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The Effect of Season on the Feed Quantity and Quality and Growth Performance of Male Bali Cattle Fattened in Smallholder Farms

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ABSTRACT

The research was aimed to determine the effect of season on feed quantity and quality, and growth performance of male Bali cattle fattened in smallholder farms. Observation from January to March for rainy season and June to August for dry season. Feed quantity and quality were observed covering all feedstuff used farmers in fattening. Cattle used for rainy season was 50 heads aged 1.5 – 4.0 years with initial body weight (BW) 188.03±31.85 kg. In dry season, observation was continued for the same cattle as many as 35 heads aged 2.0 – 4.5 years and initial BW was 261.80±38.46 kg. Data were analyzed by quantitative descriptiption for feed quantity and quality, while growth performance were analyzed by independent T-Test. Results of study showed the dominant type of feedstuff used during rainy and dry season were L.leucocephala (56.00 vs 33.14%), Zea mays fresh straw 18.44% (rainy season), natural grass (13.00 vs 22.25%), P.purpuroides (3.68 vs 3.99%) and G.sepium (1.36 vs 29.69%). Crude protein (CP) of L.leucocephala and G.sepium higher during the dry season, while S. grandiflora, natural grass, and P.purpuroides higher in rainy season. The DMD (%) of L. leucocephala and S. grandiflora in rainy and dry seasons were almost the same, but G.sepium had DMD higher in dry season. The OMD L.leucocephala and G. sepium higher during the dry season, while the S.grandiflora had higher during the rainy season. Natural grass and P.purpuroides had DMD and OMD higher during the rainy season. Dry matter intake (kg/head/day) of cattle during dry season was higher (P<0.01), but rainy season ADG and FCR was higher (P<0.01). It can be concluded the feed used by farmers during the rainy season was more varied, with better quality. As a result, the performance of Bali cattle fattened was higher in the rainy season than in the dry season.

Keywords: Bali cattle fattening, Digestibility, Feed quantity and quality, Rain and dry seasons, Smallholder farms

Introduction

Adequacy of feed in terms of quantity and quality have a very important role in ensuring the productivity of livestock throughout the year. But in fact, the lack of feed was always an issue every year. Such conditions usually experienced by farmers in smallholder farms who rely largely on the feed availability of natural generosity. Climate factor had become a universal phenomenon that determines the quality and quantity of feed given to livestock in West Timor, East Nusa Tenggara. As the rainy season is relatively short (about 3 – 4 months), the availability of forage is abundant with a high enough quality which increases the performance of livestock. On the other hand, in dry season that is relatively longer (8 – 9 months), the productivity of forage decreases. As a result, livestock growth was low (Tahuk and Dethan, 2010).

According to Semiadi and Jamal (1997), the production of dry matter and quality of grass on the Timor Island is quite fluctuative between rainy and dry season. In March to October, production of dry matter (DM) is about 3 tons/ha, and increase sharply up to 6.7 tons/ha in December to February. The content of crude fibre a fairly high with the crude protein level remains at 6%. The situation described above indicated that the value of feed ingredients commonly used in the tropics, including Indonesia, was inferior in quality. Therefore, it's not surprising if the performance of the livestock does not correspond to its genetic potential (Mathius, 1993).

Inventory of the feed quantity, nutritive value, and digestibility, as well as growth performance of cattle were an important aspects that needs to be done. This was to give a picture of the real condition in Bali cattle fattened on the smallholder farms, especially regarding to the feed

management in the rainy and dry season. Thus, decreasing the performance of livestock, especially in the dry season can be minimized. The objevtive of study was identifying and evaluating the feed quantity and quality used in male Bali cattle fattened in smallholder farms during rainy and dry seasons; and the identifying performance of cattle fattening in smallholder farms which include feed consumption, daily body weight gain and feed conversion ratio in rainy and dry seasons.

Materials and Methods

Research design, location, cattle, and animal feedstuff

The research was done in two seasons, from January to March for the rainy season and June to August for the dry season at the Nekmese Farmers Group, Usapinonot Village, Insana Barat District, Timor Tengah Utara, East Nusa Tenggara.

The feed quantity and quality were observed covering all feedstuffs used by farmers for fattening their cattle. The cattle used in rainy season were 50 male Bali cattle, aged 1.5 – 4.0 years with initial weight of 188.03±31.85 kg. In the dry season, the observation was continued for of the same cattle as many as 35 head, aged 2.0 – 4.5 years with the initial weight was 261.80±38.46 kg. The chemical composition of feed was analyzed using proximate analysis (AOAC, 2005) and in vitro analysis (Tilley and Terry, 1963).

Variable measurement and data collection

The observed variables included the feed quantity used, nutrient contents, as well as digestibility of dry and organic matter (DMD and OMD). The growth performance measured in this study included dry matter intake (kg), daily body weight gain (kg), and feed conversion ratio (FCR). For observation of the quantity of feed used of farmers, the feed weighed to determine the amount and type of feed before given to cattle. For the laboratory analysis, the feedstuffs samples were taken in sufficiently amount, sun dried, grinded, weighed, then put into oven at a temperature 105^{o}C, and analyzed the nutrient content and digestibility.

Cattle raising was conducted individually by adapting the traditional feeding practice of farmers in in the morning, afternoon, and evening. Drinking water was provided ad libitum. Prior to the administration, the feed was weighed for data collection. Feed remains were weighed to obtain data of feed consumption. The cattle were weighed once a month to determine the growth performance, in which the cattle were fasted for approximately 12 hours before weighing. Feed conversion ratio was obtained by comparing the dry matter intake with daily body weight gain.

Statistic analysis

Data collected was analyzed by quantitative description for the quantity and quality of used of farmers, while the growth performance were analyzed by the independent t-test (Steel and Torrie, 1995) to compare the growth performance of the cattle to the rainy and dry seasons. Data was analysed using SPSS 19 Software.

Result and Discussion

Feed quantity

Climatic conditions in the Nekmese Farmer's group, Usapinonot Village generally were dry climates with the highest temperatures of 32°C in dry months, and lowest at 18°C in wet months. The number of wet months was relatively short for only four (4) months between December and March, while the number of dry months was approximately eight (8) months (April to November) with an average rainfall of 50 - 2,135 mm in one year (ACIAR, 2013). In this study, the air humidity in the morning was 97, but decreased during the day to 57. This condition has an impact on the availability of feed used by farmers in cattle fattening.

The feed quantity used by farmers in Bali cattle fattening not much varied both in rainy and dry season (Table 1). Forage feedstuffs used by farmers in the rainy season reach 17 types of feed materials, whereas in the dry season reached 16 kinds of feed ingredients; where the percentage of over 1% of the 5 feedstuffs in rainy and dry season. *Zea mays* fresh straw in the rainy season was used only limited to the harvest season, especially in March.

The results showed that *L. leucocephala* was potential feedstuffs since it was dominantly used by the farmer, but its availability was slowly declining during the dry season. This was caused by the aspect of availability that was decreasing. According to Mathius (1993), as a source of forage feedstuffs, this plant had not been used optimally and had not been widely commercialized as green feedstuffs. Nulik *et al.* (2004) reported that the plant of performance of *L. leucocephala* KX2 hybrid and *L. leucocephala cv. Tarramba* had a better production than the other types and had the potential to be developed in the NTT province. Production of *Leucaena* KX2 hybrid reached 18.1 tons DM/ha/year and *L. leucocephala cv. Tarramba* reached 10.9 tons DM/ha/year, while the local *L. leucocephala* production was only 8.1 tons DM/ha/year.

The usage of *Gliricidia sepium* as feed during the rainy season was quite low at only 1.36%, but in the dry season, it increased until 29.69%. The increased of *G. sepium* utilization as a feed was associated with the availability of other feedstuffs began to decrease its, for example *L. leucocephala*. Utilization of *G. sepium* by farmers as feed was still low due to low palatability so the consume of livestock was lower when compared with the other feedstuff which has a high palatability. Utilization of *Sesbania grandiflora* by farmers as feed was still lacking (4.53%). It wasdue to the development of legumes by

farmers still limited. The utilization of natural grass during the rainy season was relatively low (13.04%), but in the dry season, it increased to 22.25%. *Pennisetum purpuroides* as the superior grass was still limited in use, both in the rainy season (3.68%) and dry season (3.99%). This was related to the cultivation carried out by farmers that was still limited. According to Hasan (2012), the lack of water will slowly result in slower growth, lack of stalk range, leaves widening, and do not even showing up shoot.

The results of this study illustrated that there were fluctuations in the availability of feed to ensure the productivity of livestock throughout the year in West Timor, East Nusa Tenggara. Variations in using feedstuffs was caused by several factors, such as the availability of feed material itself that was influenced by season, farmers' access to sources of feed materials as well as the availability of labors. According to Panjaitan *et al.* (2003), the nutrient content of feed in the dry season is very low. Nevertheless, the main problem in the dry season is not on quality, but it is related to the quantity of feeds obtained by livestock.

Feed quality

Nutrient composition. The crude protein (CP) of *G. sepium* and *L. leucocephala* in rainy season was lower than the CP content in dry season. *S. glandiflora*, otherwise, had high CP content in the rainy season, but during the dry season, it decreased (Table 1). The results of this study illustrated that although the forage legume trees were more resistant to environmental stress of extreme climate, but the difference in dry and rainy season turned out to be sufficient to affect the content of the nutritional value of the forage legume. According to Dahlanuddin *et al*. (2014), tree legumes are a ruminant feed source that are high in protein (20-25%), easily established and persist throughout the dry season and may be one feed option available to smallholder Bali cattle across Eastern Indonesia.

This research report was not much different from the report of Tahuk *et al.* (2017) who obtained the CP and energy content of *L. leucocephala* were respectively 25.00% and 4903 kcal/g, *S. glandiflora* were respectively 27.37% and 4,378 kcal/g. According to Jamal and Semiadi (1997), the CP content of *S. glandiflora*, *G. sepium* and *L. leucocephala* on Timor Island in the rainy season, respectively 30.85%, 26.80% and 28.48%. The report of two researchers above was higher than the results of this study, both in the rainy season and the dry season.

The content of CF, EE, the third of this legume plants had increased during the dry season when it was compared with the rainy season. Nevertheless, the NFE content of these three legumes were higher in rainy season than the dry season. If it was viewed from the ash content, then *L. leucocephala* showed higher ash content in the rainy season, otherwise, *G. sepium* and *S. grandiflora* indicated higher the ash content in dry season. The difference in the nutrient content of *L. leucocephala* mainly due to differences in varieties, the location of the plant is harvested, harvesting age, soil type, climate and comparison of plants section observed (Mathius, 1993).

The natural grass on rainy season had a quite high nutritional value. The CP was 11.43%, in contrast to the dry season (July to August), a decline in nutritional value was significantly up to 6.08%. The content of CF, EE, NFE, and ash increased in dry season when compared to the rainy season and vice versa. This condition affects

Table 1. The feed quantity, nutrients, and *in vitro* digestibility of feedstuffs (%) in male Bali cattle fattening in Smallholder farms, Timor Tengah Utara, East Nusa Tenggara in rainy and dry seasons

Kinds of feed	Season	Botanical composition	Nutrien composition							Digestibility	
			DM	OM[2]	CP[2]	EE[2]	CF[2]	Ash[2]	NFE[3]	DM	OM
Leucaena leucocephala	Rainy	56.00	20.88	89.32	19.43	2.56	15.66	10.67	41.75	65.60	58.62
	Dry	33.14	25.45	90.19	25.65	8.41	18.98	9.81	29.52	65.39	60.21
Gliricidia sepium	Rainy	1.36	19.01	88.82	21.75	2.93	12.35	11.19	38.12	67.87	62.75
	Dry	29.69	24.27	87.56	24.19	12.55	14.51	12.44	36.31	74.25	69.77
Sesbania grandiflora	Rainy	0.77	16.75	89.49	24.09	3.31	9.81	10.51	39.62	81.27	79.00
	Dry	4.53	20.33	85.29	21.77	8.90	13.18	14.71	32.94	82.70	77.39
Natural grass	Rainy	13.04	18.09	89.44	11.13	2.44	28.99	14.68	33.28	65.64	63.15
	Dry	22.25	36.54	84.71	6.08	4.11	32.80	15.29	41.72	48.91	47.82
Pennisetum purpuroides	Rainy	3.68	14.20	81.37	12.47	0.71	25.58	18.63	32.47	69.75	61.62
	Dry	3.99	25.24	86.62	11.98	4.68	31.07	13.38	32.37	65.27	63.35
Zea mays fresh straw	Rainy	18,44	-	-	-	-	-	-	-	-	-
	Dry	-	-	-	-	-	-	-	-	-	-
Others feedstuffs	Rainy	6,61	-	-	-	-	-	-	-	-	-
	Dry	6,39	-	-	-	-	-	-	-	-	-

[1]Based on proximate analysis; [2] % of DM; [3]:NFE = 100 – (% CP + % EE + % CF + %ASH); DM=dry matter, OM=organic matter, CP=crude protein, EE=Ether extract, CF= crude fiber, NFE = nitrogen free extact.

the availability of nutrients, particularly protein for cattle that was insufficient to increase its productivity.

Dry matter and organic matter digestibility. Dry matter digestibility (DMD) of *L. leucocephala,* natural grass, and *P. purpuroides* (%) were higher during rainy season. Conversely, *G. sepium* and *S. grandiflora* were higher during the dry season. The organic matter digestibility (OMD) of *L. leucocephala* and *G. sepium* was higher during the dry season, while the *S. grandiflora* had higher OMD during the rainy season. The natural grass and *P. purpuroides* had higher DMD and OMD during the rainy season than dry season. This illustrates that the season affected the DM and OM digestibility of feedstuffs (Table 1).

The natural grass had a highly fluctuating digestibility due to the influence of season. The digestibility was higher during the rainy season, but during the dry season the digestibility decreased dramatically. The *P. purpuroides* showed quite higher digestibility in the rainy and dry season. However, the development of this kind grass by farmer was still limited. As a result, feed availability was insufficient to meet the need of livestock. Climatic factors became a limiting factor in the development of this superior grass, especially with very limited rainfall and a relatively long of dry season.

Growth performance

Dry matter intake. Dry matter intake (DMI) (kg/head/day) of male Bali cattle in smallholder farms during the dry season was higher (P<0.01) compared with the rainy season (Table 2, Figure 1). The intake of DM in the rainy season was only 77.62% or lower 22.38% than in the dry season.

The DMI differences were due to differences in body weight and also caused by the water content of forages. The average body weight during the rainy season was 215 kg; thus it needed lower DM. Conversely, the maintenance of body weight in the dry season reached 260.01 kg which increased DM needs to meet basic living needs as well as for growth. The high water content of forage during the rainy season limited the DM consumed. On the contrary, in the dry season, the level of DM was high so it affected the increase of DMI. The DMI ability in the rainy and dry season if it was calculated on the weight was not much different from each other 1.54±0.27 and 1.55±0.28%.

Dry matter intake during the rainy season was 3.33±0.55 kg/day, 10% lower than the recommendation of Kearl (1982) of 3.7 kg/day for steers of 200 kg body weight on condition without growing (maintenance). The TDN intake was 2.41±0.42 and CP was 0.54±0.10, 16.90 and 2.53% lower than the requirement of male cattle respectively 2.8 and 0.55 kg/day in the same daily body weight gain target of 0.5 kg/day. In contrast, the DM intake of male Bali cattle in the dry season was 4.29±0.76 kg/day, 2.5% lower from the requirement of male cattle with 250 kg body weight on condition without growing (maintenance). Similarly, TDN intake was 7.19% lower than the requirement of male cattle on the same daily body weight gain target of 0.5 kg/day. Nonetheless, CP intake that reached

Table 2. Dry matter intake, growth performance of male Bali cattle fattened of different season in smallholder farms, Timor Tengah Utara, East Nusa Tenggara[1]

Variabble	Rainy season (n=50)	Dry season (n=35)	Sig.[2]
Dry matter (DM)			
Intake (kg/day)	3.33±0.55	4.29±0.76	***
Intake/$BW^{0.75}$ (g/kg)[3]	58.90±9.50	62.97±10.68	ns
Intake/BW (% BW)	1.54±0.27	1.55±0.28	ns
Crude Protein			
Intake (kg/day)	0.54±0.10	0.78±0.16	***
Intake/$BW^{0,75}$ (g/kg)[3]	9.53±1.50	12.54±2.28	***
Intake/DM (%)	16.49±0.96	18.32±2.36	***
Crude fiber			
Intake (kg/day)	0.67±0.12	0.96±0.20	***
Intake/$BW^{0.75}$ (g/kg)[3]	11.85±2.37	14.05±2.92	***
Intake/DM (%)	20.04±1.50	22.23±1.82	***
TDN[4]			
Intake (kg/day)	2.41±0.42	2.97±0.52	**
Intake/$BW^{0.75}$ (g/kg)[3]	42.60±6.82	43.53±7.28	ns
Intake/DM (%)	72.38±2.56	69.23±2.82	***
ADG (kg/day)[3]	0.51±0.16	0.30±0.16	***
FCR[3]	7.14±2.52	15.19±8.45	***

[1]Data were presented in average±SD;
[2]sig. = significant; **(P<0.01); *** (P<0.001), ns = not significant;
[3]$BW^{0,75}$ = metabolic body weight;
[4]TDN = total digestible nutrient; ADG = average daily gain; FCR = feed conversion ratio

0.78±0.16 kg/day was in accordance with the requirement of male cattle body weight 250 kg with daily body weight gain target of 1.10 kg/day.

Increased intake of DM in the dry season affected the intake of CP, CF and TDN (kg/head/day) which were higher (P<0.01) than the rainy season (Table 2, Figure 1). In addition to the higher body weight, increased intake of DM was presumably related to feeding energy availability; and decreased the quality of feed, thereby the cattle was increasing feed intake to meet the energy needs.

The low intake of DM and TDN of male Bali cattle both in the rainy season and the dry season had illustrated that problems were faced on the cattle fattening in smallholder farms was a lack availability of feed. Therefore, increasing the amount of feed consumed by livestock is a strategy to meet intake of dry matter and energy. Improvement to the feed management assistance to farmers was another aspect that needed to be considered in addition to feeding availability. Moreover, these conditions gave clues that the maintenance needs of male Bali cattle for dry matter and nutrients were lower than the recommendation of Kearl (1982).

Differences in feed intake and the growth rate of the cattle during dry and rainy season gave clue of weak aspects of the farmer's management in accordance with low levels of education and motivation that was business oriented yet, so the desire to pursue the high productivity of livestock was becoming weaker.

Daily body weight gain. Daily body weight gain of male Bali cattle in the rainy season (Month January –March) was higher (P <0.01) than in the dry season (June – August) (Table 2, Figure 1). The results of this study illustrate that the male Bali cattle fattened during the rainy season provides a higher growth performance when compared to the dry season despite lower consumption of dry matter. This condition proves that in the rainy season with abundant amount of feed, the growth of livestock can be improved. Conversely, the lack of feed in the dry season has an impact on the decrease growth of livestock. According to Campell *et al.* (2010), cattle that received relatively little of feed will show higher growth efficiency. This is caused by increase in the digestibility of feed or the lack of feed wastage.

The enough high of daily body weight gain in the rainy season because reasonably available forage with sufficient quality, especially protein and energy; whereas in the dry season although consumption of CP was higher, but energy availability allegedly inadequate. This has an impact on the utilization of protein to improve growth performance was not optimal. According to Lani *et al.* (2015), the daily body weight gain of Bali cattle fattened fed *L. leucocephala* in smallholder farms is quite high at 0.76 - 0.77 kg/head/day. The increase of daily body weight gain is due to the high consumption of CP in livestock ranged from 0.71 to 0.78 kg/head/day. On fattening which aims to produce a body weight gain was high and efficient, as well as the high-quality of carcass required feed containing high energy. This is due to livestock production would increase if the energy content of the feed increased (Tillman *et al*., 1991); besides paying attention to the adequacy of protein in the ration (Kearl, 1982).

Growth performance of male Bali cattle fattened during the dry and rainy season is higher than recommendation Kearl (1982) when associated with the dry matter intake. This is due to the rainy season dry matter intake by 1.54% at 215 kg body weight if appropriate recommendation is only equivalent to the needs of the male cattle on body weight was 200 kg with ADG 0,0 kg/head/day. However, in reality, ADG obtained of cattle from 0.51 kg/head/day. Likewise, in the dry season, dry matter intake of 1.55% at body weight 260.1 kg only equivalent of male cattle needs body weight was 250 kg with

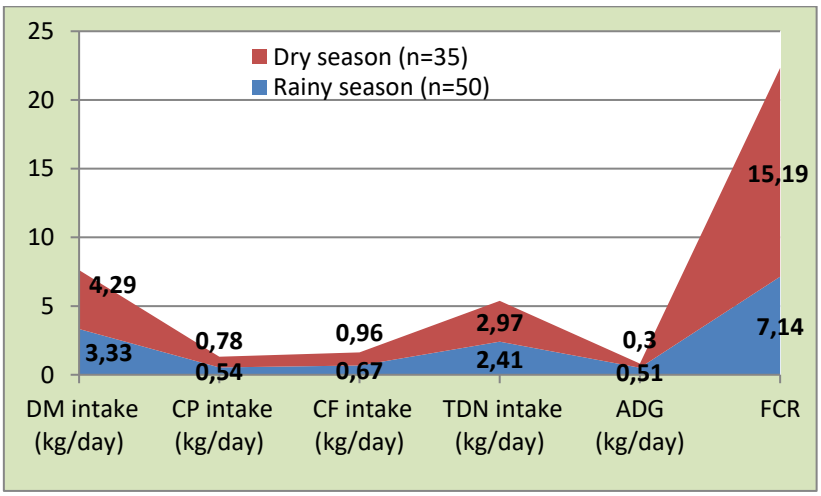

Figure 1. The graph of feed intake and growth performance of male Bali cattle fattened in different seasons at the smallholder farms.

ADG 0 kg/head/day; but the reality can be improved the ADG of cattle reach 0.30 kg/head/day. This condition illustrates that the requirements dry matter and nutrient of male Bali cattle to improve body weight are lower than recommendation Kearl (1982).

Body weight gain of cattle on the observation of the rainy season is not much different from the reports of Tahuk and Dethan (2010) of 0.53 kg/day in male Bali cattle young which obtain 100% forage on smallholder farms. Conversely, body weight gain of cattle in the dry season was almost the same as the reported by Tahuk *et al*. (2017) of 0.32 kg/head/day in the raising with the forage on smallholder farms. According to Oka *et al.* (2012), when the average increase in daily body weight gain of male Bali cattle prior to the slaughter reached 0.35 kg/day, it was included in the excellent category.

Feed conversion ratio. Feed conversion ratio (FCR) of male Bali cattle fattening during the rainy season was lower ($P<0.01$) than in the dry season (Table 2, Figure 1). This condition illustrated that fattening in rainy season produced higher economic efficiency since to produce one unit of body weight required less feed. On the other hand, in the dry season, producing one unit of body weight required more feed. The quality of feed determined the value of FCR, as it relates to the total amount of DM consumption and daily body weight gain obtained.

Differences in feed conversion ratio between the rainy and dry seasons describes the different types and quality of feed and response livestock to the feed use in different seasons. The quality of feed is determining the value of feed conversion as it relates to the amount of dry matter intake and daily body weight gain was obtained. If the quality of feed the better, then the animal would growing faster so that better of feed conversion. In this study, animals kept in the rainy season quality diets better. As a result, daily body weight gain obtained was high that contribute to more efficient feed conversion.

In addition, differences in feed conversion is also influenced by the quality of the livestock kept (including adaptation of cattle to the feed given), and the method of feeding and the amount of body weight gain and the value of digestibility (Martawidjaja *et al.,* 1999; Tahuk *et al.,* 2008). According to Campell *et al.* (2010), feed conversion in livestock can vary due to differences in animal genetic, age, weight of livestock, sex, physiological status of livestock, as well as the composition of the feedstuffs constituents of ration, feeding levels, and daily body weight gain.

The value of feed conversion ratio of the rainy season is not much different from the reports of Tahuk and Dethan (2010) in males Bali cattle young aged 2 to 2.5 years at greenlot fattening with a feed conversion ratio of 7.55; Oematan (2000) of 6.01 to 7.56 on males Bali cattle aged 1,5 - 2,5 years on concentrate rations with different of protein and energy ratio; as well as reports by Hafid and Rugayah (2009) of 9.89 to 10.40 on male Bali cattle aged 2 years old, emaciated condition and being in the concentrate ration of local raw material.

Conclusions

The feed quantity used by farmers on fattening male Bali cattle in smallholder farms during the rainy season were more varied than the dry season. The nutrients content, dry matter, and organic matter digestibility of feedstuffs during the rainy season was better than the dry season. Feed intake was lower during the rainy season than the dry season, but in general, on both season the cattle needed adequate protein. In contrast, cattle needed for energy in both seasons was not fulfilled so it has to be fulfilled with the use of energy sources feed. The better feedstuffs quality during in rainy season resulted in higher growth performance of male Bali cattle fattening than in the dry season.

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