native grass in Paminggir swamp grazing area.

Based on the height of the water, the Kalang buffalo production system is divided into two practices, namely deep-water and shallow-water season practices. In deep-water season management practices, adult buffalo are released in the morning to graze in the swamp and return to the Kalang in the afternoon. Respondents stated that in deep-water season, the availability of grass is reduced and buffaloes have to swim further to find palatable grass. In addition, buffalo calves that are not yet strong enough to swim in search of feed will be left behind and experience a lack of feed, especially buffalo calves that are still lactating. This is suspected to cause high mortality in buffalo calves and adversely affect the buffalo's reproductive performance [5].

During the shallow-water season, buffaloes and buffalo calves will be released into the swamp for grazing. Buffaloes do not return to the Kalang at night during the shallow-water season, because the low water level makes it difficult for the buffalo to step up back to the Kalang. During shallow-water season, the respondents stated that palatable grass is more available and buffalo mating more possibly occurs because male and female buffalo can interact better during the day and night.

This study found grass dry matter production more likely increases in the deep-water season. This finding is contrary to respondents' perception that during the deep-water season, less grass is available in the buffalo grazing area. This can be caused by the frequency of grass with high production during the deep-water season being lower than the frequency of grass with low production during the deep-water season. In their study, [7] showed that the relative frequency and relative density of Kumpai minyak decrease in the rainy season. Furthermore, respondents explained that some types of grass will sink when the water level increase but some other types of grass withstand and grow following the level of water surface. In deep-water season, the pols of some grass species will be washed away and can still grow following the water flow. Therefore, further research is needed to study the characteristics of native grass species according to the water level or season.

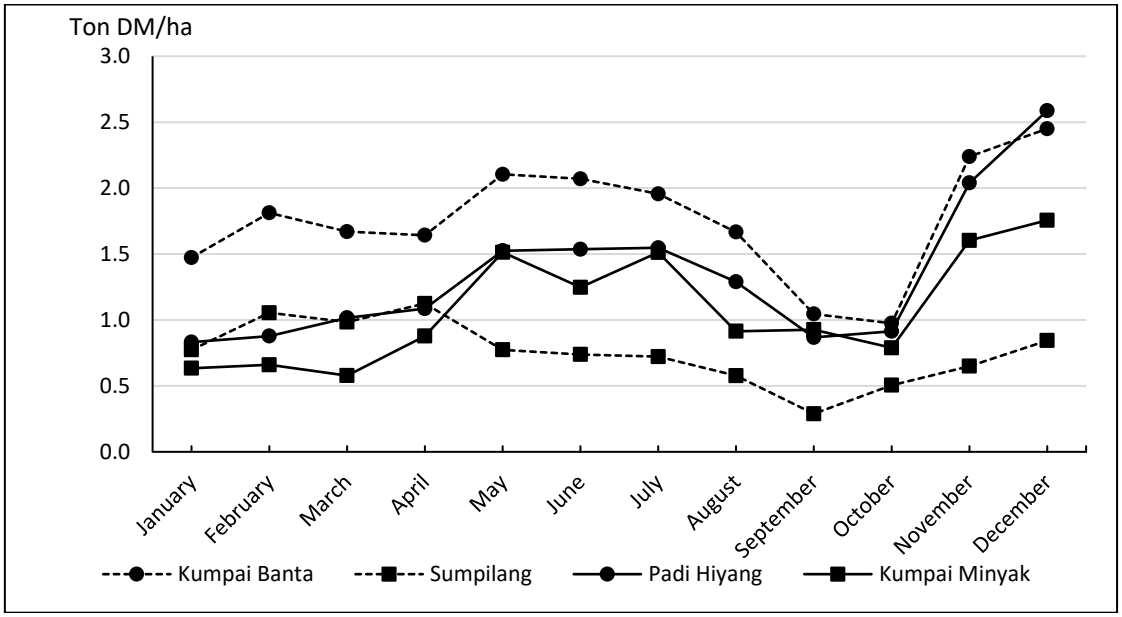

Figure 2. Monthly fluctuation of native grass production in the Paminggir swamp grazing area.

3.2. Seasonal Grassland Production and Carrying Capacity

This study showed dry matter production and carrying capacity of swamp grazing area is higher in the deep-water season (Table 1).

Table 1. Seasonal production and carrying capacity of Paminggir swamp grazing area.

Season	Productivity (Ton dry matter/ha/month)	Carrying Capacity (Animal Unit/season)
Shallow-water (July-November)	4.61	13.6
Deep-water (December-June)	5.18	15.5
Per Year	4.94	14.7

Respondents generally assumed that feed availability decreases in the deep-water season. However, as shown in Figure 2, there was a monthly fluctuation in grass production over the seasons. Despite the production is very high at the beginning of the shallow-water season, the lowest production occurs at the end of the shallow-water season (November) and then increases to the highest at the beginning of the deep-water season (December). This was because the grass grows well when it is not completely submerged, so it will grow well during the shallow-water season. But at the end of the shallow-water season, the availability of water decreases and lowers the productivity of the grass. Therefore, at the beginning of the deep-water season, grass production will be very high.

The carrying capacity of swamp grazing area in the Paminggir sub-district is relatively high (14.7 AU/ha/year) when compared to the report [7] on swamps in Pampangan District, South Sumatra Province (3.7 AU/ha/year). The production of dry matter and the carrying capacity of swamp grazing areas seem to be higher than dry land grazing areas, as reported by [8] who estimated the carrying capacity of grassland in Sumba island to be 1.01/ha/year as well as compared to the well-managed grasslands in Padang Mangatas estimated to 5 AU/ ha/year [9].

The carrying capacity of the Paminggir grazing area can still meet the needs of the existing buffalo population. Based on data [10], the Paminggir sub-district has an area of 196,780 ha with a buffalo population of 8,994 head. The ratio of the availability of fodder for each animal unit compared to the needs of each animal unit in the Paminggir swamp grazing area is estimated to be > 1 (463), which shows that the number of livestock is less than the amount of feed available from pasture [11]. However,

in other swamp areas of South Kalimantan, it was reported to have declined in feed availability due to swamp conversion into oil palm plantation, water pollution by domestic wastes or palm oil plantation, and golden snail (*Pomacea canaliculate*) invasion [6] [12].

4. Conclusion

Dry matter grass production and carrying capacity of swamp grazing area in the Paminggir is fluctuating along seasons, but it reached the highest at the beginning of each season. In general, grass availability, dry matter production, and carrying capacity were higher in the deep-water season. However, buffaloes had to swim further for grazing. This study reveals that the amount of feed available in the Paminggir grazing area exceeds the current buffalo population.

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References

[1] Sumantri I, Widi T S M, Widyas N, Habibah and Albana H 2022 Morphometrics and carcass production of Kalimantan swamp buffalo under extensive production system (kalang) *Livestock Research for Rural Development* **34**, Article #15. Retrieved September 18, 2022, http://www.lrrd.org/lrrd34/3/3415isuma.html

[2] Pineda P S, Flores E B, Herrera J R V and Low W Y 2021 Opportunities and challenges for improving the productivity of swamp buffaloes in Southeastern Asia *Front. Genet.* **12** 629861. doi: 10.3389/fgene.2021.629861

[3] Sumantri I and Chang H S 2021 Impact of imported Indian buffalo meat on red meat supply and demand in South Kalimantan, Indonesia *IOP Conf. Ser.: Earth Environ. Sci.* **902 012033** https://iopscience.iop.org/article/10.1088/1755-1315/902/1/012033/pdf

[4] DGLS (Directorate General of Livestock and Animal Health Services) 2020 Livestock and Animal Health Statistics 2020 (Jakarta: DGLAHS, Indonesian Ministry of Agriculture) p 236

[5] Widi T S M, Pratowo S, Sulaiman A, Hulfa R and Sumantri I 2021 Reproductive characteristics of female swamp buffalo reared under Kalang production system in South Kalimantan *IOP Conf. Ser.: Earth Environ. Sci.* **902 012041** https://iopscience.iop.org/article/10.1088/1755-1315/902/1/012041

[6] Hilmawan F, Subhan A and Hamdan A 2020 Kerbau rawa di Kalimantan Selatan: potensi dan permasalahannya *Proc. Sem. Teknologi dan Agribisnis Peternakan (Purwokerto)* vol 7 (Purwokerto: Faculty of Animal Science, UNSOED) pp 175-183

[7] Muhakka, Suwignyo R A, 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

[8] Hae V, Kleden M dan Temu S 2020 Produksi, komposisi botani dan kapasitas tampung hijauan pada padang penggembalaan alam awal musim kemarau *Jurnal Nukleus Peternakan* **7(1)** 14-22 https://doi.org/10.35508/nukleus.v7i1.2299

[9] Muhajirin, Despal dan Khalil 2017 Pemenuhan kebutuhan nutrien sapi potong bibit yang digembalakan di Padang Mengatas *Buletin Makanan Ternak* **104(1)** 9-20

[10] BPS-Satistick 2022 *Hulu Sungai Utara District in Figure* (Amuntai: BPS of HSU District) p 9-232

[11] Kleden M M., Ratu M R D, and Randu M D S 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

[12] Agusliani E and Dharmaji D 2017 Biodiversity of the swamp of Danau Panggang Hulu Sungai Selatan District. *EnviroScienteae* **13(3)** 187