UNIVERSITI PUTRA MALAYSIA

ON-FARM EVALUATION OF GROWTH AND REPRODUCTIVE PERFORMANCE OF TIMORENSIS DEER KEPT IN TAMAN PERTANIAN UNIVERSITI, UNIVERSITI PUTRA MALAYSIA, SELANGOR

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SERDANG

2015

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BY

MUHAMAD ALIF BIN ZAKARIA

A project paper submitted to the

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It is hereby certified that we have read this project paper entitled "On-Farm Evaluation Of Growth and Reproductive Performance of Timorensis Deer Kept In Taman Pertanian Universiti, Universiti Putra Malaysia, Selangor" by Muhamad Alif Bin Zakaria and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project

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DEDICATION

In the name of Allah, The Most Benevolent, The Most Merciful

To

Mak, Abah, Adik, Abang

Let not any one of you belittle himself. They said: O Messenger of Allah, how can any one of us belittle himself? He said: He finds a matter concerning Allah about which he should say something, and he does not say [it], so Allah (mighty and sublime be He) says to him on the Day of Resurrection; what prevented you from saying something about such-and-such and such-and-such? He say: [It was] out of fear of people. Then He says: Rather it is I whom you should more properly fear.

(Ibn Majah)

ACKNOWLEDGEMENT

In the name of Allah: The Most Merciful and The Most Compassionate

I would like to express my sincere appreciation and deepest gratitude to my supervisor, Prof. Dr. Zamri Saad for his encouragement, guidance, supervision, patience and dedication, comments and suggestion throughout the completion of this project paper. His guidance and friendship has made this project a meaningful education.

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I would like to thank my parents and my family for their support and blessing, all my coursemates and who involved in my project preparation either directly or indirectly.

Thank you very much.

MUHAMAD ALIF BIN ZAKARIA

MARCH 2015

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ABSTRAK

Abstrak daripada kertas yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada kursus VPD 401 – Projek Ilmiah Akhir Tahun

PRESTASI KESIHATAN DAN PEMBIAKAN RUSA TIMORENSIS DI TAMAN PERTANIAN UNIVERSITI, UNIVERSITI PUTRA MALAYSIA

Oleh

Muhamad Alif Bin Zakaria

2015

Penyelia : Prof. Dr. Mohd Zamri bin Saad

Satu kajian ke atas prestasi kesihatan dan reproduksi rusa Timorensis telah dijalankan di Ladang 16, Taman Pertanian Universiti. Ladang ini telah ditubuhkan bagi memberi kemudahan pembelajaran, pameran kepada orang ramai dan sebagai ladang contoh untuk penternak rusa. Kajian ini dijalankan terhadap rusa baka Timorensis, merangkumi aspek kesihatan dan pembiakan. Namun, umur pada kebuntingan pertama, berat lahir, purata pertambahan berat harian dan umur mula beranak tidak dapat dianalisa kerana ketiadaan rekod. Kadar kelahiran yang tinggi dicatatkan antara bulan Oktober dan Disember dan kadar tertinggi pada bulan Disember. Peratus kelahiran untuk tempoh 4 tahun bagi rusa Timorensis adalah 60% sementara peratus kematian pula adalah rendah (<10%). Kadar tumbesaran harian

ialah 0.02±0.02 kg (n=140) dan tidak terdapat perbezaan signifikan antara kadar pertumbuhan bagi setiap tahun ($p>0.05$). Namun, taburan hujan menunjukkan perkaitan positif dengan kadar kelahiran ($p<0.05$). Oleh itu, kemungkinan terdapat musim membiak bagi rusa timorensis di ladang ini iaitu di musim kemarau bulan Februari hingga April yang menghasilkan musim beranak pada musim tengkujuh bulan Oktober hingga Disember. Oleh itu, pihak ladang sepatutnya mengenal-pasti musim pembiakan ini dengan mengambil langkah sewajarnya untuk menyiap-siagakan pembiak betina untuk pembiakan dan tenaga pekerja untuk menyambut kelahiran.

Kata kunci: *rusa, aspek kesihatan, aspek reproduksi, Ladang 16, UPM*

ABSTRACT

Abstract from a project paper submitted to the Faculty of Veterinary Medicine as partial fulfilment of the requirement of the course VPD 4999 – Final Year Project

ON-FARM EVALUATION OF GROWTH AND REPRODUCTIVE PERFORMANCE OF TIMORENSIS DEER KEPT IN TAMAN PERTANIAN UNIVERSITI, UNIVERSITI PUTRA MALAYSIA

By

Muhamad Alif Bin Zakaria

2015

Supervisor : Prof. Dr. Mohd Zamri bin Saad

A retrospective study was conducted to evaluate the health and reproductive performances of timorensis deer kept in Field 16, Taman Pertanian Universiti. The farm was built with the aim of being a model farm for teaching, public exhibition, and a model for farmers. This study involved all timorensis deer kept at the farm. Available farm records between 2011 and 2014 were collected and analysed. However, the age at first fawning, mean birth weight (kg), fawning intervals, litter size, age at first parturition and parturition interval (months) could not be analysed since the records were not kept. Most fawning occurred between October and December each year with apparent peak in December. The mean fawning percentage for the past 4 years was 60% while the average rate of mortality was low (<10%).

The average daily gain was 0.02±0.02 kg (n=140) and there was no significant (P>0.05) difference between the average monthly ADG every year. The risk factors particularly the monthly rainfall showed significant (p<0.05) negative correlation with the monthly ADG but positive correlated with monthly rate of fawning (p<0.05). Therefore, there might be a breeding season within the mild dry months of February to March that resulted in fawning season in the rainy months of October to December. Thus, the farm should recognize these seasons to take appropriate actions in preparing hinds for breeding and farmhands in handling fawning.

Key words*: on-farm, performance, Deer, health status, reproductive status*

1.0 INTRODUCTION

Deer industry is a relatively new growing industry in Malaysia. It is becoming important to the Malaysian economy in trying to meet the increasing demand for meat and to reduce the dependence on imports. With the increasing both consumption and population, there is a need to look for other animal as an alternative source of meat, which has the same potency as conventional animal. Deer is one of the wild animals, which are later domesticated in the 20th century and have a wide prospect to be developed. Currently, in the whole world, there are less than 20 species of wildlife that has been domesticated in order to produce meat as a source of protein.

Universiti Putra Malaysia (UPM) keeps two types of deer, the Sambar and Timorensis deer. The timorensis were brought in from Mauritius while the Sambar was local deer. The university is planning to improve the efficacy of the animal health and reproductive management, so that it can be developed into a showcase farm to the public, a model farm for farmers and a good teaching farm for students on campus. Since the university believes in the concept of halal meat production, it is determined to implement good husbandry practice so as to produce good quality wholesome products. Therefore, the deer project is aimed to be developed into an economic unit to create income for the university.

Before implementations for improvement could be carried out, it is important to understand the current situation. Thus, it is essential to collect and analyse the baseline data on current performance. The justifications of this project are mainly to know the actual risk factors that contribute to the overall performance of the farm.

The objectives of the project are:-

1. To document the husbandry practices of deer in Taman Pertanian Universiti, Universiti Putra Malaysia

2. To measure productive and reproductive performances of deer under farm management conditions.

3. To identify factors influencing the performances of deer on the farm

2.0 LITERATURE REVIEW

2.1 Deer farm

Deer is one of the wild animals and is considered difficult for domestication. It is new in the livestock industry and not yet exploited commercially. Nevertheless, it provides an alternative to cattle and goats but expensive. In Malaysia, deer farming was first started in 1977 by farming Sambar deer in Perak and Sabah (Idris *et al*,. 2000). This was followed by Selangor (1987) and Negeri Sembilan (1988) through integration with palm oil, and then in 1989 in Perak (Animal Plantation Behrang Ulu) and in Pulau Pinang (Seberang Prai Utara). Following attempts of farming, deer population has grown rapidly; in 1986 with 300 deer, 1991 with 9,360 deer, 1998 with 10,000 deer and 2003 with 11,000 deer. The advantages of farming deer includes high birth rate (80% - 90%), resistance and durable to rain and heat, low mortality (2% - 5%) and high yield (Shaffer *et al*,. 2005). Deer also have a high resistance to disease and they do not choose to graze. Their meats contain less fat and cholesterol (Table 1), and much tastier (Drew et al.,1991; Dahlan, 2000; Shin et al., 2000).

Table 1: Nutritional content of deer meat in comparison with other livestock

Livestock	Protein(%)	Fat(%)	Mineral(%)	Cholestrol(%)	Calorie(%)
Deer	24.5	0.33	0.2	74	545
Rabbit	20.7	3.8	1.5	50	118
Cattle	18.3	18.9	0.9	95	217
Sheep	15.6	30.9	0.9	84	241
Chicken	18	9	1.1	90	129
Duck	18.3	19	1.3	70	-
Pig	13.3	34.2	0.8	110	396

SOURCE: USDA research; venison analysis by The National Food Laboratory, Inc.

(Shaffer *et al*,. 2005)

2.2 Timorensis deer (*Cervus timorensis*)

Timorensis deer (*Cervus timorensis*) is an indigenous animal to the Indonesian Archipelago. It was later introduced to South-East Kalimantan, New Guinea, the Bismarck Archipelago, New Caledonia, Australia and New Zealand (Food and Agriculture Organization, 1982). There are two main subspecies of timorensis deer; the Javan and Moluccan. Timorensis hinds are aseasonal polyestrous breeders (Food and Agriculture Organization, 1982). Both hinds (females deer) and stags (males deer) attain sexual maturity at 18 months old and the body weight of hinds at first mating is approximately 46 kg (Van Mourik, 1986). They are long day breeders without delayed implantation (Van Mourik and Stelmasiak, 1985). Major breeding activities are between March and July (Mahre *et al*., 2012).

Timorensis deer is closely associated with sambar deer, but smaller. An adult stag can achieve an average weight of 100-140 kg while the height at the shoulder is approximately 110 cm. The females weight 50-90 kg and the height at shoulder is 90 cm (English, 1988; Dryden, 2000a). Reddish-brown to dark brown in colour with fine body hair and sparse compared to other breeds of deer. Three-pronged antlers and form like "lyre". Average gestation period is between 247 and 257 days. The lifespan of breeder is around 12-15 years.The main product is meat (venison) and they are suitable for commercially farmed.

2.2.1 Growth performances

Growth is an important factor for meat production as it determines the overall productivity of the flock and the economic return from livestock enterprises (Awgichew, 2000; Mengistie, 2008). Growth rate, predominantly during the early stages of growth, is strongly influenced by breed (genotype), milk yield of the hind and the environment under which the animals are maintained including the availability of adequate feed supply in terms of both quantity and quality (Awgichew, 2000; Mengistie, 2008). Parity, pre-mating weight of the hind, type of birth, sex, season and month of birth also contributes to growth performance. Body measurements according to Rabinowitz (1993) included shoulder height (top of ridge between shoulder bones to base of foot, including the hoof), body length (from the anterior end of nuzzle on the head to the posterior part of the pin bone of the body), and girth (circumference of the body measured behind the front legs at the heart level).

2.2.2 Birth weight and pre-weaning growth performances

Birth weight is one of the most important aspects influencing the pre-weaning growth of the young and has a positive correlation with subsequent live body weight development (Awgichew, 2000). However, birth type and sex are bases of variation in pre-weaning growth rate (Taye *et al.*, 2009). This is because fawns that are heavier at birth are usually singles or are those produced by hind with larger body conformation and good body conditions. Therefore, fawns that are heavier at birth have larger adult weight and higher growth capacity (Awgichew, 2000; Taye *et al.*, 2009). Similarly, parity also affect the pre-weaning growth rate, particularly from birth to 30 days of age. The indication is that fawn from second and third parity grow better than the first and fifth parities (Abebe, 1999; Awgichew, 2000; Tibbo, 2006; Taye *et al.*, 2009). Furthermore, genotype significantly influences the birth weight of fawn.

2.2.3 Weaning weight and pre-weaning average daily gain (ADG)

Weaning weight is an important economic trait in meat production since it has a strong influence on growth rate and survival (Taye *et al.*, 2009). Different values of weaning weight were reported by different authors. Thus, weaning weight and post-weaning growth rate are crucial for the pre-weaning growth performances, mainly when the objective is producing meat. Seasonal variation in growth rate has been reported in tropics because feed supply varies remarkably (Awigichew, 2000). Significant effect of season on post-weaning weight was reported on fawn growth (Tibbo, 2006; Taye *et al.*, 2009) while there was non-significant effect of sex and

birth type (Taye et al., 2009). Besides that, weaning shock also lowers the growth rate (Taye *et al.*, 2009).

2.2.4 Reproductive performances

Reproductive performance is necessity for any successful livestock production programme. Where farm resources are severely limited, reproduction failure is the first sign of decreased productivity (Mukasa Mugerwa *et al*., 2002). Reproductive traits are difficult to measure and are strongly influenced by management decisions, but are also of paramount economic importance (Notter, 2000). Flock reproductive rate also affects selection intensity and consequently the rate of genetic improvement in all traits under selection. Reproductive rate can be influenced by conception rate, litter size, young mortality and interval between parturitions (Ndlovu and Simela, 1996).

3.0 MATERIALS AND METHODS

3.1 Farm

The deer farm belonging to Universiti Putra Malaysia was selected for the study. The population was kept at about 100 deer at any one time. Nevertheless, at the time of study, there were 140 timorensis deer that ranged between 2 months to seventeen years old. The total area for the deer rearing is approximately 20 hectares, divided into several grazing areas in which the shrubs were left intact. The animals were left grazing in the paddocks at all times.

3.2 Study parameters

The reproductive and fawn growth performance parameters were derived from the calculations below:

3.2.1 Reproductive parameters

1. Fawning percentage =

$$\frac{\text{Number of fawnings}}{\text{Number of females breeding age}} \times 100$$

2. Fawn born per month percentage =

$$\frac{\text{Number of fawn born in the month}}{\text{Total number of fawn born in the year}} \times 100$$

3. Mortality percentage =

$$\frac{\text{Number of deaths}}{\text{Total number of animals}} \times 100$$

3.2.2 Fawn growth performance parameters

1. Weaning weight (kg)

2. Average daily gain from birth to weaning (kg./day) =

$$\frac{\text{Weaning weight – Birth weight (kg.)}}{\text{Weaning days (days)}}$$

3.3 The evaluation

3.3.1 Data collection

Data collection was done by using flock monitoring, previous survey results and secondary data from the Taman Pertanian Universiti on overall agricultural production, socioeconomics and crop-livestock integrations. Field visits were also made to gather pre-information. Case histories to obtain adequate information on the parameters like age at first parturition, parturition interval, abortions and udder problems and case histories of breeding females were taken.

3.3.2 Data processing

Data obtained were organized, summarized and analysed by using SPSS statistical package method and presented in tables and graphic forms. Data on growth parameters (body weight & ADG) were analyzed by using independent t-test to detect differences between genders. Reproductive performance records were analyzed to calculate mean and range values of fawning percentage and fawn sex

ratio. Correlation between risk factor and farm performance were analysed by using Pearson's correlation.

3.3.3 Evaluation

The results were compared with the standard obtained from the literature.

3.4 Assumptions

Three assumptions were made in this study:-

1. All data were accurate
2. The farm was in a sub-optimal production
3. The farm management model was accurate

3.5 Hypotheses

The null hypothesis was that there was no significant differences on the performance of the farm throughout the years and for the risk factor, there was no significant correlation between farm performance and risk factor. The alternative hypothesis stated otherwise.

4.0 RESULTS

4.1 Management system

Livestock component of Taman Pertanian Universiti (TPU) was established in 1980 and consisted of fields 10, 15 and 16. Field 10 consisted of Kedah-Kelantan (KK) cattle, field 15 for feedlot cattle and field 16 consisted of various animals such as cattle, deer, horse and goats. Fields 15 and 16 were located within the ERL (train tract), the Kajang Silk and PLUS highways. The accessible road was good; half gravelled and half tarred available from the highway to the farm. The rainfall was also suitable as the average rainfall for the whole year was about 2000mm; highest in October to February and lowest in May to September. Mean annual temperature was 27°C with little variation throughout the year. Relative humidity was high at 77%. The farm was acceptable as the office and the staff housing were situated right in the middle of the farm.

The land area for field 16 was about 128 hectares (320 acre) while the grazing area was about 300 acre. The total area for the deer raring was approximately 20 hectares with carrying capacity of 7 deer per hectare. Pastures in Field 15 and 16 were *Bracharia decumbens*, Guinea grass, *Setaria splendida*, *Setaria kazangula*, and *Cynodon plectotahyus*. Legumes are *Centrosema pubescens* and *Leucaena leucocephala*. Nitrogen, phosphorus and calium (NPK) were used as fertilizer, at the ratio of 15:15:15. About 300 bags of NPK and 100 bags of urea were used in pastures for cut and carry methods per year.

Other facilities in fields 15 and 16 included tractor shed, feed store for palm kernel cake, lecture room, office and restraining yards. Facilities in deer unit

included paddock fence and perimeter, shading area, paddock, dark house, deer crush/stocks, herd path/raceway, and holding yard (quarantine deer).

Timorensis deer was first brought in from Mauritius while Sambar was local. There were about 100 deer in the area at any one time. The deer in field 16 were reared using extensive system with open shed housing. Cut and carry grass (Napier and guinea grass) was provided other than grazing *Bracharia decumbens* and *Setaria splendida* in the paddock. The guinea grass was harvested using forage harvester, while Napier grass was manually. Both grasses were chopped down using chopping machine. It was found that deer were not fussy in eating chopped grass compared to other livestock.

Approximately 1kg of pastures was provided per deer per day. Palm kernel cake (PKC), supplements feed (goat pellet) and salt block were also given in the paddock. The goat pellet was given once every two days at the rate of 1kg/animal/day and the amount was increased to 2kg/animal/day during rainy season. *Leucaena leucocephala* was occasionally provided as supplement feed. In general, farmed deer require 7-10% wet material or 2-3% of dry matter weight per day. Besides that, all animals were allowed to graze day and night. Drainage system was good with proper flow of the waste water. Waste water flow freely by gravity to the paddock and along the lane.

Disease prevention activities included quarantine, mass immunization and chemoprophylaxis. All newly arrived animals were quarantined before being introduced into the farm proper. The deer were vaccinated only against foot and mouth disease (FMD). Chemoprophylaxis involved routine administration of

anthelmintic. No dipping and spraying of acaricide was done. Animals that were suspected of died of infectious diseases were referred to the Faculty of Veterinary Medicine UPM for final diagnosis.

4.2 Record and data management system

Although the farm was established since 1980, the farm only started to keep proper record from 2011. Even so, this records were incomplete. Currently, the records that were available were the post-weaning body weight, daily treatment record, mortality record and the cause of death. The birth weight was not recorded as the preferred no interference with newborn fawn and risking injuries to the animal. The body weights were recorded three times per year; in April, August and December. At the same time, fawning rate was recorded before identification tag was applied. Record of sales, fertilizing activities and breeding were also kept. Record analyses were routinely done by the farm unit management.

4.3 Breeding protocol

The breeding protocol that was used was the natural breeding at the ratio of stag to hind of 1:4-5. The stag was allowed to mix with the group of hind permanently since mating usually occur at dawn or dusk. Being wild animal kept extensively, pregnant animals were not identified. The fawns were kept running with the hinds until weaning age at 3-4 months.

In this farm, breeding seasons were between February and April and between June and August. Average age of first fawning was estimated at 2 years old. However, there was no introduction of new breeder animals into the flock ever since leading to possible inbreeding. Since natural breeding was used in a manner as wild

animals, there was no set criteria for culling system. Animals were only culled based on disease problem.

4.4 Farm performance

4.4.1. Rate of mortality

Between 2011 and 2014, 7 (5.38%) fawns of the age below 1 year old out of 130 births were dead (Table 2). There was no fawn mortality in 2011 and 2014. The mortality rate was 2% in 2012 and 26.8 % in 2014. Mortality was markedly high during monsoon months of October, November and December.

Table 2. Rate of mortality of timorensis fawn between 2011 and 2014

Year	No. of fawn born alive	No. of fawn died	Mortality Rate (%)
2011	51	0	0
2012	50	1	2
2013	23	6	26.08
2014	6	0	0

The main causes of mortality among deer in this farm included dog attack (57.14%) and traumatic injury (28.57%). Mortality among adults revealed increasing pattern from 2010 to 2013, mainly due to dog attack and traumatic injury (Table 3).

Table 3. Cause of death for timorensis deer

Causes	2009	2010	2011	2012	2013	2014	Total	COD (%)
Dog attack	3	0	0	0	24	4	31	37.35
Traumatic injury	3	2	3	4	13	1	26	31.33
Unknown cause	0	0	1	0	6	0	7	8.43
Accidental death	0	0	0	7	0	0	7	8.43
Stress after vaccination	0	0	4	0	0	0	4	4.82
Suspected urea poisoning	0	0	0	4	0	0	4	4.82
Tuberculosis	0	0	2	0	0	0	2	2.41
Old age	0	0	1	0	0	0	1	1.2
Dystocia	0	0	0	0	0	1	1	1.2

A total of 74 deer were reported dead over the 4-year period between 2011 and 2014 (Table 3). Other than the previously described cause of death, post-capture myopathy, suspected urea poisoning, tuberculosis and old age were recorded. Therefore, average culling rate was approximately 10% while the average mortality rate was < 10%.

4.4.2 Growth performance

Analyses were made on 130 births between 2011 and 2014. The weaning weight of male fawn ranged between 9 and 31.5 kg, an average of 20.67$\pm$1.0 kg and the female ranged between 12.5 and 36.5 kg, an average of 20.29$\pm$0.8 kg. There was no significant ($p>0.05$) differences between the weaning weight of both sexes. At six months of age, the average body weight of the fawn was 23.52$\pm$1.0 kg. At one year

old, the average fawn weight was 36.23±0.9 kg. Therefore, average daily weight gain for up to one year of age was 0.042±0.02 kg while the daily weight gain after one year of age was 0.0515±0.01 kg.

The mean weight of adult timorensis deer at 24 months old was 48.5± 1.4 and 44.5± 0.9 kg for male and female, respectively. The overall mean body weight was 45.2±1.2 kg. The heaviest stag was 96.5 kg at the age of 120 months and the heaviest hind was 91.0 kg at the age of 120 months. Fawns that were rejected by the hinds were kept separated and were given colostrums for 4 days post-fawning before they were fed with replacer milk.

4.4.3 Reproductive traits

The farm did not have a system for heat detection, and thus the age at first mating could not be determined. Nevertheless, it is estimated to be between 1.5 and 2 years old. The gestation period was calculated to be between 8 and 9 months resulting in the age at first fawning between 2 and 3 years old with fawning percentage ranged between 50% and 70%.

4.4.4 Herd health

There was no proper herd health program for the deer. However, the farm practiced routine deworming and deticking programmes at 3-monthly intervals involving the entire deer population. Vaccination was done only against FMD in the month of April. Other herd health programmes were not practiced.

4.4.5 Marketing

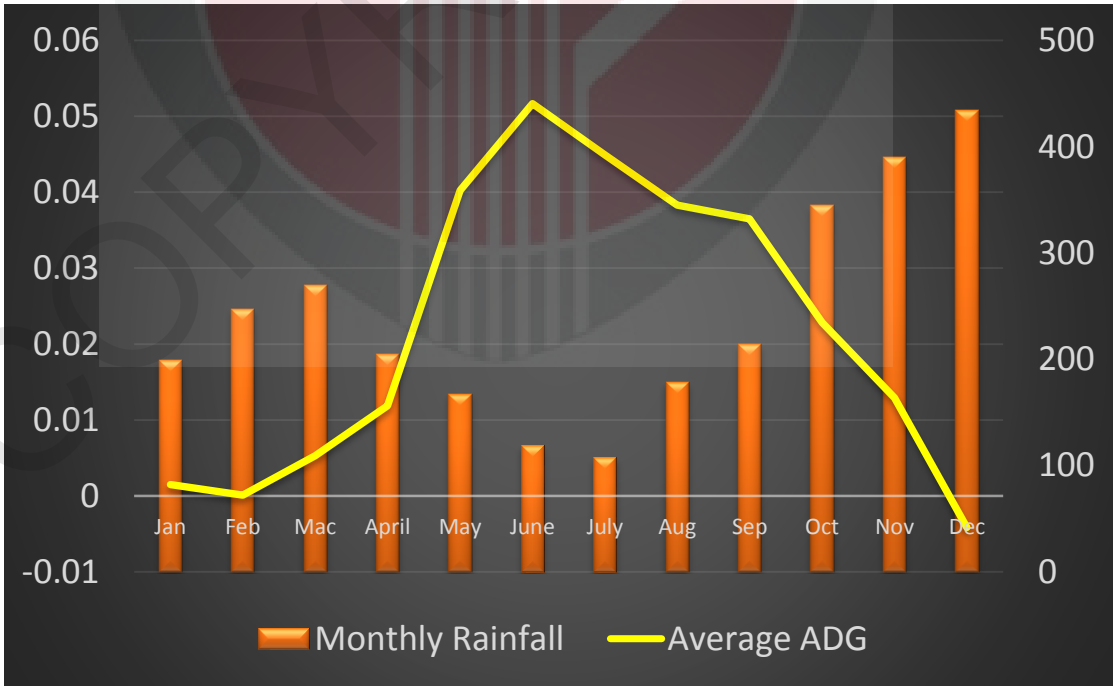
Since the farm has no culling policy, animals were sold based on the request from the public. Therefore, between 2011 and 2014, a total of 104 deer were sold either for breeding or for slaughter.

4.5 Influence of monthly rainfall on farm performance

4.5.1 Effect of monthly rainfall on average daily gain

Significantly ($p<0.05$) higher daily gain was recorded between May and September, when the average rainfall was low and low daily gain in the rainy months between October and April (Fig. 1). There was significantly ($p<0.05$) negative correlation ($r= -0.374$) between the monthly rainfall and daily weight gain (Fig. 1).

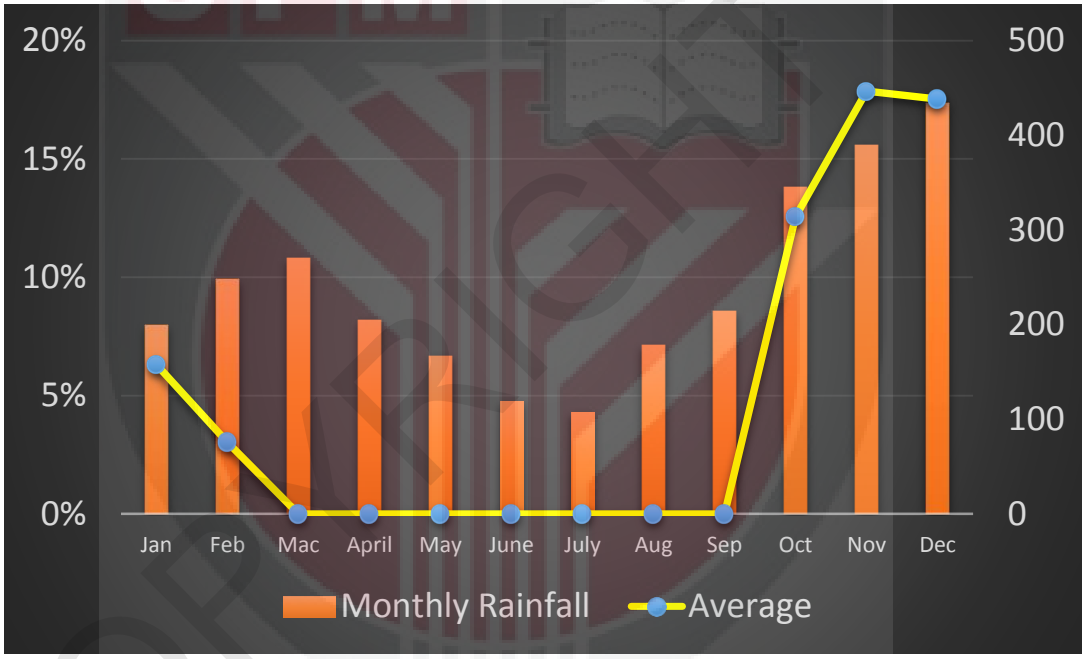
Figure 1. Correlation between monthly rainfall and average daily gain



4.5.2 Effect of monthly rainfall on fawning percentage

Fawning was significantly ($p<0.05$) high during rainy season between October and February. In fact, between 2011 and 2014 all fawnings were within those months (Fig. 2). There was strong positive correlation ($r=0.425$) between the rainfall and fawning percentage (Fig. 2).

Figure 2. Effect of monthly rainfall on average fawning percentage



4.6 Constraints

Major constraints impeding the performance of deers at Taman Pertanian Universiti were predators, recording system, feed and feeding, and breeding protocol. Cross-cutting issue across the study sites was that animals die primarily due to poor managements which otherwise could have been tackled by simple interventions.

Grazing land size is diminishing due to cropping encroachment and land re-distribution, putting nutritional stress on livestock in general. Tethering pressure and insufficient nutrition are often responsible for the appearance of prolonged anoestrous and silent oestrous periods, a reduction in fertility, prolonged parturition interval and reduction in prolificacy.

5.0 DISCUSSION

5.1 General management

Field 16 is located in Taman Pertanian Universiti where various animals such as cattle, deer, horse and goats were kept. However, distance between those farms are susceptibly far. This is important to prevent disease transmission. The farm location, which lies within ERL, Kajang Silk and PLUS triangle is also strategic in promoting the farm, while the farm is also away from housing estate. Pastures used in Field 16 are the common grass used as deer feed. The standard carrying capacity for deer farm is 20 deer per hectare (Food and Agriculture Organization, 1982). Although the carrying capacity of this farm was 7 deer per hectare, the poor soil and poorly maintained pasture resulted in inadequate feed and feeding.

Deer in Field 16 are reared in open and extensive system. This means that the deer were not sheltered although shrubs were available. This might exposed animals to lightning strike and heat stress. Therefore, providing shelter in the form of housing or trees might be beneficial to the deer (Idris, 1996). Under normal conditions, adult deer do not usually need housing but they do need protection from adverse weather conditions and should have access to a lying area (Deer farming: health and welfare, 2012). Hinds normally fawn down in hiding and kept their calves hidden for about a month. Fawns that were born healthy were able to take care of themselves naturally. However, shading has help in percent fawning and survival rate (Dahlan, 2003).

Records on farm performance are pre-requisite to effective decision making, particularly on breeding policy (Food and Agriculture Organization, 1982). The information can be used to improve herd performance and profitability of an

operation. For example, reproductive information can help cull poor producers, which include open hinds, log inter-fawning interval and below average weights. In fact, good information can be used to select breeding stock, particularly the above average characteristics and strong weight gains. Nevertheless, recording in general is hardly practiced in livestock farms in the country (Awigichew, 2000; Tibbo, 2006), thus could not be used to identify the performance and management gaps (Awigichew, 2000; Tibbo, 2006) since reproductive and productive performances are important early indicators of adaptability and management adequacy (Abegaz *et al*, 2002; Getahun, 2008). Thorough monitoring of the productive, reproductive and economic performances, a full picture of their contribution and thereby verifying possible intervention areas can be made (Getahun, 2008).

The data from individual deer of different ages showed some variation in body weight. The variation in body weight was due to stags in rutting period, hinds at pregnancy stage, individual differences, and seasonal reduction in food intake due to quality and quantity of undergrowth vegetation (Dahlan *et al*,. 2013). The variation in body weight of deer in a herd was also explained by Geist (1998). Therefore, there was no significant differences between the body weight of male and female deer in this farm at weaning and at 2 years old.

The farm population for timorensis deer had been decreased over the last 4-year period. Based on the records, some of the offsprings produced were weak and defective, likely due to inbreeding. Similarly, the population growth rate seemed to decline. Culling the old hinds and stags, and introduction of new genetic materials in the form of new male and female breeders together with good breeding management

will probably improve breeding performance of the deer. Fennessy and Milligan (1987) observed that the presence of a tame hind can help newly weaned calves to settle down and reduce post-capture myopathy problems.

5.2 Feeding

The amount of cut grass of 1kg per deer per day was not enough to fulfill the nutritional requirement as a deer requires between 10 and 15 kg of grass daily. The deer can only survive on grass if the grass is of high quality. Otherwise, supplementary feed and mineral salts are required (Perkins, 1991) as supplemented feed can reduce the amount of grass consumed. The farm provided supplemented feed in the form of PKC and goat pellet but whether these fulfil the requirement was not determined.

Some farmers feel uncomfortable about increasing their deer harvest and choose to artificially increase the carrying capacity of their farm. One way is by providing supplemental feed (Perkins, 1991). Feeding a deer herd is extremely expensive and generally the costs of maintaining the additional deer far outweight the financial returns. In addition, the extra nutrition provided by feeding magnifies the problem, resulting in increased reproduction. Fawning rates will increase and herd size will expand until it is once again above the carrying capacity.

Managers can influence the quality of deer forage by manipulating vegetation and encouraging plant diversity. The greatest influence on feer nutrition can be achieved by managing forage quality. This is done through correct stocking rates, proper hervest of deer to keep numbers and forage in balance and discriminate brush and weed management. In addition, the farmer should be aware of the nutritional

value of deer food plants so that informed brush, weed and grazing management decisions can be made (Richardson, 2009).

5.3 Health

The vaccination and deworming programmes practiced in this farm were acceptable to control important infectious and parasitic diseases. The 2-monthly deticking program was also good, especially in the case of extensive farming system as in this farm. In general, deer in this farm were free from major zoonotic and infectious diseases. Although regular deworming was done, there was no screening on the gastrointestinal parasite.

5.4 Reproduction

The natural mating ratio of stag to hind of 1:4-5 in this farm was below average when the standard ratio is 1:15. Therefore, it was expected that the fawning rate to be high. The fawning rate varied between farms and depends on the mating method that has been practiced (Food and Agriculture Organization, 1982). However, keeping more stags that required might lead to increase cost of production. Therefore, culling some of the stags should be considered.

In the present study, the neonatal mortality rate was low (7%) relative to a previous study (69.8%) and pre-weaning fawn mortality was also lower (14%) than those of farmed cervids previously reported (28.9%). An investigation of perinatal mortality in farmed fallow deer in Australia indicated that the majority of postparturient death (43.1%) was caused by mismothering/ starvation of fawns that had birthweights lower than the average for surviving fawns (3.0 kg vs. 4.1 kg, respectively). This farm recorded good mothering ability of timorensis deer.

Similarly, it was reported that the major factor of fawn mortality in farmed deer was fawn weight, especially for females. Similarly, a previous investigation in North America identified factors resulting from nutritional deprivation, such as emaciation and malnutrition, were major causes of neonatal mortality (47%) in caribou (*Rangifer tarandus*). Although the cause of neonatal mortality in wild caribou may not be comparable with that in farmed deer, it was clear that the malnutrition played an important role in both species. In this study, weaning weight of males and females showed no significant differences, making them to be able to survive better. In the current study, although the cause of neonatal mortality could not be determined in most cases, dystocia caused 16.6% of the total mortality. Therefore, strict attention should be paid to predisposing factors, mainly environmental stress, which usually contributed to dystocia in farmed hinds.

The sex ratio of fawn born is equal at birth and at weaning. This was consistent with the extensive study (>3000 fawns) done in New Zealand. However, this was inconsistent with the finding of Suzuki and Ohtaishi (1993), who reported a male–female ratio of 1.4:1 for 22 fawns of sika deer in Hokkaido. However, due to the small sample size, significant gender differences were not identified. In the present study, the male/female ratio (1.3:1) of fawns at birth differed significantly from the equal ratio. In terms of commercial strategies, this trend should increase the potential for velvet antler production on farms.

The farm's female/offspring ratio generally reflects the fertility among deer since it is the result of previous reproductive performance and offspring mortality (Food and Agriculture Organization, 1982). Preferential feed and feeding is desirable

for the achievement of good reproductive performance. Furthermore, management of stags at mating is a crucial factor in reproduction and much of it is related to their competitive behaviour (Food and Agriculture Organization, 1982). Stags intended for mating should be well fed prior to the rutting season, as during that time there are considerable weight loss as much as 15% (Mitchell *et al*., 1977). Therefore, high level of feeding is required to minimize weight losses.

In general, this farm received a well distributed rainfall throughout the year with two obvious seasons, the rainy and dry seasons. Nevertheless, rainfall pattern affects the growth of grass. Heavy rain, although stimulated groth of grass, prevented farm management from adhering to pasture renovation programme and the cut and carry activities. These resulted in reduction of available forage. Besides, the high water content of the forage reduced the overall dry matter intake during rainy season. Furthermore, studies shows that feed intake of deer is greatly reduced during rainy season as there prefer resting under the shedding area due to stress from weather changes (Abney and Galyean, 2006). Therefore, deer in this study were provided with extra supplemented feed during rainy season.

Milder dry season between February and Mrach provided opportunity for the breeder deer to consume enough forage dry matter. With suplementation, the body condition of breeders was enhanced that made them ready for breeding and eventually fawned in 8 to 9 months later in October to December, as observed in this study. Therefore, it is suggested that February to March be recognized as breeding season for deer in this farm, when they should be flushed with extra supplemented feed to enhance the body condition prior to breeding. This resulted in fawning season

between October and December, when control of predators particularly stray dogs and records can be updated. This is partially similar to the results of some studies. Chan *et al.* (2009) reported that Formosan sambar stags were capable of mating during any month of the year, which resulted in fawning occurring almost throughout the year. Rodriguez-Hidalgo *et al.* (2010) reported that red deer in Spain showed seasonal variation in Mediterranean habitats reflecting the abundance and quality of food (Zerbe *et al*., 2012). Similarly, Haigh (1992) stated that the onset of estrus is governed by weight and lactating hinds in poor nutritional condition might not conceive at all. Fennessy and Milligan (1987) stated that a hind in good body condition could be expected to conceive earlier than the one in poor condition. The likelihood of pregnancy occurring was strongly influenced by hind body mass (Rodriguez-Hidalgo *et al*,. 2010).

As expected, there is a significant negative correlation between the monthly rainfall and average daily weight gain (ADG). As the monthly rainfall increase, there is a decreased in average daily gain. It has been shown that weather conditions, including temperature, wind and rain affect feeding and rumination behaviour. When raining, the deer have to spend extra energy to search and feed because of low visibility. More importantly, rain decreases herbage acceptability because of the palatability effect, which results in a reduction of dry-matter intake. Excessive water in the rumen might not decrease forage intake but would reduce saliva production during the ingestion of low dry-matter forages. Thus, ungulates are usually observed to reduce feeding time, biting rate and intake per bite on rainy days (Cameron, 2013).

Traumatic injury has been recognized as one of the major health problem among deer in this study. It might have been inflicted by changes in social status within the herd, overcrowding, fighting of stags during the rut and competition over limited feeder space (Arthur *et al.*, 2003). Furthermore, presence of dogs and other animals on the farm influence the overly excited deer in the herd. Inappropriate animal handling procedures or equipment may also be an important factor contributing to traumatic injuries. Nevertheless, predators tend to prey selectively on young deer because they are easier to catch and to bring down, and because they are more inexperienced at avoiding predators than are adults (Okarma *et al*., 1995; Jedrzejewski *et al*., 2000). This study, however, failed to correlate rainfall with rate of mortality.

6.0 CONCLUSION

This study suggests that Timorensis deer in Taman Pertanian Universiti was consistent in producing one fawn a year. Both males and females showed equal fawn growth performance, as sex difference was not significant. In general, the reproductive and growth performance of Timorensis deer obtained in this commercial farm were comparable while few were lower than other studies. The reason for these was probably related to the improper management and nutrition in the farm.

Feed and feeding is probably most influencial factor affecting the performance of deer, which was affected by rainfall pattern leading to reduced feed intake. This, however, leads to a possible breeding season in February to March and fawning season in October to December, which should be exploited by the farm management to improve reproductive performance of the farm.

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