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Research Article

Assessing Buffalo Carrying Capacity Based on Grass Yield and Nutrient Content in West Sulawesi

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Abstract | Feed is the main factor that is considered in optimizing production in order to develop an efficient livestock productivity. This study was conducted to examine the carrying capacity for buffalo based on grass production in West Sulawesi. The data collection method in this study used primary and secondary data. Primary data was carried out by field observations, direct measurements and interviewing respondents. Secondary data was obtained from information from Central Bureau of Statistics. The forage samples were taken from several regencies in West Sulawesi province. Feed samples were analysed proximately to determine nutrient levels in the feed. Land forage production was calculated by multiplying feed nutrients by the area of grazing land in West Sulawesi. Carrying capacity was calculated by dividing forage production in West Sulawesi by ruminant requirements of grass. The study showed that grass in West Sulawesi contained an average of 87.3% Dry Matter (DM), 8.8% Crude Protein (CP) and 60.2% Total Digestible Nutrients (TDN). Total ruminant in West Sulawesi was 144,766.6 AU (1 AU equivalent to an adult buffalo or cattle) with DM requirement was 1,954,349.9 kgDM. The grass production in West Sulawesi was 7,017,943,851.4 kgDM/year. Carrying capacity in this study was 1,588,867.97 AU. Therefore, the number of buffalo that can still potential to be developed or added in this province were 1,444,101.3 AU of buffalo. In conclusion, West Sulawesi Province has great potential to develop buffalo farming. The biggest area that could still be developed to graze buffaloes was Pasangkayu Regency, with a carrying capacity of 342,368.5 AU. In addition, efforts by the government and farmers are also needed to improve quality grass in order to increase buffalo productivity.

Keywords | Carrying capacity, Buffalo, Grass, Production

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INTRODUCTION

Livestock are sources of meat, milk and other products in developing countries. On global scale, the livestock also contribute not less than 40% to agricultural gross domestic product (GDP; Salmon et al., 2022). In Indonesia, livestock contributed more than 325 trillion rupiah to GDP in 2023 and in the same year, the ruminant contributed 1.56% to the Indonesia's economy (Siahaan, 2024).

Not only improving the economy, livestock also has several important roles in human life and one of them is culture (Luthfi *et al*., 2024). Buffalo in West Sulawesi is one of the major sources of animal protein. This demand increases from year to year. Besides, the buffalo is required as an offering in a famous traditional funeral ceremony in West Sulawesi, called Rambu Solo. Rambu Solo is carried out by the Toraja ethnic in South and West Sulawesi and has been existing for hundreds of years. These need buffalo supply along the year in West Sulawesi Province (Suryaalim and Fausiah, 2022). Therefore, buffalo rearing development in West Sulawesi is very necessary to maintain the sustainability of this culture and meat supply.

West Sulawesi Province, Indonesia, has potential livestock to be developed especially buffalo. The population of buffalo increased every year, namely 8,725 in 2019, 8,948 in 2020 and 9,412 in 2021 (Directorate General of Livestock and Animal Health, 2023). The farmers in this area have been using grasses for rearing their buffaloes (Asriany, 2017). Luthfi *et al*. (2022) claimed that the availability of feed is the main factor that needs to be considered in order to develop an efficient in the rearing system. Pasture or grass is one of the factors that can increase profits in a grazing system because it does not take any cost and reduces the cost for rearing (feed, land, labor, equipment) (O'Donovan *et al*., 2021), but it also causes a common problem faced by farmers in developing countries, namely the forage availability to fulfil feed requirements of the ruminants (Tikam *et al*., 2013). The balance between the amount of grass available and the requirements of animal feed needs to be considered to maximize the use of pasture (Meehan *et al*., 2018). The balance between grass availability and animal requirements is also important for managing graze land (Moorby and Fraser, 2021). Therefore, the level of forage utilization in West Sulawesi Province needs to be observed while buffalo are grazed to obtain an estimated stocking rate. This study was conducted to examine the carrying capacity for buffalo based on grass production in West Sulawesi Province.

MATERIALS AND METHODS

Study Site

The research was carried out in 5 months (April - September). The forage samples were taken from several regencies in West Sulawesi Province. The data collected in this study were primary and secondary data. The primary data were obtained by interviewing correspondents (farmers), direct measurements and observations. Interviews were conducted directly and in depth in the field using a structured questionaire with 100 respondents in four regencies (30 respondents from Polewali Mandar, 30 respondents from Mamuju, and 30 respondents from Mamasa). The selection of respondents was carried out using multistage random sampling, by selecting 3 regencies that had the highest buffalo population. From each regency, the districts were selected to be sampled. The number of respondents was divided based on proportional sampling, and the results were analysed descriptively. The selected areas were areas representing the lowlands (Polewali Mandar and Mamuju Regencies) and the highlands (Mamasa regency). The grazing lands (pastures) were selected based on latitude. The questionnaire contained questions about feeding managements. In each regency, 10 pasture locations were selected to take grass samples. Observations on the production and nutritional contents of cultivated and uncultivated grass were made by taking samples through tiling with a size of 1 x 1 m^2 for each grass area (Basuki *et al*., 2010). Quadrants were made every 5 m along a transverse or diagonal line. Within the quadrant, grass samples were cut at a height of approximately 3 cm from the ground surface. Secondary data was taken by collecting data from related agencies such as Animal Husbandry, Agricultural Extension Agency, Central Bureau of Statistics, Regency and Village Offices. The variables observed in this study are dry matter production (DM), crude protein (CP) and total digestible nutrients (TDN) as well as DM, CP and TDN capacity whose values are obtained using proximate analysis on forage. The analysis of the dry matter (DM; method 934.01), ash (method; 942.05), crude fibre (Cfi, method 962.09) and extract ether (EE; method 920.39) of forage was carried out according to AOAC standard procedure (2016), the nitrogen content of feed was analysed using Kjehldahl method (AOAC, 2016).

Feed samples were analyzed proximately to determine nutrient levels in the feed. Land forage production was calculated by multiplying feed nutrients by the area of grazing land in West Sulawesi. Livestock capacity was calculated by dividing forage production in West Sulawesi by livestock DM, CP and TDN requirements. According to Tresia *et al*. (2021) technical coefficient of one head of cattle/buffalo (adult = 1 AU, young = 0.5 AU) and one head of goat/sheep (0.24 AU) and considering NRC (1984), requirements for beef cattle were 3% DM of body weight with PK needed was 12% and TDN was 60-65%. All data obtained in this study was reported descriptively.

RESULTS AND DISCUSSION

Nutrients and Grass Production

All respondents grazed their buffaloes in pastures. Only about 6.7% of farmers provided setaria grass and 10.2% of farmers provided Napier grass as additional grass for the buffalo.

The nutrient content of grass in West Sulawesi were presented in Table 1. The result showed that the averaged nutrients of grass consisted of DM 20.1%, Ash 5.8%, CP 8.8%, Cfi 26.5%, EE 2.0%, NFE 57% and TDN 60,0.

Table 1: The nutrient content of grass in west sulawesi province.

Feed sample	location	DM (%)	Ash (%)	CP (%)	Cfi (%)	EE (%)	NFE*	TDN**
Napier Grass	Mamasa	83.3 ± 0.86	6.6 ± 0.07	11.7 ± 0.12	26.9 ± 0.28	0.7 ± 0.01	54.1 ± 0.56	62.54 ± 0.64
Setaria Grass	Mamasa	82.8 ± 1.74	5.2 ± 0.11	10.0 ± 0.21	27.9 ± 0.59	1.6 ± 0.03	55.3 ± 1.16	60.25 ± 1.27
Natural Grass	Mamasa	89.0 ± 0.98	4.7 ± 0.05	7.6 ± 0.08	26.8 ± 0.29	1.9 ± 0.02	59.0 ± 0.65	60.74 ± 0.67
Natural Grass	Polewali	86.9 ± 0.77	5.2 ± 0.05	5.0 ± 0.04	31.6 ± 0.28	2.9 ± 0.03	55.3 ± 0.49	44.82 ± 0.40
Napier Grass	Polewali	89.1 ± 0.89	6.6 ± 0.07	7.2 ± 0.07	24.5 ± 0.25	2.0 ± 0.02	59.8 ± 0.60	62.89 ± 0.63
Napier Grass	Mamuju	89.3 ± 0.88	6.6 ± 0.06	9.8 ± 0.10	28.6 ± 0.29	2.5 ± 0.02	52.6 ± 0.52	55.14 ± 0.54
Natural Grass	Mamuju	90.6 ± 0.91	5.6 ± 0.06	10.1 ± 0.10	19.4 ± 0.19	2.3 ± 0.01	62.6 ± 0.63	74.79 ± 0.75
Averaged		87.3 ± 3.09	5.8 ± 0.81	8.8 ± 2.27	26.5 ± 3.81	2.0 ± 0.71	57.0 ± 3.58	60.2 ± 9.02

Legends: DM = Dry Matter, CP = Crude Protein, Cfi = Crude Fibre, EE = Ether Extract, NFE = Nitrogen Free Extract (Hartadi, 2005), TDN = Total Digestible Nutrients (Hartadi, 2005). * NFE = 100 - Ash - CP - Cfi – EE;** TDN = -54,572 + 6,769 Cfi - 51,083 EE + 1,851 NFE - 0,334 CP - 0,049 Cfi + 3,384 EE^2 - 0,086 Cfi NFE + 0,687 EE NFE + 0,942 EE CP - 0,112 EE^2 CP.

Table 2: The population of ruminant in west sulawesi.

DISTRICT	Cattle (head)	AU (1)	Buffalo (head)	AU (1)	goat (head)	AU (0,14)	total AU
Mamuju	19,652	19,652	787	787	15,611	2,185.5	22,624.5
Mamasa	9,540	9,540	7,472	7,472	205	28.7	17,040.7
Poliwali Mandar	35,882	35,882	839	839	94,999	13,299.8	50,020.8
Majene	38,592	38,592	384	384	151,140	21,1596	21,927.6
Pasangkayu	15,526	15,526	37	37	5,236	733.0	16,296.0
Mamuju Tengah	15,399	15,399	173	173	9,178	1,284.9	16,856.9
Total	134,591	134,591	9,692	9,692	276,369	38,691.6	144,766.6

In general, the nutrient content of grass in West Sulawesi was the same with other province in Indonesia. The finding of Despal *et al.* (2021) found that grass in West Java contained 11,43% CP, 28.8% Cfi, and 5.5% EE. The finding by Mashudi *et al.* (2022) found that field grass in East Java consisted of DM 23,59%, CP 6,43% and CFi 3,87%. However, the cultivated grass such as Caliandra consisted of DM 30.66%, CP 20.33% and Cfi 22.63% and Odot grass consisted of DM 28.97%, CP 12.38%, and Cfi 27.94%. The difference in nutrient content of grass was due to several factors that influence the quality of grass in grazing environments. Climate, weather, soil fertility, fertilizer application and management in each area might be difference. Tresia *et al.* (2021) stated that forage availability was strongly influenced by season. The finding by Tahuk *et al.* (2018) showed that the feed used by the farmers in the rainy season was more varying and had better quality than the feed produced during the dry season. As a result, Bali cattle fattening productivity was higher in the rainy season than in the dry season. Nasrullah et al. (2003) claimed that grass quality could be influenced by climate, altitude and soil condition.

Based on nutrients content of grass, it was calculated that grass production in West Sulawesi was 695.2 gDM/m^2 with CP of 60.2 gDM/m^2 and TDN 396.4 gDM/m^2. So that, grass production that was yielded in a hectare was 6,952.4 kgDM and the production as fed was 312,857.1 kg/ha. This finding was indicated that West Sulawesi Province had good production throughout the year. It was due to the grazing area used was still quite large with abundant grass production throughout the year. Toputri et al. (2003) found that grass production was 7.5 tons/ha as fresh weight, and 1.5 tons/ha as dry matter on post-mining land. Tahuk *et al.* (2018) stated that adequate feed, both quantity and quality, played an important role to ensure the nutritional requirements of the animals were fulfilled and improve their productivity throughout the year. Previous research by Widi et al. (2021) reported that changes in land allocation to housing, rice fields, and plantations resulted in a decrease in the area of buffalo grazing land and a decrease in the availability and productivity of grass preferred by buffalo.

Ruminant Population and Nutrient requirements

All populations and nutrients requirements of livestock that were grazed in West Sulawesi must be calculated first. This was because it is not possible to distinguish the pastures used by each livestock species. Furthermore, the availability of grass is used for buffalo development if the population of cattle and goats is considered constant. The population of ruminants in West Sulawesi Province was presented in Table 2. Based on the survey, the population of ruminant animals in West Sulawesi Province was 420,652, consisted

Table 3: Nutrient requirements of ruminant in west sulawesi.

Requirements of livestock				
DISTRICT	total AU	DM (KgDM)	CP (kgDM)	TDN (kgDM)
Mamuju	22,624.5	30,5431.3	36,651.8	198,530.3
Mamasa	17,040.7	23,0049.5	27,605.9	149,532.1
Poliwali Mandar	50,020.9	67,5281.6	81,033.8	438,933.0
Majene	21,927.6	29,6022.6	35,522.7	192,414.7
Pasangkayu	16,296.0	21,9996.5	26,399.6	142,997.8
Mamuju Tengah	16,856.9	22,7568.4	27,308.2	147,919.5
Total	144,766.7	1,954,349.9	234,522.0	1,270,327.4

Table 4: Carrying capacity of ruminant in west sulawesi based on grass production.

DISTRICT	Area (m^2)	Forage production per year	Total AU	Carrying capacity	The difference
Mamuju	84,434.60	528,319,354.29	22,624.54	107,218.54	84,594.00
Mamasa	169,592.00	1,061,161,371.43	17,040.70	242,274.29	225,233.59
Polewali Mandar	229,862.10	1,438,279,997.14	50,020.86	328,374.43	278,353.57
Majene	153,675.80	961,571,434.29	21,927.60	219,536.86	197,609.26
Pasangkayu	251065.20	1,570,950,822.86	16,296.04	358,664.57	342,368.53
Mamuju Tengah	232959.5	1,457,660,871	16,856.92	332,799.29	315,942.37
Total	1,121,589.20	7,017,943,851.43	144,766.66	1,588,867.97	1,444,101.31

of 134,591 cattle, 9,692 buffaloes, and 276,369 goats. Considering concept and coefficient of animal unit by Tresia *et al.* (2021) that one cattle/buffalo (adult) was 1 AU, young cattle/buffalo was 0.5, calf was 0.25, one goat (adult) was 0.14 AU, a young goat = 0.07 AU, a kid was 0.0035 AU, then the population of ruminant animals in West Sulawesi Province was 144,766.6 AU. The ruminant animals spread across several regencies. The highest population was in Polewali Mandar Regency, i.e 50,020.8 AU and the lowest population was in Pasangkayu Regency, i.e 16,296 AU.

Nutrient requirements of ruminant was presented in Table 3. Considering NRC (1984), DM requirements of cattle was 3% body weight, with CP being 12% and TDN being 60-65%. Based on the calculation, the total nutrients requirements of ruminants for DM, CP and TDN were 1,954,349.9 kg/d; 234,522.0 kg/d and 1,270,327.4 kg/d, respectively. Polewali Mandar Regency had the highest ruminant population in West Sulawesi Province, so that the nutrient requirement for DM, CP and TDN of the ruminants in this area were the highest, i.e. 675,281.6 kg/d, 81,033.8 kg/d and 438,933.0 kg/d, respectively. The lowest population of ruminants in Pasangkayu resulted the lowest nutrient requirements for DM, CP and TDN, i.e 219,996.5 kg/d, 26,399.6 kg/d and 142,997.8 kg/d, repectively.

Carrying Capacity

The carrying capacity of the grassland in West Sulawesi Province is presented in Table 4. The results showed that area that could be used to graze the animals was 1.121.589,20 m^2. This area was an area consisting of fields, gardens, forests, pastures, state forests and others. The largest area in West Sulawesi Province was located in Pasangkayu Regency, so that grass production was high, i.e 1,570,950,822.8 kgDM/year. The lowest area in West Sulawesi Province was located in Mamuju Regency, the yielded grass at amount of 528,319,354.2 kgDM/year.

Based on area and ruminant nutrient requirements, it can be estimated how many animal units that can be grazed in thus area for a certain time (carrying capacity). Total carrying capacity (CC) in West Sulawesi was 1,588,867,9 AU. The highest CC was in Polewali Mandar regency, and the lowest was in Mamuju regency. Carrying capacity was affected by area and nutrient requirements of animals. If the population of cattle and goat was constant, there was an opportunity to develop buffalo farming. The total amount of buffalo that can be developed in West Sulawesi was 1,444,101.3 AU. This implied that there were opportunities for the farmer to increase the scale buffalo farming; which hopefully increase family income. In this study found that the highest area with a small population, still has the potential to develop or increase the number of buffalo. Pasangkayu regency, a biggest CC with small population, this area still has the biggest potential to develop as many 342,368.5 buffalo as possible, and the lowest potential to be reared was in Mamuju with the number of buffalo were 84,594.0 AU. To realise this opportunity, the local government should develop farmer community and grazing system that buffalo farmers could take benefit from abundant grass availability.

CONCLUSIONS AND RECOMMENDATIONS

West Sulawesi Province had big potential to develop buffalo farming. The carrying capacity in West Sulawesi Province was 1,588,867,9 AU with grass production was 7,017,943,851.4 kg/year. The number of buffalo that can still potential to be developed or added in this province was 1,444,101.3 AU of buffalo. The biggest area that still could be developed to graze buffaloes was Pasangkayu Regency, with carrying capacity of 342,368.5 AU. To increase the buffalo production and productivity, new knowledge and technology of buffalo feeding such as feed supplementation should be introduced to the farmers.

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NOVELTY STATEMENT

Studies regarding the Carrying Capacity For Buffalo Based On Grass Production In West Sulawesi Have Not Been examined.

AUTHOR'S CONTRIBUTIONS

All authors contribute to the conduct of research, the writing process, and data analysis.

Conflict of Interest

The authors state there is no conflict of interest.

REFERENCES

AOAC (2016). Official Methods of Analysis As-soc. Off. Anal. Chem., Arlington, VA. Washington DC, USA.

Asriany A (2017). Kearifan Lokal Dalam Pemeliharaan Kerbau Lokal Di Desa Randan Batu Kabupaten Tana Toraja. Bul. Nutr. Makanan Ternak, 12(2).

Basuki CT, Purwanto J, Fajarningsih RU, Ani SW (2010). Dampak Alih Fungsi Lahan Pertanian Ke Sektor Non Pertanian Terhadap Ketersediaan Beras Di Kabupaten Klaten Provinsi Jawa Tengah. Caraka Tani: J. Sustainable Agric., 25(1): 38. https://doi.org/10.20961/carakatani.v25i1.15732

Despal LJ, Andini, Nugraha E, Zahera R (2021). Regional Variation Accuracy Detection of Natural Grass Multi-Species as Dairy Cattle Forage using FT-NIRS. Int. J. Dairy Sci., 16: 153-160. https://doi.org/10.3923/ijds.2021.153.160

General Directorate of Livestock and Animal Health (2024). Accessed 24 March 2024.

Godfray HCJ, Beddington JR, Crute IR, Haddad L, Lawrence D, Muir JF, Pretty J, Robinson S, Thomas SM, Toulmin C (2010). Food security: The challenge of feeding 9 billion people Science, 327: 812-818. https://doi.org/10.1126/science.1185383

Luthfi N, Adiwinarti R, Purnomoadi A, Rianto E (2022). Effect of feeding level on growth rate, carcass characteristics and meat quality of thin tailed lambs. J. Indones. Trop. Anim. Agric,. 47(4):290-300. https://doi.org/10.14710/jitaa.47.4.290-300

Luthfi N, Susanti SI, Nuraliah S, Faradila S, Suryani HF, Salido WL, Armayanti AK, Jannah R, Khaeruddin, Prima A (2024). Pengantar Peternakan. PT. Sonpedia Publishing Indonesia. Jambi, Indonesia.

Mashudi DHT, Irsyammawati A dan Hermanto (2022). Potensi Daya Dukung dan Daya Tampung Pakan Hijauan untuk Mendukung Peternakan Kambing Peranakan Etawah di Kecamatan Ampelgading, Kabupaten Malang, Jawa Timur. J. Nutr. Ternak Trop.,. 5 (1): 23-36. https://doi.org/10.21776/ub.jnt.2021.005.01.3

Meehan M, Sedivec KK, Printz J, Brummer F (2018). Determining Carrying Capacity and Stocking Rates for Range and Pasture in North Dakota.

Moorby JM, Fraser MD, Moorby JM, Fraser MD (2021). Review: New feeds and new feeding systems in intensive and semi-intensive forage-fed ruminant livestock systems, Animal, 15(1): 100297. https://doi.org/10.1016/j.animal.2021.100297

Nasrullah M. Niimi R. Akashi, Osamu K (2003). Nutritive evaluation of forage plants grown in South Sulawesi, Indonesia. Asian-Aust. J. Anim. Sci. 16:693-701. https://doi.org/10.5713/AJAS.2003.693

National Research Council. 1984. Nutrient Requirements of Beef Cattle. Washington, DC: The National Academies Press. https://doi.org/10.17226/19398

O'Donovan M, Hennessy D and Creighton P (2021). Ruminant grassland production systems in Ireland. Ir. J. Agric. Food Res., 59(2): 225-232. https://doi.org/10.15212/ijafr-2020-0118

Tahuk PK, Baliarti E, Budhi EPS, Panjono (2018). The Effect of Season on the Feed Quantity and Quality and Growth Performance of Male Bali Cattle Fattened in Smallholder Farms. Buletin Peternakan 42 (3): 203-209. https://doi.org/10.21059/buletinpeternak.v42i3.33058

Tikam K, Phatsara C, Mikled C, Vearasilp T, Phunphiphat W, Chobtang J, Cherdthong A, Sudekum KH (2013). Springer Plus. 2-6. https://doi.org/10.1186/2193-1801-2-604

Tresia GE, Puastuti W, dan Inounu I (2021). Kapasitas Tampung untuk Ternak Ruminansia Berdasarkan Pakan Hasil Samping Perkebunan dan Potensi Emisi Gas Metana Enterik. WARTAZOA, 31 (1) : 23-36.

Toputri NAA, Habibi RA, Harri E, Sema, Utamy RF, Hasan S (2023). Preliminary study: Production and quality of signal grass (Brachiaria decumbens) on the post mining land. AIP Conf. Proc. 2628, 110003. Proc. 4th Int. Conf. Anim. Sci. Technol., (ICAST 2021) 9–10. https://doi.org/10.1063/5.0143973

Salmon GR, MacLeod M, Claxton JR, Pica CU, Robinson T, Duncan A, Peters AR (2020). Exploring the landscape of livestock 'Facts', Global Food Security, 25: 100329, ISSN 2211-9124. https://doi.org/10.1016/j.

gfs.2019.100329
Siahaan M (2024). Gross domestic product (GDP) from livestock sector in Indonesia from 2014 to 2023 (in trillion Indonesian rupiah). Statista. Accessed: 6 January 2024.
Suryaalim AMA, Fauziah A (2022). Analisis hirarki proses pada penetapan harga kerbau di kabupaten mamasa propinsi sulawesi barat. Agrovital J. Ilmu Pertanian, 7(2): 85-90. https://doi.org/10.35329/agrovital.v7i2.3561
Widi TSM, Pratowo S, Sulaiman A, Hulfa R, Sumantri I (2021). Reproductivecharacteristics of female swamp buffaloreared under Kalang production system inSouth Kalimantan. IOP Conf. Ser. EarthEnviron. Sci. 902. https://doi.org/10.1088/1755-1315/902/1/012041