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Enhancement of Performance of Farmed Buffaloes Pasture Management and Feed Supplementation in Sabah, Malaysia

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ABSTRACT

A buffalo-breeding farm run on an extensive grazing system without feed supplementation was selected for this study. Farm records between 2004 and 2011 were analysed for selected parameters, particularly calving rate, calving interval, average daily gain of calves and calf mortality. Following the analysis, interventions were implemented in January 2012, which included increase in pasture area from 399 to 441 acres followed by application of organic fertiliser. The selected breeder buffaloes were prepared for breeding by supplementing palm kernel cake-based feed at the rate of 1.5 kg/animal/day for two weeks before breeder males were introduced at the rate of one male to 20 females. Weaning age was reduced from six to three months. Prior to the intervention, proximate analysis of pasture revealed 7.6% crude protein content; approximately 79% of breeder buffaloes were found with a body score of ≥3; the average annual calving rate was 22%; the calving interval was 24±11.2 months; average daily gain of calves was 0.89±0.21 kg; the average birth weight was 28.31±3.26 kg; and calf mortality was 26.8±7.0%. Following intervention, proximate analysis of grass revealed 12% crude protein content. With feed supplementation, the percentage of breeder females with a body score of ≥3 increased to 95%, leading to an average annual calving rate of 50%. Average birth weight was significantly ($p<0.05$) improved to 35.4±5.39 kg, while the average daily gain was 0.95±0.32 kg. Subsequently, the average calving interval

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was reduced to 15.2±9.2 months. Similarly, calf mortality rate was significantly ($p<0.05$) reduced to 17.6±4.7%. In conclusion, improved management, particularly of pasture and feeding, significantly enhanced the performance of farmed buffaloes.

Keywords: Farmed buffaloes, feed supplementation, pasture, performance, body weight

INTRODUCTION

Asian buffalo or water buffalo is classified under the genus Bubalus, species bubalis. The domestic water buffalo, commonly found in Malaysia, has been classified into two sub-species known as the river and swamp types, both of which are different genetically and morphologically as well as in purpose (FAO, 2005). The river buffalo, which also known as murrah, has 50 chromosomes, of which five pairs are submetacentric, while 20 are acrocentric while the swamp buffalo has 48 chromosomes, of which 19 pairs are metacentric. Swamp buffalo is largely concentrated in Southeast Asia (e.g. Thailand, the Philippines, Indonesia, Vietnam, Myanmar, Laos, Sri Lanka, Malaysia) and Southern China, whereas river buffalo is mainly found in South Asia (e.g. India). Indeed, these Asian buffalo remains of high economic importance for farmers in many developing countries in Asia (Cruz, 2010). Besides being utilised as draught power for smallholders, they also provide high quality milk and meat and other by-products such as hide and skin (Wanapat & Wachirapakon, 1990). They are commonly kept under traditional management, which is mostly concentrated in the rice-growing states of Kelantan, Terengganu, Kedah and Pahang. They are usually provided with relatively poor digestible feeds (Yindee, 2011). Indeed, buffaloes are known to be better at converting poor-quality roughage (e.g. crop by-products and poor quality grasses) into milk and meat. They are reported to have a 5% higher digestibility of crude fibre and 4-5% higher efficiency of utilisation of metabolic energy than high-yielding cows (Mudgal, 1988). They graze in harvested paddy fields, along roadsides and on the edges of cultivated plots during the day and are kept within the village, usually under the house, at night (Khajarern & Khajarern, 1989). Nowadays, the buffalo has lost its prominence due mainly to farm mechanisation and urbanisation. Both breeds, murrah and swamp buffalo, are farmed mainly for meat production under an extensive production system. Some oil palm estates use swamp buffalo as draught animals for pulling carts carrying oil palm bunches (FAO, 2005). In addition, crossbreeding between murrah and swamp buffalo was also initiated as a programme at the Buffalo Breeding and Research Centre Farm in Telupid, Sabah. In general, murrah and swamp buffalo have a small body size, with body weight ranging between 350 and 450 kg, and a slow growth rate that leads to poor reproductive performance (e.g. late maturity and a long calving interval), but are very well adapted to local ecological conditions and display good

disease resistance (Nanda et al., 2003). Nevertheless, the body size and body weight in crossbreds are greater than in the pure breed (FAO, 2005). This was also reported in other studies conducted in Asia and Southeast Asia that concluded that the murrah crossbred buffaloes were heavier and grew faster compared to indigenous swamp buffaloes (Momongan et al., 1990; Kamonpatana et al., 1991; Situmorang & Sitepu, 1991; Parker et al., 1991; Salas et al., 2000). Indeed, there is a need to enhance scientific and technological development in buffalo nutrition, production, reproduction, biotechnologies and genetic improvement (Sethi, 2003). Thus, this paper describes the attempts to enhance the selected performance parameters of murrah crossed buffaloes that are kept at a breeding farm in Sabah, Malaysia through improved pasture and feeding management.

MATERIALS AND METHOD

The Farm

This study was conducted at the Buffalo Breeding and Research Centre Farm located at Telupid, Sabah, Malaysia (5^{o} 30' N, 117^{o} 7' E). The average daily temperature and annual rainfall in the farm recorded were between 29˚C and 30˚C and 200 and 400 mm/year, respectively. At the start of the study, the farm had a total of 335 buffaloes. Of these, 180 were breeder females, 78 were breeder heifers, seven were breeder males and 70 were calves, of which 51 were females and 19 were males (Othman et al., 2014). The 399 acres of pasture land were divided into paddocks with established pasture (*Brachiaria decumbens)* and wallowing sites. Besides *Brachiaria decumbens,* the paddocks were also covered with other vegetation, which included herbage, legumes, weeds and ferns, most of which are palatable to buffalo. However, the identification of each vegetation species was not done in this study. In addition, the farm did not apply a proper pasture management system that practised fertilisation and soil analysis as a routine. Although the pasture was generally poorly maintained, the farm practised an extensive 30-day rotational grazing system without feed supplementation (Othman et al., 2014).

At the start of the study, eight-year farm records between 2004 and 2011 were selected and analysed retrospectively for selected parameters associated with feed and feeding. Among the parameters analysed were calving rate, calving interval, birth weight, average daily gain of calf and calf mortality. Pasture samples were collected randomly in quadruplicate from four representative paddocks. A pair of scissors was used to cut off the mixed herbage sample on each paddock at six sites of 1m^{2} area. The samples were then dried and used for proximate analysis of the nutrient content (Galyean, 2010). Proximate analysis was performed to determine the nutrient content, which was found to include the following: dry matter, crude protein, crude fat, crude fibre and metabolisable energy. All the analyses were carried out according to certified procedures

outlined by the Manual of Laboratory Techniques, Universiti Putra Malaysia, and developed according to procedures of AOAC (1990). The proximate analysis of the samples was done in replicates of four.

Intervention

Intervention was implemented in January 2012. This included the use of organic fertiliser on pastureland at the rate of 20 tonnes of organic fertiliser supplemented with 200 kg of urea/ha/year to improve the pasture. After six months, pasture samples were collected from the four paddocks for re-analysis of the proximate nutrient content. After six months, the organic fertiliser as supplemented again, at the end of June 2012, as the farm was scheduled for pasture management. However, the results presented here are only for the first six months (January-June 2012) after supplementation with organic fertiliser.

A total of 150 breeder females of more than 350 kg body weight were selected as breeders. They were re-grouped into 20 heads per group according to body weight and were allowed to graze in the paddocks. They were prepared for breeding by being fed palm kernel cake-based supplemented feed at the rate of 1.5 kg/animal/day for 14 days before the breeder males were introduced in January 2012 at the rate of one male to 20 females for a period of three months. Pregnant buffaloes were re-grouped into 20 heads per group according to body weight and allowed to graze on supplemented feed of 1 kg/animal/day. The non-pregnant females were prepared again for breeding by being fed supplemented feed at 1.5 kg/animal/day for 14 days before the breeder males were re-introduced. The procedure was repeated one more time before the remaining non-pregnant breeder females were culled.

Data Analysis

The pre-intervention calves that were produced between 2004 and 2011 were weaned at six months of age, while those post-intervention calves that were produced between 2012 and 2014 were weaned at three months of age. All dead calves were recorded. Birth weight of the calves was measured and recorded within three days of birth. The body weight of calves was measured and recorded every three months and the average daily gain was calculated based on the body weight of the first three months according to this formula:

$$\text{Average daily gain (ADG)} = \frac{\text{Final weight} - \text{Initial weight}}{\text{90 days}}$$

In this study, birth and body weight of calves between 2009 and 2011 were used to calculate the average birth and daily weight gain during pre-intervention, while those between 2012 and 2014 were used for post-intervention calculations. The body condition score was measured using a scale of 1 to 5 as described by Anitha et al. (2011). Briefly, after each check point was observed thoroughly by sight and palpation, the scores were recorded and an average body condition score was assigned to the buffaloes. The percentage

of calving rate was calculated according to this formula:

$$\text{Calving rate (\%)} = \frac{\text{Total no of calf born}}{\text{Total no of cows calving}} \times 100$$

whereas the percentage of calf mortality was calculated according to this formula:

$$\text{Mortality rate (\%)} = \frac{\text{Total no of calf died}}{\text{Total no of calf born}} \times 100$$

The calving interval was calculated based on the number of days between the birth of a calf and the birth of a subsequent calf, both from the same cow (Mellado et al., 2004).

Statistical Analysis

All data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20 software. Means were tested using the T-test based on analysis of variance (ANOVA), with $p<0.05$ considered a significant difference.

RESULTS

Pre-Intervention

Prior to the intervention, proximate analysis of the pasture revealed 7.6% crude protein content (Table 1), while 79% of the breeder buffaloes showed a body score of $\geq$3 and were ready for breeding. The annual calving rate ranged between 15% and 31%, with an average of 22.1±6.4%, and the calving interval ranged between nine and 56 months with an average of 24±11.2 months. During the eight-year period, 73 (29%) breeders calved twice and 35 (14%) calved three times. The average birth weight was 28.31±3.26 kg, the average daily gain was 0.89±0.21 kg (Table 2) and calf mortality was 26.8±7.0% (Table 3).

Table 1
The nutrient composition (% DM) of pasture and palm kernel cake

	Pasture	Palm kernel cake
Dry matter	95.3	89.1
Ash	10.1	3.5
Crude protein	7.6	16.9
Crude fat	2.3	5.5
Crude fibre	36.4	13.0
Acid detergent fibre	44.7	34.3
Neutral detergent fibre	81.2	66.8
Acid detergent lignin	8.2	6.7
Metabolisable energy (MJ/kg DM)	7.7	11.9

Table 2
Average birth weight and daily weight gain of buffalo calves before and after intervention

Year	Birth weight (kg) (Mean±SD)	Daily weight gain (kg) (Mean±SD)
Pre-intervention		
2009	28.5±1.36	1.0±0.16
2010	27.2±1.04	1.0±0.16
2011	28.7±2.08	0.7±0.21
Average	28.3±3.26	0.9±0.21
Post-intervention		
2012	30.5±3.43	0.9±0.24
2013	32.5±5.27	0.9±0.25
2014	37.1±4.76	1.2±0.35
Average	35.4±5.39*	1.0±0.32

*$p<0.05$ significant difference between pre-intervention and post-intervention

Table 3
Calf mortality before (2004 to 2011) and after intervention (2012 to 2014)

Year	No. of calves		% Calving	% Mortality
	Birth	Death		
Pre-intervention				
2004	60	13	24.0	21.6
2005	73	12	29.2	16.4
2006	43	15	17.2	34.8
2007	78	29	31.2	37.2
2008	42	13	16.8	31.0
2009	37	9	14.8	24.3
2010	66	17	26.4	25.8
2011	43	10	17.2	23.3
Average	55.3±15.9	14.8±6.3	22.1±6.4	26.8±7.0
Post-intervention				
2012	53	8	35.3	15.9
2013	101	14	67.3	13.8
2014	72	9	48.0	12.5
Average	73.3±24.2	10.3±3.2	50.2±16.1	14.1±1.7

Post-Intervention

Following intervention, proximate analysis of the pasture revealed a significantly higher content (12%) for crude protein compared to the crude protein content before intervention (7.6% crude protein). With feed supplementation, the percentage of breeder females with a body score of ≥ 3 increased significantly ($p<0.05$) to 95%, leading to a significant ($p<0.05$) increase

in the average annual calving rate to 50.2±16.1%. A total of 69 (46%) had calved twice, which was significantly ($p<0.05$) more than in the pre-intervention period and eight (5%) calved three times in the three-year study period, significantly ($p<0.05$) less than in the pre-intervention period. The average birth weight had significantly ($p<0.05$) improved to 35.4±5.39 kg and the average daily gain was improved to 1.0±0.32 kg (Table 2). Subsequently, the calving interval was significantly ($p<0.05$) reduced to 15.2±9.2 months. Similarly, the calf mortality rate was significantly ($p<0.05$) reduced to 17.6±4.7% (Table 3).

DISCUSSION

Diet is the main factor that affects body weight and the body condition of livestock (Zerbini & Wold, 1999). Nevertheless, Mahmoudzadeh and Fazaeli (2009) indicated that manipulation of diet could sometimes exert a profound effect on the weight gain of buffalo calves. This explained the slight increase in the post-intervention average daily weight gain of the buffalo calves compared to in the pre-intervention period of this study. These results were in agreement with those reported in previous studies such as the work of Situmorang and Sitepu (1991) in Indonesia, Kamonpatana et al. (1991) in Thailand and Momongan et al. (1990), Parker et al. (1991) and Salas et al. (2000) in the Philippines, who concluded that the murrah crossbred buffaloes were heavier and grew faster after having been fed with improved feed. However, feeding and pasture management can also enhance other parameters such as birth weight, which can show significant increases in post-intervention (Khajarern & Khajarern, 1989). Indeed, birth weight in this study was higher compared to that recorded in a study by Nordin et al. (2004) in Malaysia and Thevamonaharan et al. (2001) in Thailand. Similarly, the average birth weight of murrah crossbred buffaloes reported by Charlini and Sinniah (2015) in Sri Lanka was also lower compared that recorded in the present study. In addition, Mahmoudzadeh and Fazaeli (2009) reported that improvement of growing and fattening performance of buffalo calves could be achieved through nutritional and management manipulation. Indeed, the average daily gain was shown to reach the maximum figure recorded when the animals received 10% crude protein (CP) in the diet through improved pasture (CP, 12%) as observed in this study (Tatsapong et al., 2010). Similarly, the buffaloes were shown to have gained weight with feed supplementation; this effect was less pronounced when the basal diet was only grass (Van Thu & Preston, 1999). This was due to the high CP and total digestible nitrogen (TDN) levels in the supplemented diet that increased the feed intake, while ruminal pH was reduced and the ammonia nitrogen and blood urea nitrogen concentration were increased (Chanthakhoun et al., 2014). Therefore, feed supplementation helps in maintaining the body condition of breeder buffaloes by reducing weight loss (Sanh, 2005; Jabbar et al., 2013).

Body condition score (Anitha et al., 2011) has been used as an indicator of energy status resulting from feed supplementation (Qureshi, 2009). Animals receiving metabolisable energy (ME) above the requirements during the pre-partum period are able to maintain a relatively good body condition score (BCS) (Qureshi, 2009), a phenomenon observed in this study when the percentage of breeder buffaloes with a good body score increased to 95% following feed supplementation. Furthermore, feed supplementation improved reproduction, as evident from the short post-partum ovulation interval and low incidence of silent ovulation (Qureshi, 2009). Therefore, high-energy supplemented feed such as the palm kernel cake-based diet implemented in this study helps to improve the reproductive performance of buffaloes.

Early weaning at 45 days of age has been recognised as a major cause of mortality among buffalo calves (Parera, 1999). Nevertheless, climatic features, such as rainy season (Othman et al., 2014), and pre-weaning nutrition level also play an important role in calf mortality. Low supplies of CP and TDN for lactating mothers, such as during pasture-deficient period or poor quality pasture lowered milk yield (Hayashi et al., 2006), particularly among buffaloes in their second and more lactation cycle (Hayashi et al., 2005). Therefore, the average growth rate of buffalo calves is better when feed is supplemented (Lubis & Fletcher, 1987). In addition, the high average body weight and the rapid growth rate for buffalo calves may have been influenced by the feeding management of the dam. Indeed, good quality pasture together with high-energy concentrate feed provided to the dam have been shown to result in high production of milk (Donker et al., 1968; Sarwar et al., 2012) and better quality of milk (Slots et al., 2009; O'Donovan et al., 2011). A study on the nutrient composition of milk for lactating buffaloes reared on this farm revealed that the nutrient composition of the milk was higher in protein content and lower in fat content compared to that reported by Siregar et al. (2015) in Indonesia for swamp buffalo and by Chiangmai et al. (1987) in Thailand and Ren et al. (2015) in China for murrah crossbred buffalo. Apart from that, the better growth rate led to a better survival rate (Thevarnanoharan et al., 2001).

CONCLUSION

This study revealed that improved management of pasture through regular use of fertiliser and supplemented feed at 1.5 kg/animal/day for 14 days improved the body condition of breeder females. Maintaining pregnant females with supplemented feed at 1 kg/animal/day improved the reproductive performance of the breeders and enhanced the body weight gain of the calves.

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