UNIVERSITI PUTRA MALAYSIA

COMPARATIVE STUDY ON THE GROWTH PERFORMANCE BETWEEN INDIGENOUS SWAMP AND MURRAH CROSSBRED BUFFALOES

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COMPARATIVE STUDY ON THE GROWTH PERFORMANCE BETWEEN INDIGENOUS SWAMP AND MURRAH CROSSBRED BUFFALOES

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CERTIFICATION

It is hereby certified that I have read this project paper entitled "Comparative Study on The Growth Performance Between Indigenous Swamp and Murrah Crossbred Buffaloes", by Jaizurah Vera Tingkas and in our opinion it is satisfactory in term of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999- Final Year Project.

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DEDICATIONS

This final year project is dedicated to my supervisor, Professor Dr Mohd Zamri Saad, my co-supervisors, Professor Dr Md Zuki Abu Bakar and Dr Hasliza Abu Hassim, statistical lecturer, Professor Mohamed Ariff Omar, my academician advisor, Dr Hafandi Ahmad, assistant director of Department of Veterinary Services and Animal Industry, Sabah, Dr Punimin Abdullah, assistant veterinary officer of Buffalo Breeding and Research Centre, Telupid, Sabah, Mr. Jonny Engkias, recordkeeper of Buffalo Breeding and Research Centre, Telupid, Sabah, Mrs. Irene Disuah and; my family and friends.

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kg	: kilogram
kg/day	: kilogram per day
%	: Percentage
ADG	: Average Daily Gain

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar memenuhi sebahagian daripada keperluan kursus VPD 4999 - Projek Ilmiah Tahun Akhir.

KAJIAN PERBANDINGAN PRESTASI TUMBESARAN DI ANTARA KERBAU SAWAH DAN KERBAU KACUKAN MURRAH-SAWAH

Oleh

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2017

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Kebanyakan negara di Asia Tenggara telah melaporkan pengurangan jumlah populasi kerbau setiap tahun kerana mempunyai kawasan ragutan tanah yang terhad. Walau bagaimanapun, permintaan daging lembu dan kerbau di pasaran pada masa kini telah meningkat hasil daripada peningkatan jumlah populasi manusia. Sehubungan itu, produktiviti kerbau telah ditingkatkan melalui penambahbaikan genetik dengan tujuan untuk menghasilkan kerbau kacukan (sawah x sungai) yang

berupaya menghasilkan susu dan daging sekaligus. Kajian retrospektif ini telah dilakukan untuk membandingkan prestasi pertumbuhan di antara kerbau sawah dan kerbau kacukan Murrah, serta menentukan kebaikan menternak kerbau kacukan Murrah berbanding kerbau sawah dari segi prestasi pertumbuhan. Rekod untuk kedua-dua kerbau sawah dan kerbau kacukan Murrah yang lahir di antara tahun 2014 dan 2016 telah diperolehi dari Pusat Pembiakan dan Penyelidikan Kerbau, Telupid, Sabah, Malaysia. Pengenalan haiwan dan baka, berat lahir, berat cerai susu dan berat badan pada setiap tiga bulan telah diperolehi dan dianalisis dengan menggunakan ujian T sampel tidak bersandar. Semua anak kerbau telah dicerai susu pada umur 3 bulan dan kemudiannya, dilepaskan ke kawasan ragutan yang berlainan dan jauh dari induknya. Setiap anak cerai susu telah diberikan makanan tambahan pada kadar 1 kg/ekor/hari. Purata berat lahir anak kerbau kacukan Murrah adalah 36.63±5.18 kg lebih tinggi secara signifikan ($P<0.05$) berbanding purata berat kelahiran kerbau sawah 34.69±5.28 kg. Purata pertambahan berat badan harian sebelum cerai susu untuk kerbau sawah dan kerbau kacukan adalah masing-masing 0.73 kg/hari and 0.98 kg/hari sementara purata pertambahan berat badan selepas cerai susu masing-masing adalah 0.39 kg/hari dan 0.44 kg/hari. Oleh itu, berat badan pada setiap 3 bulan untuk kerbau kacukan Murrah adalah lebih tinggi ($p<0.05$) berbanding kerbau sawah dari lahir hingga berusia 24 bulan. Kerbau kacukan Murrah dan kerbau sawah mencapai berat badan untuk pasaran sebanyak 250 kg masing-masing pada usia 15 dan 18 bulan, manakala berat badan untuk pembiakan sebanyak 385 kg masing-masing dicapai pada usia 26 dan 30 bulan. Secara kesimpulannya, kerbau kacukan Murrah mempunyai kadar pertumbuhan berat badan yang lebih cepat dan mencapai sasaran berat badan untuk tujuan pasaran dan pembiakan pada usia lebih awal

berbanding kerbau sawah. Oleh itu, penternak boleh mengurangkan kos penternakan dan memperolehi lebih banyak keuntungan dengan menjual kerbau campuran Murrah pada usia lebih awal sama ada untuk disembelih atau tujuan penternakan.

Kata kunci: sawah, kerbau kacukan Murrah, berat badan, berat badan harian

ABSTRACT

Abstract from project paper for submission to Faculty of Veterinary Medicine in fulfilment of the requirements for the subject VPD 4999 – Final Year Project.

COMPARATIVE STUDY ON THE GROWTH PERFORMANCE BETWEEN INDIGENOUS SWAMP AND MURRAH CROSSBRED BUFFALOES

by

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2017

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The Southeast Asia has been reporting annual reduction in the buffalo population with limited land availability for rearing purposes but the demand for beef has increased as a result of increasing human population. Therefore, enhancement in buffalo productivity was done through genetic improvement with the intention of producing dual-purpose crossbred buffaloes (Swamp x River) both for milk and beef productions. This retrospective study was conducted to compare the growth performance and to determine the benefits of the rearing crossbred compared to

swamp buffaloes. The records for both swamp and crossbred buffaloes that were born between 2014 and 2016 were acquired from the Buffalo Breeding and Research Centre, Telupid, Sabah, Malaysia. The animal identification and breed, birth weight, weaning weight and the body weights at three monthly intervals were recorded and analyzed using independent T-test. All calves were weaned at 3 months old and were released into paddocks to graze. Supplemented feed was provided at the rate of 1 kg/animal/day. The average birth weight of crossbred buffaloes was 36.63±5.18 kg, significantly ($p<0.05$) higher than the average 34.69±5.28 kg birth weight of swamp buffaloes. The average pre-weaning daily weight gain for swamp and crossbred buffaloes was 0.73 kg/day and 0.98 kg/day while the average post-weaning daily weight gain was 0.39 kg/day and 0.44 kg/day, respectively. Therefore, the 3-monthly body weights of Murrah crossbred buffaloes were significantly higher ($p<0.05$) than that of swamp buffaloes until the end of the study at 24 months old. The Murrah crossbred and swamp buffaloes achieved the targeted market weight of 250 kg at 15 and 18 months old, respectively while the targeted breeding weight of 385 kg at 26 and 30 months old, respectively. In conclusion, the Murrah crossbred buffaloes showed faster growth rate and reached targeted market and breeding weights at earlier age than that of swamp buffaloes. Thus, farmers can reduce the rearing cost and earn more profit by selling crossbred buffaloes at an earlier age either for slaughter or rearing purposes.

***Keywords**: Swamp, Murrah crossbred, body weight, average daily gain*

1.0 INTRODUCTION

Malaysia has two types of Water buffaloes, also known as Asian buffaloes, and further classified as indigenous Swamp buffalo (Kerbau Sawah) and the imported River buffaloes (Johari, 2005). Buffalo serves many purposes such as meat production, milk production and drought power mainly for paddy land preparation and pulling of carts for oil palm bunches within the oil palm plantations. Generally, swamp buffaloes are for meat production while Murrah buffaloes are for milk production. In Sabah, buffaloes are primarily used as a 'sogit' (penalty) to the those who commit a breach of native customary laws [Native Courts (Native Customary Laws) Rules, 1995].

In 2014, the total number of buffalo population in Malaysia was 122,943 heads in which 51.4% of the total buffalo populations in Malaysia were found in Peninsular Malaysia, 43% in Sabah and 5.6% in Sarawak (MOA, 2015). Therefore, Sabah has the highest population of buffalo among states in Malaysia (43%), followed by Perak and Pahang each with 11.2% of the buffalo population in Malaysia (MOA, 2015). Nevertheless, buffalo population is decreasing yearly at an alarming rate. This is mainly due to the decreased use of buffaloes for draught power in paddy land preparation following extensive farm mechanisation. Also, urbanisation and the use of areas for cultivation lead to a decreased in grazing land, thus subsequently reduced the number of buffalo population.

Generally, there is an increased demand for beef and milk, including buffaloes among the fast-growing population of Asia with the decreased in the availability of land for rearing livestock (Cruz, 2012). The meat self-sufficiency level in Malaysia is less than 30% for over 10 years from 2006 to 2016 thus, Malaysia is highly dependent on the imported meat. Therefore, the Department of Veterinary Services Sabah is attempting to revive the buffalo rearing industry through genetic improvements. This is achieved via crossbreeding of the local swamp with Murrah buffaloes with the hope that the resulted crossbred animals are bigger in size with better milk production than the native swamp buffaloes. This is following a conclusion of a study that highlighted that crossbred buffaloes grow faster, mature earlier and produce more milk compared to local buffaloes (Salas et al., 1999). Later, Timsina et al. (2015) reported similar findings that milk yield from crossred buffaloes is significantly higher than the local buffaloes. Furthermore, they have longer lactation period, hence farmers harvest more milk and generate more income (Tismina et al., 2015). Crossbred buffaloes also matured earlier and have shorter calving interval, hence produce more calves in their lifetime (Tismina et al., 2015).

1.1 Objectives

This study was conducted:

1. To compare the growth performance between the indigenous swamp and the crossbred buffaloes
2. To determine the benefit of rearing crossbred compared to swamp buffaloes

1.2 Hypotheses

Null hypothesis, H_o: There is no difference in the growth performance and the benefit of rearing crossbred compare to swamp buffaloes

Alternate hypothesis, H_a: There is difference in the growth performance and the benefit of rearing crossbred compare to swamp buffaloes

2.0 LITERATURE REVIEW

2.1 Species of Buffalo

Buffalo is a member from Bovidae family and subfamily Bovinae. There are two types of buffaloes in worldwide: the African buffalo (*Syncerus caffer*) and the Asian buffalo (*Bubalus spp.*). The genus *Bubalus* is further subdivided into two types or subgenus, which are *Bubalus* and *Anoa*. The subgenus *Bubalus* is comprised of water buffalo (*Bubalus bubalis*) and tamaraw (*Bubalus mindorensis*). The subgenus *Anoa* consists of lowland anoa (*Bubalus depressicornis*) and mountain anoa (*Bubalus quarlesi*) and both of these species are native buffaloes in Indonesia. In 2008, both lowland anoa and mountain anoa buffaloes are listed as endangered species in the International Union for Conservation of Nature (IUCN) Red List (Burton et al., 2016) whereas the tamaraw buffalo, which is the native buffalo in the Philippines is listed under the critically endangered species in 2013 (Boyles et al., 2016).

2.1.1 Asian water buffalo

This study is focused more on the domestic Asian water buffaloes. The species of Asian water buffaloes are further subdivided into the Swamp and the River buffaloes. Swamp buffalo is largely concentrated in the Southeast Asia and Southern China. Traditionally, swamp buffalo is mainly used for draught power and then slaughtered at retirement age for human consumption. On the other hand, river buffalo is mainly found in south Asia and is primarily reared for milk. In the field, swamp and river buffaloes can be differentiated based on the morphological and

behavioural criteria. Swamp buffalo is ash-gray with a white line on the neck (chevron) while the horns are swept backwards (Roth, 2004). They prefer to wallow in the marshland and mud, have large feet with the slow steady movement that makes them well suited for paddy land preparation in the swampy waterlogged rice fields (Tuyen & Ly, 2013). The river buffalo is black with tightly curled horns forward which prefer to wallow in clean water (Roth, 2004).

2.2 Buffalo Population in Malaysia

The buffalo population in Malaysia has decreased by 2.9% over a decade between 1990 and 2000 (FAO, 2001). Recent statistic on buffalo population in Malaysia also revealed that the buffalo population decreased by 2.8% over six years between 2009 and 2014 (MOA, 2015). However, the beef consumption keeps increasing for up to 47% over the years (MOA, 2015). The declined in buffalo population could be due to the increased use of agricultural machinery and increased urbanisation and deforestation. Furthermore, there is low acceptability of buffalo meat among the community as the buffalo is used for draught power initially and then slaughtered at retirement age. This could influence the tenderness of the buffalo meat that tends to be tough with age (Kiran et al., 2016). However, a study revealed that the buffalo meat is superior in tenderness compared to the cattle meat of the same age (Neath et al., 2007).

2.3 Performance of Swamp and Crossbred Buffaloes

All productive parameters include live weight, milk yield, lactation length and lactation production are higher in the river buffaloes, followed by the crossbred

buffaloes and lastly the swamp buffaloes regardless of the type of production system the farmer used (Momin et al., 2016).

2.3.1 Growth Performance

Previous studies conducted in 1991 reported that the crossbred buffalo (River x Swamp) is heavier than swamp buffalo (Parker et al., 1991; Situmorang & Sitepu, 1991). A similar finding was reported by Salas et al. (2000) that the growth rate in Murrah crossbred buffaloes is faster and reached maturation much earlier than the swamp buffaloes.

2.3.2 Milk Production Performance

In relation to the milk production, Murrah crossbred buffaloes have higher milk yield than that of swamp buffaloes (Salas et al., 2000). A similar outcome was also shown in a study by Timsina et al. (2015) in Bhutan, where they revealed that Murrah crossbred buffaloes can produce milk for up to 5.9 ± 0.18 L/cow/day compared to the swamp buffaloes (2.6 ± 0.041 L/cow/day). Lactation length for Murrah crossbred is longer (10.1 ± 0.50 months) compared to swamp (9.2 ± 1.90 months) (Timsina et al., 2015). Hence, a farmer can harvest more milk and earn more income when rearing buffalo with longer lactation period.

2.3.3 Reproductive Performance

Murrah crossbred has shorter calving intervals (14.6 ± 0.52 months) than that of swamp buffaloes (17.4 ± 1.01 months) (Timsina et al., 2015). Murrah crossbred can achieve first calving at earlier age (35.1 ± 2.49) months compared to swamp

buffaloes (43.4 ± 6.86 months) (Timsina et al., 2015). Performance study on buffalo in a nearby country also proved that the crossbred buffalo experienced first calving at an earlier age and shorter gestation period and postpartum heat compared to the swamp buffaloes (Momin et al., 2016). Hence, crossbred buffalo can produce more calves in their lifetime.

2.3.4 Draught Performance

Although the body weight of Murrah crossbred buffalo is heavier compared to swamp buffalo, swamp buffalo has significant deeper ploughing depth and faster ploughing rate compared to Murrah crossbred buffaloes under dry ploughing condition (Salas et al., 2000). The draught force under both dry and wet ploughing conditions are higher in swamp buffaloes irrespective of the body weight of the buffalo (Salas et al., 2000).

2.3.5 Profitability

The farm profit is highly dependent on the output of products by the animals themselves, which are mainly the milk and meat. Nowadays, the farmers seldom use animals as a draught power in agriculture, especially in the paddy plantation although they are still used in palm oil plantation in Asia. Thus, draught power as well as the manure, contribute the least economic value in the farm production (Khan, 2009). The yield profit gained by selling the milk and meat is determined by the quantity of milk produced by the buffalo cow and the live body weight of the buffalo respectively (Momin et al., 2016).

3.0 MATERIALS AND METHODS

3.1 Study Area

This study was conducted at the Buffalo Breeding and Research Centre, Telupid, Sabah. It is owned by the Department of Veterinary Services and Animal Industry. Initially, the Centre was established at Sook in 1975 before being relocated to the current site at Telupid in 1979 (Malaysian Livestock Breeding Policy, 2013).

This farm consisted of 749 acres of land with the current total of 405 heads of buffaloes. There were three types of breed reared in this farm; the swamp, the Murrah x Swamp crossbred and the White buffaloes, representing 44%, 46% and 10% of the total buffalo population in this farm, respectively. The Murrah cross buffaloes used Murrah bull for breeding while the white buffaloes were imported from Indonesia. The farm is used as a buffalo breeding and research activities to produce meat buffaloes to be sold live to farmers for rearing.

3.2 Buffalo Management

All buffaloes were left for grazing extensively on the established pasture (*Brachiaria decumbens*) with concentrate supplementation at the rate of 1 kg/animal/day. Wallowing areas were available in each paddock. Rotational grazing was practiced and the rotational intervals were determined according to the size of each paddock and through the supervision the farm manager. The pasture was fertilized twice a year while silage was prepared occasionally when pasture production exceed demand.

This farm practiced natural breeding with male to female ratio of 1:20. Breeding season was between November and January each year and pregnancy diagnosis was carried out every 3 months following breeding. The calving rate ranged between 60% and 70% since 2014. The calves remained with their dams in the paddocks until reached three months old. Then, the calves were weaned and released into the different paddock where their feeding management was similar as other buffaloes in the farm until they reached body weight of 250 kg, the weight suitable to be sold to farmers for rearing. The farm practiced minimum breeding weight of 385 kg following recommendation by Universiti Putra Malaysia. All the buffaloes were weighed every three months. The different breeds of buffaloes in this farm were kept separated from each other.

3.3 Data Collection

A total of 154 heads of swamp buffaloes and 248 heads of crossbred (Murrah x Swamp) buffaloes that were born between 2014 and 2016 were included in this study. All selected buffaloes had gone through the same management system described previously. The growth records of the selected animals, which included the animal identification and breed, birth weight, weaning age, weaning weight, and the 3-monthly body weights were acquired and analysed retrospectively using Statistical Package for the Social Sciences (SPSS) software version 22. The average daily gain, and period of time to reach 250 kg targeted weight and the 385 kg breeding weight were calculated. The average weight gain was determined as the weight difference between the final weight and initial weight divided by the number of days between the final and initial weight. Similarly, the average body weight of the breeder swamp

and Murrah crossbred buffaloes were analysed and recorded. The difference in the three-monthly interval body weight between birth and 24 months old for swamp and Murrah crossbred buffaloes were anaylzed using independent T-test.

4.0 RESULTS

4.1 Body Weight for Swamp Buffaloes and Murrah Crossbred Buffaloes

The mean (± standard error) body weight values of both swamp and Murrah crossbred buffaloes from birth until 24 months old are shown in Table 1. There was significant ($p<0.05$) difference in the birth weight between swamp (34.69±5.28 kg) and Murrah crossbred (36.63±5.18 kg) buffaloes. Thereafter, the Murrah crossbred showed significantly ($p<0.05$) higher body weights at every 3-monthly interval until 24 months old. At 24 months old, swamp buffalo showed significantly ($p<0.05$) lower body weight of 320.75±25.25 kg compared to 355.34±37.49 kg for Murrah crossbred buffaloes (Table 1). The targeted 250 kg body weight was achieved by 18 months old for swamp buffalo and by 15 months old for Murrah crossbred buffalo (Table 1).

Table 1: The Body Weights at 3-month Interval (Mean ± SEM) for Swamp Buffaloes and Murrah Crossbred Buffaloes

	Body Weight (kg)								
	Birth Weight	3 months old	6 months old	9 months old	12 months old	15 months old	18 months old	21 months old	24 months old
Swamp	34.693[a] ± 0.494	99.877[a] ± 3.063	132.657[a] ± 3.549	163.608[a] ± 4.772	189.877[a] ± 4.037	235.327[a] ± 5.934	271.083[a] ± 4.583	307.920[a] ± 6.534	320.750[a] ± 5.645
Murrah Crossbred	36.629[b] ± 0.380	124.704[b] ± 2.818	160.545[b] ± 2.698	198.896[b] ± 3.005	232.668[b] ± 3.370	276.698[b] ± 3.334	302.139[b] ± 3.911	325.868[b] ± 4.189	356.682[b] ± 5.882

[ab]Values on the same column with different superscript indicate significant difference (P<0.05)

4.2 Average Daily Gain (ADG) for Swamp and Murrah Crossbred Buffaloes

The mean (± standard error) average daily gains for swamp and Murrah crossbred buffaloes ranged are shown in Table 2. The highest average daily gain was observed during the pre-weaning period whereas the lowest average daily gain value was observed at the period between 12 and 24 months old. The pre-weaning ADG was 0.98 kg and 0.73 kg for Murrah crossbred and swamp buffaloes ($p<0.05$), respectively. Furthermore, Murrah crossbred buffaloes have significantly ($P<0.05$) higher average daily gain compared to swamp buffaloes from birth until 12 months old. However, between 12 and 24 months old, the average daily gain between the two types of buffaloes did not differ significantly ($P>0.05$) at 0.30 kg/day and 0.29 kg/day for swamp and crossbred buffaloes, respectively. In overall, the average daily gain of Murrah crossbred buffaloes (0.44 kg/day) was significantly ($p<0.05$) higher compared with 0.39 kg/day for swamp buffaloes.

Table 2: The Average Daily Gain (Mean ± SEM) for Swamp Buffaloes and Murrah Crossbred Buffaloes

	Average Daily Gain (kg/day)			
	0-3 month	3-12 month	12-24 month	After 24 month
Swamp	$0.727^{a} \pm 0.035$	$0.315^{a} \pm 0.015$	0.304 ± 0.010	$0.394^{a} \pm 0.074$
Murrah crossbred	$0.977^{b} \pm 0.031$	$0.368^{b} \pm 0.013$	0.292 ± 0.010	$0.439^{b} \pm 0.080$

^{ab}Values on the same column with different superscript indicate significant difference ($P<0.05$)

Figure 1 shows the body weight patterns for both swamp and Murrah crossbred buffaloes between birth and 24 months old. It revealed that the Murrah crossbred gained more weight than the swamp buffaloes within that 24-month study period. The average daily gain for swamp buffaloes and Murrah crossbred buffaloes was 0.39 kg/day and 0.44 kg/day, respectively. Thus, Murrah crossbred reached the targeted breeding weight of 385 kg by 26 months old while the swamp buffalo by 30 months old.

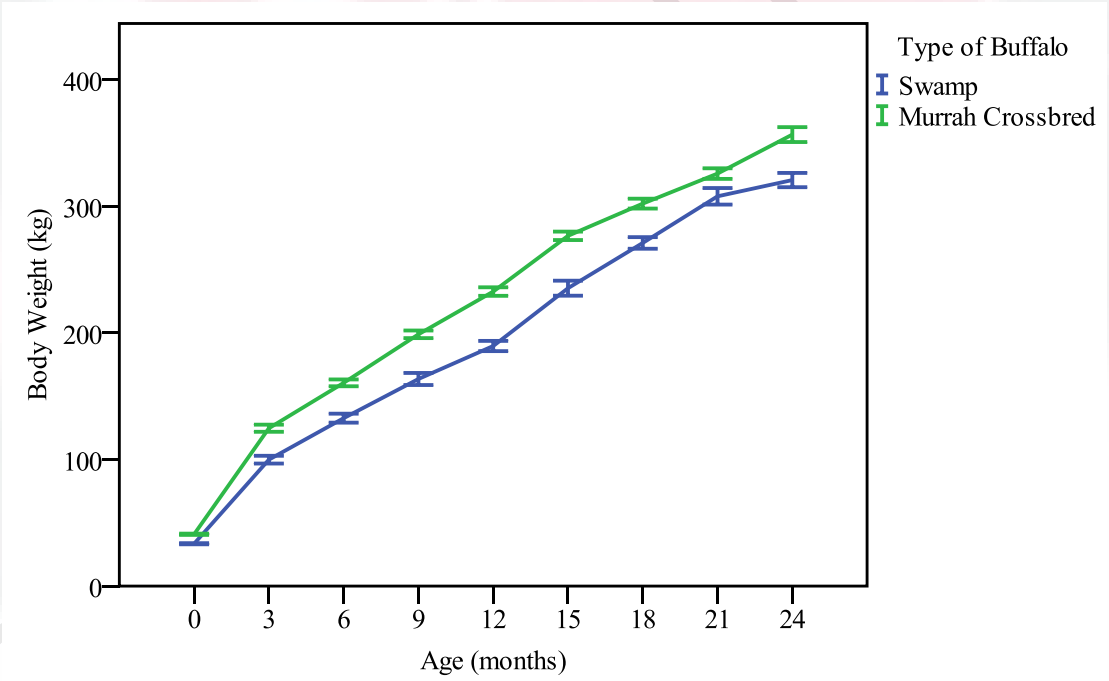

Figure 1: The Body Weight Patterns for Swamp and Murrah Crossbred Buffaloes

5.0 DISCUSSION

The average birth weight of Murrah crossbred was significantly heavier compared to swamp buffaloes, which in line with the findings reported by Momongan et al. (1990), Kamonpatana et al. (1991) and Salas et al. (2000). In addition, the average birth weight in the present study was higher for both swamp and Murrah crossbred buffaloes compared to those previous reports. Furthermore, the average of birth weight in swamp buffaloes reported by Nordin et al. (2004) in Malaysia and Thevamonaharan et al. (2001) in Thailand was lower compared to the present study. Similarly, the average of birth weight in Murrah crossbred buffaloes reported by Charlini and Sinniah (2015) in Sri Lanka was also lower compared to the present study. Generally, the average birth weight may be influenced by the season of birth, year of birth, sex and parity of the dam (Thevarnanoharan et al., 2001; Thiruvenkadan et al., 2009; Pandya et al., 2015).

The pre-weaning growth pattern for both swamp and Murrah crossbred buffaloes showed a steep line, which indicates rapid growth rate of the calves. Furthermore, the average pre-weaning daily gain for Murrah crossbred buffaloes was significantly higher compared to swamp buffaloes. This leads to a better overall average daily weight gain of the buffaloes in the present study (0.89 kg/day) compared to the study by Vaz et al. (2010) who reported the average daily gain at the pre-weaning period from birth until 3 months old for buffaloes was 0.648 kg/day regardless the type of breeds of buffalo. Likewise, the average body weight of 3-month old buffaloes in the present study (112.29 kg) was higher compared to those

reported by Vaz et al. (2010) with 86.5 kg. A similar study by Salas et al. (2000) revealed that approximately 9 months was needed for the calves to achieve body weight of more than 100 kg irrespective of the type of breed of the buffaloes.

The high average body weight and the rapid growth rate at the pre-weaning period for both swamp and Murrah crossbred buffaloes may be influenced by the feeding management of the dam. According to Siti Hafizah et al. (2012) who conducted a study on the proximate analysis of the grasses nutrient content in this farm, *Brachiaria decumbens* contains high nutritive value with high dry matter and crude protein content. The dams were also supplemented with high-energy concentrate feed. Besides, this farm practices good pasture management where they practiced rotational grazing and applied organic fertilizer with urea supplementation on the pasture, which subsequently resulted in increased crude protein content of the grasses (Rafidah et al., 2014).

A good quality pasture added with high-energy concentrate feed have been shown to result in high production of milk (Donker et al., 1968; Sarwar et al., 2012) and better quality of the milk (Slots et al., 2009; O'Donovan et al., 2011). This is important as it influences the body weight of pre-weaning calves that highly dependent on the milk quality and production of the dam during the pre-weaning period (Krohn, 2001). According to De Passile (2001), calves fed with more milk have rapid growth rate at the pre-weaning period. Therefore, the rapid growth rate at the pre-weaning period was most likely a result of the good quality and higher milk intake of the calves. Likewise, a study on the nutrient composition of milk for swamp and Murrah crossbred buffaloes reared in this farm revealed that the nutrient

composition of the milk is of the same value for both breeds (unpublished research). However, the milk composition for both swamp and Murrah crossbred buffaloes reared in this farm was higher in protein content and lower in fat content compared to those 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 Thus, this farm has good quality of milk where the milk contains high protein and low-fat content for both breeds of buffaloes, which attributes to the higher body weight of calves at wean.

In general, the growth patterns revealed that the Murrah crossbred buffaloes had significantly heavier body weight compared to swamp buffaloes from birth until 24 months old. These results are in agreement with the previous studies reported by Situmarong and Sitepu (1991) in the Indonesia, Kamonpatana et al. (1991) in Thailand and Momongan et al. (1990), Parker et al. (1991) and Salas et al. (2000) in the Philippine who concluded that the Murrah crossbred buffaloes were heavier and grew faster compared to indigenous swamp buffaloes. The average body weights at 3-month intervals in the present study were higher from birth until 24 months old for both swamp and Murrah crossbred buffaloes compared to those reported by Parker et al (1991) in the University of Philippines. The body weights of the buffalo calves can be affected by many factors such as the feeding management (Barque et al., 1996; Hoamyoun & Hassan, 2009; Paengkoum et al., 2010), breeds of buffalo (Salas et al., 2000; Charlini & Sinniah, 2015; Pandya et al., 2015), and environment factors (Thevarnanoharan et al., 2001; Bondoc et al., 2002; Javed et al., 2013).

The average daily weight gain is an indicator of the growth performance in the meat industry. All in all, the average daily gain from birth until 24 months old was significantly higher for Murrah crossbred (0.44 kg/day) compared to the swamp buffaloes (0.39 kg/day). These results are in line with the study reported by Bunyavejchewin et al. (1991) who concluded that the average daily gain of Murrah crossbred was higher compared to swamp buffaloes. Nevertheless, the present study revealed that the average daily gain of swamp and Murrah crossbred buffaloes between 12 to 24 months old was not significantly ($P>0.05$) as reported by Parker et al. (1991). The feed intake and the feed conversion ratio of the swamp and Murrah crossbred buffaloes might differ; however, there is no report available to support this fact. Based on the average daily gain from 0 to 24 months old, the Murrah crossbred buffaloes grew faster and reached all the targeted weights earlier compared to swamp buffaloes. These results are in accordance with the previous studies reported by Kamonpatana et al. (1991) and Salas et al. (2000) who concluded that the Murrah crossbred grew at a faster rate compared to swamp buffaloes.

6.0 CONCLUSION

Based on the findings in this study, it can be concluded that Murrah crossbred buffaloes have faster growth rate and heavier body weight compared to swamp buffaloes from birth until 24 months old. Besides, Murrah crossbred buffaloes achieved targeted body weights, which include 250 kg market weight, 385 kg breeding weight and 400 kg slaughter weight at an earlier age compared to swamp buffaloes. Therefore, the breeding policy made by Department of Veterinary Services meets the objective of the crossbreeding programme in buffalo where the proposed crossbred buffalo program is expected to be beneficial to local farmers.

7.0 RECOMMENDATION

In this study, it is proven that the Murrah crossbred buffaloes have better performance in term of growth rate and the body weights at every 3 monthly intervals from birth until 24 months. Further study is recommended to evaluate the carcass and the meat quality for both swamp and Murrah crossbred buffaloes. Besides, further study also needed to determine the milk production performance and reproductive performance for both swamp and Murrah crossbred buffaloes in Malaysia.

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