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DRAFT AND REPRODUCTIVE PERFORMANCE OF THE SWAMP BUFFALO IN AN OIL PALM PLANTATION

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by

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Dedicated to
my parents and wife

'And they carry your heavy loads to lands that
ye could not (otherwise) reach except with souls distressed:
for Allah is indeed Most Kind and Most Merciful'

(AL-Quran XVI, 7)

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ABSTRACT

The physiological responses, draft performance and feeding behaviour were studied in eighteen draft buffaloes (one animal per day) in an oil palm plantation. In addition, the records maintained by the breeding unit for the period 1977-1983 were analysed for birth weights, calving intervals and calf crop. The climatic data were obtained from the estate weather unit.

The total number of fresh fruit bunch hauled daily average 175 which was equivalent to a work load of 4550 kg transported over a distance of 1.19 km. The work period averaged 5.3 hour daily.

The mean maximum and minimum ambient temperatures were 32. and 22.6 C respectively. The relative humidity averaged 95% at 0700 h, 80.4% at 1000 h and 70.9% at 1500 h. The average body temperature, pulse and respiration rates/minute before wor (0700h) were 37.8 C, 41 and 25 respectively. There was a gradua increase in rectal temperature, pulse and respiration rates during work and reached 38.8 C, 62 and 26 respectively at 1230h.

The time spent on grazing was 26% of the entire working period. The composition of plant population in the inter-rows was native grasses (81%), broadleaves (13%) and ferns (6%).

Of 215 calves born, the mean birthweight was 28.3 kg. for males and 26.2 kg for females with an overall mean of 26.5 kg The overall mean calving interval was 483 days with 44% of the calving intervals ranging from 375 to 474 days. The calving interval decreased with increasing parity. No significant relationship existed between calving pattern and rainfall, month or year.

Based on the results of this study, it is concluded that (1) The body temperature, pulse and respiration rate of draft buffaloes remain within normal limits during work, (2) the buffalo is more efficient than other traditional systems currentl used in harvesting fresh fruits bunches in oil palm plantations (3) both oil palm byproducts and fodder in the inter-rows in pal oil plantations are enormous feed resources for buffaloes, (4) herd of 50 breeding females are needed to provide the annual replacement requirements of 15, 2-year old males for draft for every 750 ha of oil palm, and (5) smallholder farmers in oil pal schemes should be encouraged to use the buffalo in harvesting as it would increase their income.

INTRODUCTION

Palm oil is one of Malaysia's foremost income earners. The and area under oil palm was estimated at about 1.2 million ha or 1984. The sources of draft power for harvesting and transporing fresh fruit bunch (FFB) may be human, animal or machine. The high cost of fuel has compelled oil palm plantations to explore alternate sources of power for harvesting FFB.

Of the animal species, the swamp buffalo (Bubalus bubalis is probably the most adaptable and versatile draft animal used for land preparation and harvesting of rice and sugarcane in many Southeast Asian countries. It ia also used for other purposes such as pumping water, hauling logs, carts or boats and carry people [5, 17].

The swamp buffalo population of 220,000 heads in Malaysia i fast declining due to the advent of mechanization in various sectors of agriculture. Between 1966 and 1976 the buffalo population in Malaysia declined by 18%, mainly due to their displacement by tractors and an increase in illegal slaughter.

A few oil palm estates in Malaysia utilise buffaloes to supplement human and/or mechanical power for transporting (FFB in difficult terrains and loads over short distances. Hauling of FFB to the collecting platforms with a buffalo-driven cart, can increase the efficiency of a harvester by 2-3 folds and hi income significantly.

Basic data on performance of the buffalo as a draft anima in the oil palm industry is lacking. Therefore, a study was undertaken to measure the draft and reproductive performance physiological responses and feeding behaviour ·of the swamp buffalo in an oil palm plantation.

REVIEW OF LITERATURE

In Malaysia, swamp buffaloes are primarily used for draft purposes providing 20 to 30 percent of farm power in the rice fields [17]. Limited information is available on economical benefits [15], feeding, breeding [7] and physiology of draft buffaloes in oil palm plantations.

The draft power of the buffalo is clearly reflected by its body structures, especially the distribution of bodyweight over the feet and legs. Its large cloven hooves and the flexibl fetlock and pastern joints provide an added advantage during wor particularly under under wet conditions [9].

Work capacity of a buffalo depends on its size, conformation, condition, training, method of hitching and speed o travel (5). Male buffaloes are preferred because of their body size and asset value [7]. Training starts at 3 to 4 years of age [10]. Buffaloes are worked from 5-10 hours daily [5] Their average working life span is 11 years [17]. In Sabah buffaloes used to haul FFB in oil palm plantations increased productivity by 60% [7].

Despite its versatility as a draft animal, the buffalo has less physiological adaptatability to extremes of heat and col [17]. In reasonable shade, its temperature, pulse and respiration are lower than those of cattle. The buffalo, being poor dissipator of surplus body heat, responds to an increase i ambient temperature by a more rapid increase in body temperature pulse and respiration than cattle [1, 17]. During heat stress the buffalo dissipates heat mainly through radiation, and a smal amount through sweating [3] due to a scarcity of sweat glands an thickness of skin. Wallowing is a thermoregulatory mechanism for dissipating excess body heat in buffalo [11]. Swamp buffaloes, sprinkled with water to simulate wallowing lose heat readi ly by conduction and evaporation [13]. Grazing and wallowing occur mainly during the day [22].

Swamp buffaloes perform fairly well under adverse condition of limited pastures and cultivated forage crops [17]. Forage intake under free grazing is about 12% of body weight [3]. Th dry matter yields of natural pastures are 3-7 tons/ha/year; ferns and broad leaves have a higher crude protein content than natura grasses. Palm oil effluent is a potential feed source for buffaloes within the plantation [6, 7].

The swamp buffalo's reputation as a sluggish breeder, mainl due to poor feeding, results in long calving intervals [12]. The buffalo attains puberty at a late age than cattle, with the first oestrus occuring at 21 to 36 months. The buffalo is polyestroua with an oestrous cycle length of 21 days and estrus duration o 18 to 21 hours. Oestrus commences during late evening, with peak sexual activity occuring during the night. Signs of estrus which are less obvious than in cattle are usually depresse

during the days. Length of gestation is 320 to 340 days and the mean calving interval is about 18 months under improved management practices in the University buffalo herd. Under range conditions, the swamp buffalo in Malaysia and Thailand can produce a calf every 20-21 months. Swamp buffalo breeds throughout the year ut seasonal calving patterns have been reported under field conditions.

MATERIALS AND METHODS

This study was conducted at Pamol Plantation Sdn. Bhd, luang, which is 4453 ha in extent and subdivided into three divisions. Monthly crop production from January to April 1984 averaged 10600 metric tons. In 1977, the plantation purchased 35 male swamp buffaloes from Trengganu. Through a breeding program the number of male buffaloes over two years of age increased to 200 hundred by 1984. Male buffaloes, 18-24 months of age an weighing about 200 kg are sold by the 'plantation breeding unit' to the harvesters at M$3.74 per kilogram liveweight or about $700 per animal with an interest free loan, repayable ove 3 to 4 years. Before sale, the young bull is trained to haul cart for a two-week period at a training plot. The total weight of the metal yoke and cart is 100 kg and costs M$400.

Work routine of draft buffaloes

Buffaloes work six days of the week between 0700 h and 1230 h each day. The buffalo and cart are brought to the harvesting site for loading . After work, the animal is released from the cart and tethered for grazing in a selected site within the inter-rows. Forage is supplemented if feed is inadequate particularly near the housing area. Unlike the breeding herd, draft buffaloes receive no supplemetary feed.

Experimental Animals

Eighteen draft buffaloes, aged 4-8 years and weighing 307 570 kg, from '8' division were used for this study during May 19

Measurements

One animal was selected each day to record rectal temperature, pulse and respiration rates before, during work at hourl intervals, and immediately after work. During work, the tota distance travelled (with and without load), the time taken, an the number of FFB hauled were recorded. The observation perio extended from the time the yoke was secured until it was remove from the animal.

The forages available at the working site and the commo forages consumed by the animal during work were recorded. Forage samples were collected for identification. The distribution o various forages within a particular work site was determined by

collecting the forage samples at each step over 800 steps in a straight line ('step-point' method).

Management of the breeding herd

The breeding herd was established in 1977, with 59 buffalo cows, 2 buffalo bulls and 32 calves. The herd was expanded in 982 with the purchase of an additional 109 breeding females and one stud male. The breeding herd consisted of 197 cows, 3 bulls and 134 calves in December 1983.

Mating and calvings occurred in the field or yard. Calves were weighed at birth and ear-tagged at two weeks of age. The dam and calf were stall-fed for about 3 months before they are allowed to graze. Calves were dewormed twice at 6-month interval and all buffaloes over six months were vaccinated annuall against haemorrhagic septicemia.

The breeding herd was divided into five groups: Dams an calves less tha two months (Gr 1); dams and calves over 3 month old (Gr 2); buffalo heifers and cows with stud males (Gr 3 and 4); and 18-24 months old bull calves (Gr 5).

Except for Gr 1, all other groups were taken out to graz from 0830 h to 1700 h in selected areas within the plantation On the average, Gr 3 and 4 covered an area of 100 acres/ group daily. One to two herdsmen were required for this task. Al groups were supplemented with a mixture of palm pressed fibre and oil palm sludge with mineral blocks available in the yards.

Records maintained by the 'breeding unit' for the period 1977-1983 were analysed for birthweights, calving intervals, and calf crop. The climatic data were obtained from the estat weather unit.

Statistical Analysis

Duncan's Multiple Range Test was used to test the significance of the changes in temperature, pulse and respiration of buffaloes during work. The relationship of calving to rainfall month and year was determined by multiple linear regression analysis.

RESULTS

Draft capacity

A buffalo hauled a 100 kg cart loaded with 6-35 FFB, eac FFB averaging 26 kg (total load of 156-910 kg) over a distance of 18-318 metres. The number of hauls and work period averaged 8 and 5.3 h respectively. The total number of FFB transported averaged 175 which was equivalent to a work load of 4550 k transported over a distance 1.19 km from the inter-rows to the collecting platforms. This was equivalent to an average hour

hauling capacity of 45 FFB or 1170 kg (Table 1). More and heavier FBs were transported in a buffalo-drawn cart in less time than ith a wheelbarrow (Table 2). However, a minitractor hauled more kg/h FFB than a buffalo-drawn cart.

Physiological responses

The mean maximum and minimum ambient temperatures for May, 1984 were 32.2 and 22.6 C respectively. The relative humidity averaged 95% at 0700 h, 80.4% at 1000 h and 70.9% at 1500 h.

The average body temperature, pulse and respiration rates/min before work were 37.8 C, 41 and 25 respectively. A gradual increase in rectal temperature, pulse and respiration (Fig. 1 and Table 3) occurred in all draft buffaloes during work and reached a maximum of 38.8 C, 62 and 26 respectively at 123 h.

Table 1. Activities of 18 Draft Buffaloes Hauling a Cart Loade with Fresh Fruit Bunches from Inter-rows to the Collecting Platforms in an Oil Palm Plantation.

Activities	Range	Mean + SD
Total working period (h/day)	4.08 - 6.2	5.3 ± 0.5
Time spent hauling a loaded cart as a percentage of total working period (%)	71 - 75	72.2 ± 5.9
Number of fresh fruit bunch transported		
per haul	6 - 35	20.3 ±2.4
per day	128 - 230	174.8 ±31.9
Hauling capacity		
FFB/h	35.7 - 60	45.4 ± 5.1
Kg/h	928.2 -1560	1179 ±132.3
Average distance travelled per day (km)		
With load	0.6 - 2.0	1.2 ± 0.3
Without load	0.6 - 1.6	0.9 ± 0.3
Time spent grazing during work (%)	21.1 -32.6	26.4 ± 3.2

able. 2. A Comparison of Three Methods of Transporting FFB from Inter-rows to Collecting Platforms

Method	No. workers	Work (h)	No. FFB (day)	Mean Wt/FFB (kg)	FFB (kg/h)
*Wheelbarrow	2	7	113	15.4	249
Buffalo	3	5.2	175	26.0	1170
**Tractor 2	5	7	1300	14.0	2600

* Sedgely Estate, Kajang, Selangor
** Ma'mor Estate, Kluang, Johor

Table 3. Mean Rectal Temperature, Pulse and Respiration of 18 Male Buffaloes during Work in an Oil Palm Plantation.

Time (h)	Temperature (C)	Pulse/min	Respirations/min
0700*	37.8a	41.0a	24.6a
0830	38.2b	47.2a	35.1b
0930	38.3c	53.7b	41.1b
1030	38.5d	55.7b	50.8c
1130	38.7e	58.7b	54.5c
1230	38.8e	61.6b	57.3c
1700*	nd	nd	25.8a

* Values at rest. Values in columns with different super-scripts are significantly different (P 0.05). nd= not determined

Feeding behaviour

A buffalo grazed intermittently during work particularl when the cart stopped for loading or unloading. Time spent on grazing was 26% of the entire working period (Table 1), while the remaining time was spent standing, ruminating or hauling. The composition of the plant population in the inter-rows were native grasses (81%), broadleaves (13%) and ferns (6%). The forages consumed by the buffaloes during work are presented in Table 4 They also fed on oil palm leaves from the trimmed fronds an drank water from drains or ditches.

Table 4. Forages Commonly Consumed by Draft Bufffaloes in an Oil Palm Plantation

Forage Type	Name of plant	Composition (%)
Grass	Paspalum conjugatum (buffalo grass)	45.7
	Axonopus compresses (carpet grass)	5.2
	Bracharia distachya (rumput minyak)	2.4
Broadleaf	Vonoria canaria	7.1
	Asystasia coromendeliana (bunga putih)	0.7
Fern	Nephrolepis bisserata (pakis)	4.8

Note: Oil palm leaves from the trimmed fronds were also consumed.

Reproductive Performance

Of 251 calves born, 114 were males and 137 were females giving a sex ratio of 1:1.2. The mean birthweight was 28.3 kg for the males and 26.2 kg for the females with an overall mean o 26.5 kg. The first calving interval averaged 642 days but subsequent intervals decreased with increasing parity. The overal mean calving interval was 483 days with 44% of the calvin intervals ranging from 375 to 474 days (Table 5). No significant relationship existed between calving pattern and rainfall, month or year, together or individually (Fig. 2).

Table 5. Reproductive Performance of Swamp Buffaloes in an Oil Palm Plantation (1977-1983)

Trait	N	Mean ± SD	CV%
Birthweight (Kg)			
Male	114	28.3 ± 3.2	11.1
Female	137	26.2 ± 2.6	9.8
Overall	251	26.5 ± 3.6	14.0
Calving Interval (days)			
First	64	642 ± 262	40.7
Second	39	547 ± 205	37.5
Third	20	432 ± 51	11.8
Fourth	9	404 ± 38	9.4
Fifth	2	391 ± 9	2.3
Overall	134	483 ± 113	23.4

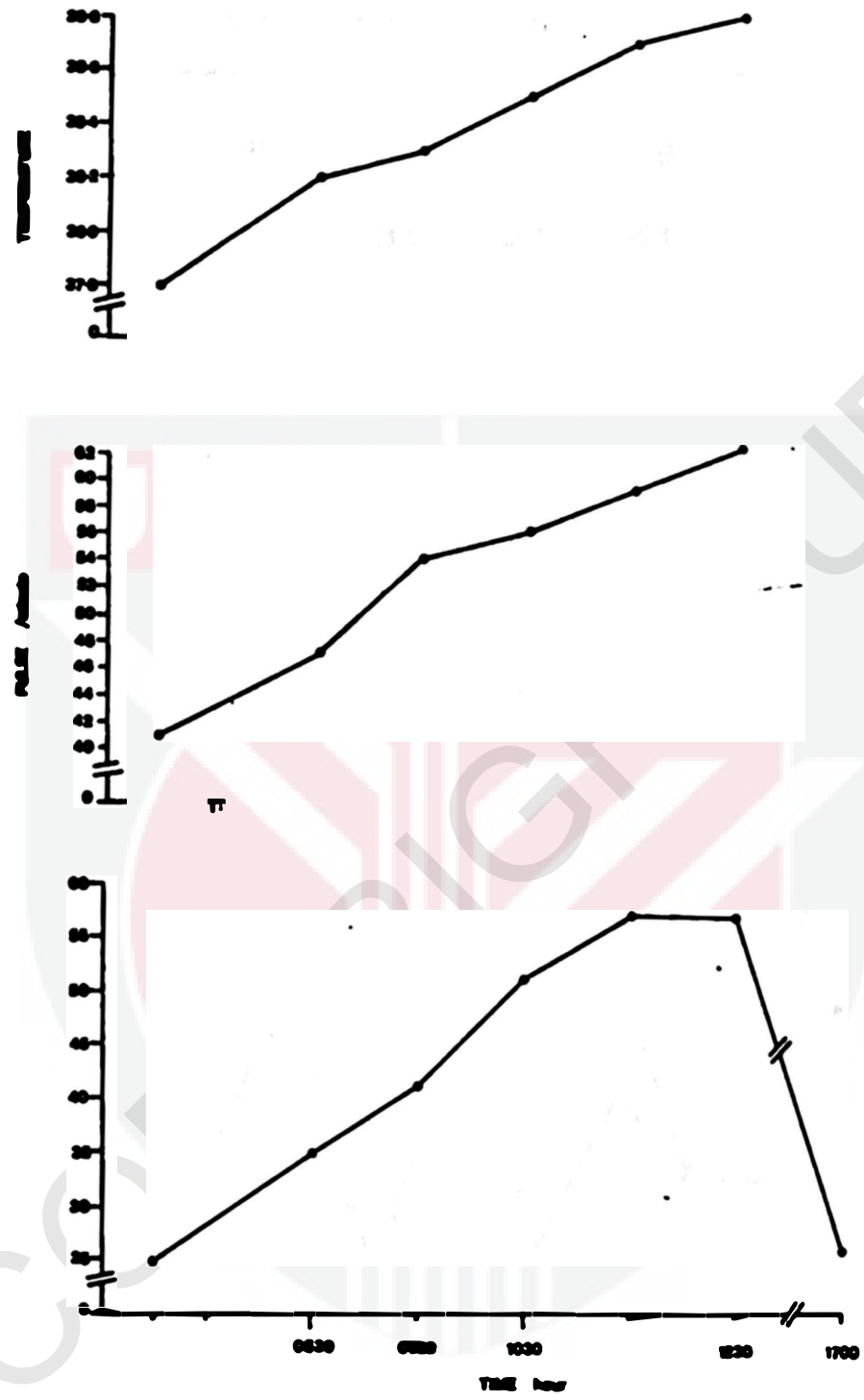


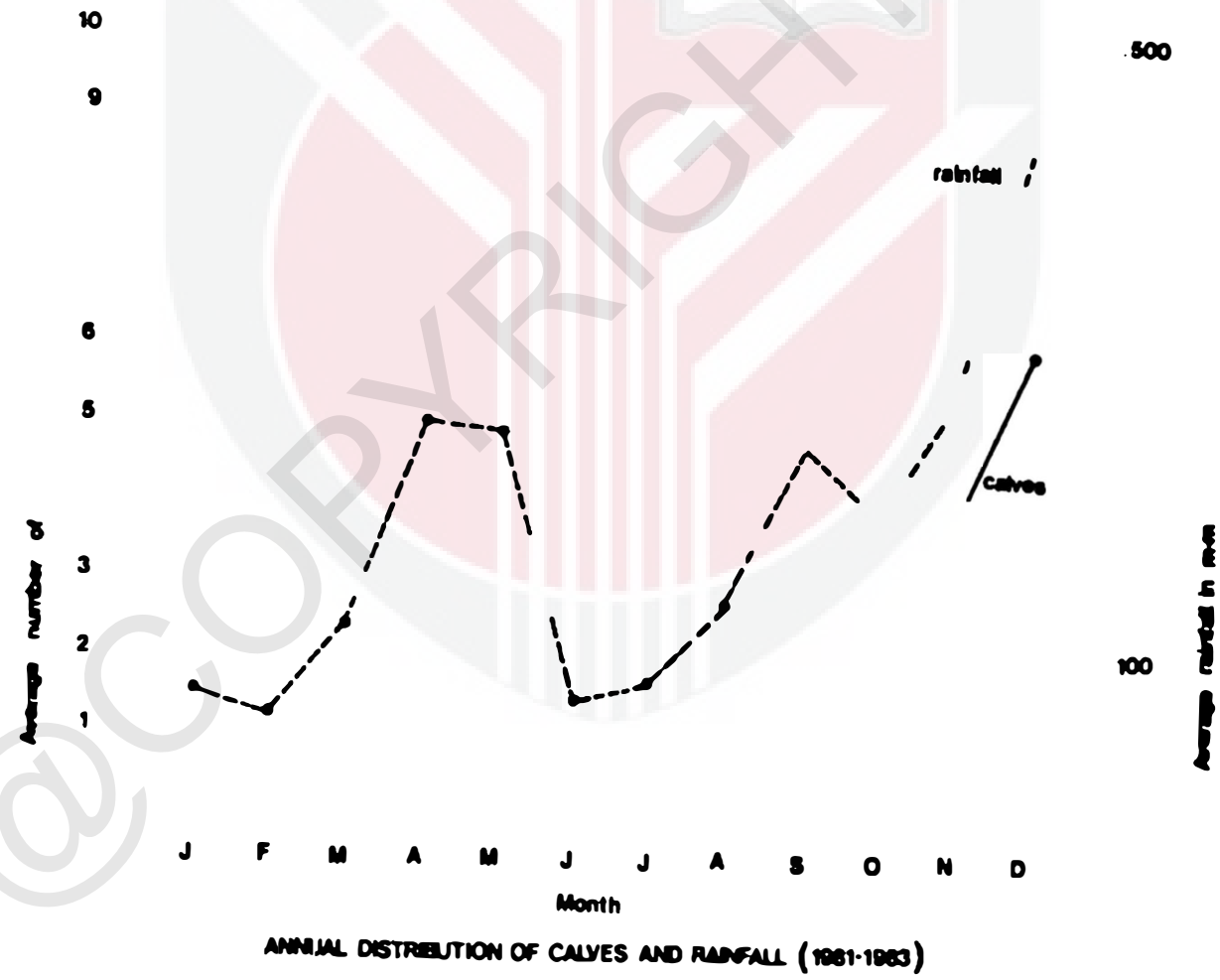
FIGURE 1: MEAN RECTAL TEMPERATURE, PULSE AND RESPIRATION RATES OF 18 DRAFT BUFFALOES DURING WORK IN AN OIL PALM PLANTATION

The annual calf crop between 1977 and 1983 ranged from 42% to 94% (Table 6) for about 60 breeding females (animals purchased in 1982 being excluded).

Table 6. Annual Calf Crop for a Swamp Bufalo Herd in an Oil Palm Plantation

Year	1977	1978	1979	1980	1981	1982	1983
No. of breeding females*	59	51	57	59	54	74	88
No. of calves born	25	31	31	41	51	59	48
% Calf Crop	42	61	54	70	94	80	55

* The 109 breeding females purchased in 1982 were not included in these calculations.



ANNUAL DISTRIBUTION OF CALVES AND RAINFALL (1981-1983)

FIGURE 2: ANNUAL DISTRIBUTION OF CALVINGS AND RAINFALL

DISCUSSION

A buffalo drawing a cart was much more efficient than the traditional methods of hauling FFB, e.g., basket, and wheelbarrow, but less efficient than the recently developed minitractor. The average hourly hauling capacity of a buffalo is 4-5 times higher than that using a basket [15] or a wheelbarrow (Sedgely Estate, Selangor). Although the mini-tractor hauled twice the weight per hour than a buffalo, it is quite unlikely that they could perform as efficiently as the buffalo in difficult terrains and slippery ground. A minitractor costs $12,000 and transports FFB from about 16 hectares/day. Any tractor breakdown or absence of the driver would affect the harvesting markedly. Thus it would necessitate the maintenace of additiona tractors and drivers. These problems seldom arisa with draft buffaloes as the Plantation maintains a constant supply o trained buffaloes for replacement. The added cost for a buffal and cart amounted to an average of only $5.02 per year [15] Presently, the minitractor is estimated to depreciate at 20% pe year ($2400). Information is not available on other added cost such as maintenance, land preparation and training of tractor drivers. Thus before a decision is taken to replace the draft buffalo with minitractors, a long-term study should be undertaken to determine their efficiency and economy under different terrains and soil structure.

The efficiency of a draft buffalo depends on the establishment of a close relationship with the harvester. This usuall occurred when animals were 4-8 years old. In this study, an annual replacement rate due to mortality, bad temperament and severe injuries is 4-5 times lower than reported previously [15]

Several factors affect the efficiency of a draft buffalo Hauling capacity is related to the buffalo's body weight [10] In the present study, a draft buffalo developed a tractive effort of 72-270% of body weight which is higher than the 113% reporte in Taiwan [5]. The working period in the oil palm plantation ranged from 4 to 6 hours as compared to 5 to 10 hours in the rice fields [5].

In this study, draft buffaloes worked under shade where the average ambient temperature (T_a) was 26.6-32.2^{o}. They showed neither signs of heat stress such as panting and salivation nor changes in feed intake and temperament at 1230 h when thei rectal temperatures had reached a maximum of 38.8^{o}C. This may be because their heat regulating mechanism was more efficient i shade than in the open [2, 16].

Swamp buffaloes are particularly susceptible to heat stres when their rectal temperatures reach 41^{o}C (2.7^{o}C above the ini tial body temperature) after a two-hour exposure to direct sunlight [4]. This hyperthermia may be related to the sparse hai coat and the dark-pigmented skin. The small number of sweat glands reduces the efficiency of evaporative cooling. The prac-

ice of wallowing by draft buffaloes after work helped to accelerate heat loss and significantly decreased the respiration rate o resting levels by 1700 h. Wallowing is more efficient than howering, shading [4], or eprinkling [13] in thermoregulation of the buffalo.

Buffaloes grazed and wallowed during the day but mostly rested (standing or lying down) and grazed with intermittent periods of wallowing and walking at night. In the present study, uffaloes spent most of their time grazing, ruminating in between orkin (7000-1230 h) or grazing and wallowing after work 1230-1700 h).

The annual calf crop of 42 - 94% compares favourably with those reported for the UPM herd [12] but higher than under field conditions [8]. The mean calving interval was shorter than that previously reported [12]. The interval between first and second calving was longest but decreased with increase in parity confirming previous reports [3, 14]. There was no annual calving pattern as previously reported in the rice-growing areas. Calvings occurred throughout the year as observed in the UPM herd.

SUMMARY AND CONCLUSIONS

A draft buffalo during a 5.3 hour hauled a total of 175 fresh fruit bunches daily or the equivalent of 4550 kg transported over a distance of 1.19 km.

Body temperature, pulse and respiration rates of draft buffaloes gradually increased during work, but there was no evidence of heat stress.

A draft buffalo spent 26% of the entire working period grazing in the inter-rows composed of native grasses (81%), broadleaves (13%) and ferns (6%).

The mean birthweight of buffalo calves was 26.5 kg. The overall mean calving interval was 483 days with 44% of the calving intervals ranging from 375 to 474 days. There was no significant relationship between calving pattern and rainfall, month or year.

It is concluded that: (1) The body temperature, pulse and respiration rate of the draft buffaloes remain within norma limits during work, (2) the buffalo is more efficient than other traditional systems currently used in harvesting fresh fruits bunches in oil palm plantations, (3) both oil palm byproducts and fodder in the inter-rows in palm oil plantations are enormous feed resources for buffaloes, (4) a herd of 50 breeding females are needed to provide the annual replacement requirements of 15 2-year old males for draft for every 750 ha of oil palm, and (5 smallholder farmers in oil palm schemes should be encouraged to use the buffalo in harvesting as it would increase their income.

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