UNIVERSITI PUTRA MALAYSIA

AN EVALUATION OF THE SMALLHOLDER BUFFALO FARMS IN PERAK

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AN EVALUATION OF THE SMALLHOLDER BUFFALO FARMS IN PERAK

BY

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A PROJECT PAPER SUBMITTED TO THE FACULTY OF VETERINARY MEDICINE AND ANIMAL SCIENCE, UNIVERSITY PERTANIAN MALAYSIA IN PARTIAL FULFILMENT FOR THE DEGREE IN DOCTOR OF VETERINARY MEDICINE

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ABSRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine and Animal Science in partial requirement of the course VPD 401 (Animal Industry Project).

AN EVALUATION OF THE SMALLHOLDER BUFFALO FARMS IN PERAK.

BY

MOHD. ZUHARI BIN OTHMAN

SUPERVISOR **DR. M.K. VIDYADARAN.**

A study was carried to evaluate two smallholder buffalo farms at Tapah and Taiping, Perak. Swamp and river crossbreds is the most common breed kept in the farms. In Tapah farm, buffaloes was reared for milk, average daily milk yield was 2 liters per animal with average lactation period of 250 days. Buffalo were reared for beef in Taiping. The average body weight at two years of was 300 kg. with average body average daily gain of 0.27 kg. per day.

Both farms had low calving percentage. Calving percentage for Tapah and Taiping was 58.7% and 45% respectively. The low calving percentage obtained in this study was mainly due to a lower sex male and female ratio.

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Annual mortality rate of the buffalo calves were higher in Taiping farm (10-15%) than in Tapah farm (<2%). There was no serious diseases outbreaks in both farms.

The problems faced by both farms were similar. Factors which influence buffalo production of these farms are the low quality of feed stuff, insufficient grazing area, poor reproductive performance, high calves mortality and lack of technical knowledge among the farmers.

Buffalo rearing in Taiping fam was more profitable than at Tapah. This is due to the better marketing for beef and high rate of return.

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Kedoktoran Veterinar dan Sains Peternakan untuk memenuhi sebahagian daripada keperluan kursus VPD 401 (Projek Industri Ternakan).

SATU PENILAIAN KE ATAS PETERNAK KECIL KERBAU DI PERAK.

OLEH

MOHD. ZUHARI BIN OTHMAN

PENYELIA **DR. M.K. VIDYADARAN.**

Satu kajian telah dijalankan untuk menilai dua peternak kecil kerbau di Tapah dan Taiping, Perak. Kacukan sawah dan sapi adalah baka yang utama terdapat di kedua-dua ladang ini. Di ladang Tapah kerbau dibela untuk pengeluaran susu. Purata keluaran susu se hari ialah 2 liter se ekor dengan purata tempoh laktasi 250 hari. Kerbau dibela untuk daging di Taiping. Purata berat badan pada umur dua tahun ialah 300 kg. dengan purata kenaikan berat 0.27 kg. se hari.

Kedua-dua ladang mempunyai peratus beranak yang rendah. Peratus beranak untuk ladang Tapah dan Taiping ialah 58.7%

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dan 45% masing-masing. Peratus beranak yang rendah di kedua-dua ladang ini kemungkinan disebabkan oleh perkadaran seks jantan terhadap betina yang terlalu rendah.

Kadar kematian tahunan anak kerbau adalah tinggi di ladang Taiping (10-15%) daripada ladang Tapah (<2%). Tiada penyakit-penyakit yang serius berlaku di kedua-dua ladang ini.

Masalah-masalah yang dihadapi oleh kedua-dua ladang ini adalah lebih kurang sama. Faktor-faktor yang mempengaruhi produksi kerbau di ladang-ladang ini adalah qualiti pemakanan yang rendah, kawasan ragutan yang terhad, prestasi reproduktif yang rendah, kematian anak kerbau yang tinggi dan kekurangan pengetahuan teknikal di kalangan peternak-peternak.

Peternakan kerbau di ladang Taiping adalah lebih menguntungkan daripada di ladang Tapah. Ini adalah kerana pasaran daging yang baik serta pulangan yang tinggi.

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INTRODUCTION

The buffalo (bubalus bubalis), the African wild buffalo (syncerus caffer) and the Nourth American buffalo are in the family Bovidae but belong to different genera and have different chromosome numbers. Water buffaloes are among the most important domestic ruminants of Asia and provide draft power, milk and meat to the countries extending from Assam to China; and the river buffalo from India to the Mediterranean and Egypt (Jainudeen, 1983).

In Malaysia, 1982, buffalo meat contributed about 24 percent of the national demand accounting for almost half of the present meat supply. The contribution of milk from water buffaloes is negligible.

In 1986, West Malaysia buffalo population was estimated at 141,934 (Table 1) (Jabatan Perkhidmatan Haiwan, 1986). The buffalo population was mainly concentrated in the state of Kedah, Kelantan, Perak, Terengganu which are predominantly the rice growing areas, followed by Pahang and Melaka.

In 1966, the buffalo population of west Malaysia was estimated at 330,000 (Jabatan Perkhidmatan Haiwan, 1966) compared to 1986 figure, there is reduction of buffalo population of 38% for the period of 20 years. The declined

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in the population of the buffalo was mainly due to the introduction of double cropping and increased farm mechanization.)

Most of the buffaloes in Malaysia are owned by the smallholders (Mahendranathan, 1976). The number of buffaloes kept by these famers range from 2 to more than 100 head. The main source of feed are on available native grasses. Some of the farmers feed indigineous grass and provide supplementary feeding to their buffaloes. The buffaloes are generally have good bodily condition (Hilmi, 1984) and acheieve a satisfactory growth (Syed Ali, 1980).

The present study was undertaken with following objectives:

1) to evaluate the management practices of smallholder buffalo farms.
2) to evaluate reproductive and productive performances of the buffaloes under these smallholder condition.
3) to study the economic viability of the farms.
4) to suggest recommendation for improvement.

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LITERATURE REVIEW

BUFFALO INDUSTRY

The major constraints of buffalo industry in Asia has been identified as (1) competition of human for animal feeds, (2) low and season reproductive capacity brought about by poor nutrition and management and (3) lack of well planned breeding program to utilize available superior germplasm (Guzman, 1980).

In Malaysia, buffalo farming does not contribute significanntly to livestock production. The goverment has placed much emphasis on poultry and pig production (Polikhronov, 1975). There has been steady decline about 10% in the buffalo population in this country over the last 40 years (Jalaludin, 1985).

The Malaysian Livestock Develope survey aimed to increased the number of buffaloes so that by 1990 there will be about 500,000 of buffaloes with at least 200,000 females. The increase should be through establishment of cooperation state and private buffalo farm for production of milk and meat with special attention on nutritional and breeding aspect of management (Polikhronov, 1975).

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NUTRITION

Very few research on the nutrition of Asian buffaloes are available. It is conveniently assumed that the buffalo have similar nutritional requirement of those of cattle. The feeding standards used being mostly adaptations of the standards used for dairy and beef cattle (Chutikul,1975). However, the water buffaloes are generally recognised are being superior to cattle in the utilization of roughage especially on a low plane of nutrition with coarse roughage as the main source of energy (Castillo, 1975). The buffaloes were also more efficient in utilizing by product (Aznam,1983) and required lower DM intake (Grant, 1973) compared to cattle.

Low level of nutrition are a major constraint to buffalo productivity in all tropical countries (Copland,1985). Crop residue constitute an important feature in animals where feed resources are the major limiting factor. The prospect of buffalo production in Malaysia even at a commercial level based on the utilization of palm oil milling by products such as palm frees fiber, are indeed very good (Jalaludin,1985)

REPRODUCTION

Although much studies on the buffaloes reproduction are based on the cattle, the reproductive physiology of the

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female buffaloes differs somewhat from that of the cow. The former reaching sexual maturity and puberty at later age (Toelihere, 1975).

The river type the first estrus earlier (15 to 18 month) than the swamp type (21 to 24 month). First conception occurs at an average body weight of 250 to 275 kg which usually attained at 24 to 36 months of age (Jainudeen and Hafez ,1986).

On the average , the usual breeding age of the female buffalo is three years as reported by Kalef (1942) from Bulgaria, Marsh and Dawson (1948) from Malaysia , Baradat (1960) from Cambodia, Bhattacharya (1953) from India and Hill (1967) from Brazil. In Java, the first estrus in swamp buffalo appears between 3 to 5 years of age (Toelihere, 1971).

The gestation period of the water buffalo is normaly longer than the cow . It takes about 10.5 months from the time of conception to calving (Toelihere, 1975) and it is even longer than the river type reaching from 325 to 330 days (Fisher, 1960).

Reproduction rate in buffaloes are lower than in cattle (Jainudeen, 1983). The most important factor which contribute to low production rate is the long

calving interval. This long calving interval has been attributed to a failure in the resumption of breeding cycle after calving due to adverse effects of poor nutrition and/or suckling. A management strategy for reducing the problem is to improve the nutrition of lactating buffalo and separate the calf for 2-3 days to facilitate the expression of sexual receptivity in the lactating female (Jainudeen, 1989).

PRODUCTION OF MEAT AND MILK

The most outstanding characteristics of water buffaloes compared with other farm animals are their capacity for work hard in hot, marshy, flood-prone environment and their ability to thrive on roughage of a very low feeding value. Natural selection over the centuries has resulted in the evolution of animals of great muscular development (Guzman, 1975).

In many cases, results from the comparative performance of buffaloes on daily weight gain, food conversion efficiency and carcass yield with those of corresponding classes of cattle shows that buffaloes may used effectively in suitable environment as a source of meat and meat product (Guzman, 1975). The meat yield is said to be higher than that of local meat: 34-35 percent of body weight of buffalo is whole meat compared to 28-30 percent in cattle. The buffalo meat

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contains less fat and more protein than cattle beef (Polikhronov, 1975).

Milk production from the buffalo is influenced in both quality and quantity by many factors including breed, age at first calving, stage of lactation, number of lactation, feeding and management. However a good feeding is the most important factor if we wish to obtain maximum milk production. Roughage and concentrate should be fed especially to high producing animal (Castillo, 1975). The genetic potential of swamp buffalo in milk production is lower compared to the river. Milk production from swamp buffalo are 1-2 kg/day which is sufficient only to their calves (Copland, 1985).

According to the data of Dr. X.A. Vendragon, State Veterinary Office, Kota Bharu, West Malaysia, Murrah buffalo cows can produced 12-13 kg milk daily at the height of lactation while crossbred animals yield 10-12 kg. (Polikhronov, 1975).

GROWTH PERFORMANCE

Buffaloes have a fast growth rate with high live weight at birth, puberty, first calving and maturity compared to cattle (Wahid, 1973).

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Jainudeen (1977) in his study on University Pertanian Malaysia buffalo farm, reported that the mean birth weight for male and female swamp buffalo are 31 and 30 kg respectively. Jainudeen (1983) in another study on the same farm observed that the adult male and female weighed as much as 800 and 500 kg respectively with an average daily gain ranging from 0.26-0.96 kg.

Fadzil (1969) observed that in smallholder farm the male calves weighed from 72-103 lb and famales calves weighed from 65-85 lb at birth 72 lb. A yearling buffalo weighed 450 lb, amounting to a daily gain of 1 lb.

EVALUATION

Frutchey (1967) defined evaluation as a process of collecting information, applying standards and criteria, drawing conclusions and forming judgemewnt and making decisions.

In a farm bussiness, evaluation studies are based on the success of the end results which is the profit gained (Lippicort, 1948). It involves evaluating the efficiency which necessitates monitoring how well goals have met. For this purpose, careful record keeping is a prerequisite (Calkins and Dipietre, 1983).

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In order obtained a high level of efficiency of such farm, farm layout is important. The layout of a farm is devided into fields and the location and arrangement of other fixtures such as irrigation and drainage system, building and sheds, roads, fencing and others (Johl and Kapur, 1979).

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MATERIALS AND METHOD

FARM

An evaluation of two smallholder buffalo farms was conducted in two herds located in Tapah road, (Batang Padang) and Kemunting and Taiping district Perak. The management practiced for buffalo production for both farms is semi intensive system. Both farms are family business and were established more than 30 years.

Tapah buffalo farm is located approximately 6 km. from Tapah town. This farm has a total buffalo 74 heads of swamp, river and swamp and river crosses and buffalo was raised for milk production.

Taiping buffalo farm is approximately 4 km. away from Taiping town. The purpose of this farm was primarily beef production. This farm kept all cross bred animal (220).

METHOD OF DATA COLLECTON

Data and information about the farms were derived primarily from:

a) personal communication

b) personal field observation

Data on milk production was calculated from measurement of daily milk produced.

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METHOD OF DATA ANALYSIS

. Analysis of data was done manually and with the assistance of the lotus 123 computer programmed for tabulation.

In economic analysis , the assumptions used were:

depreciation of building for 20 years

depreciation of machinery for 10 years

family labour was computed at market wage.

METHOD OF FARM EVALUATION

The farm informations were broadly classed into three area - Resources, Processes and Performance. Farm resources were identified as the farm physical structure, electricity and water facilities, utilization of land and manure and housing. Information and data pertaining to farm processes include calf management, feeding, breeding, milking practices, health and marketing. The parameters concerning performance discussed were age at first calving, calving interval, calving percentage, growth rate, milk production and for economic aspect the parameters include net farm income and the cost of production.

The analysed and interpreted information and data were evaluated by using Method C prepared by Dr. Ungku Chulan (1987).

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Evaluation was based on comparing from the available standards, previous study and by own judgement. Categories will be given to the areas which been evaluated. The categories used are given in Appendix 1. Evaluation through categorization was mainly subjectives.

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RESULTS

FARM RESOURCES

Farm layout

Figure 1and 2 depicts the farm layout for Tapah and Taiping respectively. Tapah farm is surrounded by jungle fringes and oil palm plantation whereas Taiping farm is situated in an open unused tin mine. In Taiping farm, 50 meters opposite the farm, housing construction was under progressed.

Location

The distance to the main road for Tapah and Taiping farms were approximately 200 meter and 600 meter respectively. The grazing area for Tapah farm was 3km-4km away. The buffaloes have to cross the main road in order to reach the grazing area. The grazing area was located about 100 meter-800 meter away in the case of Taiping farm.

Security

Tapah farm was fenced. The animals were under care at all times by a caretaker. In Taiping farm, the buffaloes were kept close to the owner's house.

Electricity and water facilities

Electricity and water facilities are available in both farms. The owner from Tapah does not use the electricity to reduce the cost of production.

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Utilization of land

Out of the total land owned, Tapah utilized 0.6 hectares for the oil palm plantation. A portion of the plantation area was utilized for the buffalo calves for grazing. The buffalo farming in Taiping was mainly depended on the goverment disused tin mine land. All the available land were used for grazing area for the buffaloes. The total has been reduced from 435 hectares to 87 hectares due to housing developement as mentioned earlier. Reduction of the total land had forced the farmer to reduced the number of buffaloes to one third of the population.

Utilization of manure

In Tapah farm, buffaloe's manure was utilized as a fertilizer for the oil palm plantation. Some of the manure was sold. In Taiping farm, buffaloe's manure was not utilized.

Housing

Housing of buffalo calves In Tapah farm two separated calf pens were provided. The type of housing was loose type with shed. One of the calf pen had wood flooring. The other was on earth flooring. The height from the roof to the ground was 7 feet. The floor space was 4 square meter per calf. Roofing material is zinc. The house structure was mainly made from wood. Each pen was provided with a long feed trough.

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In Taiping farm, no calf pen was provided. The buffalo calves were housed together with the adults.

Housing for adult buffaloes

In both farms the adult buffaloes were housed in a large fenced area. Flooring was on earth. In Taiping farm there was no shed provided. This situation was similar In Tapah farm. However, there were a few trees presence as a natural shed.

Milking shed

In Tapah farm, milking shed was provided. It was situated next to the calf pen. The height from the roof to the ground was 10 feet and it was unprotected. Roofing material is zinc.

Education status and training

In both farms, the education status of the farmers was only up to primary school. They were able to read and write. The farmers does not have any training on buffalo management before. Most of their daily routine management practices were based on experiences over the years of indulgement.

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FARM PROCESSES

Calf management

In both farms, there was no human intervention in calves rearing during post natal. The calves were solely nursed by the dam. Birth usually takes place in an unclean environment. There was no application of iodine to the umbilical cord. In Tapah farm, the calves were left with their mother at less than 48 hours after birth. The calves were then temporarily separated from the dam in the morning prior to milking purposes. The calves were allowed to be with the mother in the evening when all the buffaloes herded for grazing. In Taiping farm, the calves were not separated with the dam as there is no milking practices takes place.

Deworming practice was carried out in Tapah farm. The buffalo calves were regularly dewormed at the age of two weeks. The calves were again dewormed if signs of helminthiasis was observed. The anthelmintics were supplied by the government veterinarian.

In Taiping farm, deworming practices was irregular. Anthelmintic was only applied when there is a problems of diarrhoea, inappetance or depression. The anthelmintic was bought from local sources that are meant for human use.

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Feeding

a) Feeding of buffalo calves

In both farms, feeding practices for buffalo calves is the suckling the dam method. In Tapah farm, the calves were to suckled a small amount of milk before milking prior for `milk let down' and after complete milking. In the evening, when all the buffaloes herded for grazing the calves were let loose with the dam and they suckled completely. In Taiping farm, milk suckling was unrestricted since the calves joined the dam from birth.

In both farms, the calves were introduced to grass at early age. They were grazed together with the herd on local grasses.

In Tapah farm, the buffalo calves were given concentrate feeding of Palm Kernel Cake (PKC) until the age of 7 month to 1 year. Each calf received 0.1 kg of PKC per day. In Taiping farm, the calves does not received any supplementary feeding.

In both farms, water trough were provided for the calves and water was always available. They received fresh, clean pipe water.

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b) Feeding of adult buffaloes

i. Grass

The primary source of feed for buffaloes in both farms are on native grasses. The types of native grasses found in these farms are given in Table 2.

In Tapah farm, the buffaloes grazed mainly under oil palm plantation and on the road side. The grazing area for Taiping farm was mainly on disused tin mine land.

ii. Frequency of grazing

The time and length of grazing are shown in Table 3. In Taiping farm, the buffaloes were let to grazed for the whole day. They were brought to the grazing area at around 6.00 a.m. in the morning and housed at 6.00 p.m. in the evening.

In Tapah farm, the buffaloes were grazed twice daily started at 5.30 a.m. until 8.30-9.00 a.m. and 6.00 p.m. until 8.00-9.00 p.m.. The actual grazing time for this farm was 6.5 hours and 7 hours for Taiping.

iii. Shelter during grazing

In Taiping farm, there was no shelter available during grazing. The buffaloes were directly exposed to heat stress especially during hottest part of the day.

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The buffaloes in Tapah farm were less exposed to heat stress since grazing ativities takes place in the morning and evening. More over, the buffaloes were mainly grazed under the oil palm plantation which is cooler and protected from the sunlight.

iv. Wallowing facilities

In Taiping farm wallowing facilities were limited. It was observed that majority of the buffaloes were standing or lying down and panting. In Tapah farm, there was no wallowing facilities provided. However, during mid-day, the buffaloes were brought back to the farm and kept under a shed.

v. Supplementary feeding

In Taiping farm, wheat bran mixed with mollases, and salt were given to the buffaloes. In Tapah farm, the buffaloes do not received any supplementary feeding. They only given salt as a mineral supplement through drinking water.

vi. Water supply

In Taiping farm, there was no water supply available for the buffaloes during grazing. Water was provided in the evening after the animals were brought to the nearest pool for bathing. However, at the farm , pipe water was available.

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In Tapah farm, the buffaloes were brought to the tine miner pool for drinking and bathing after grazing.

Breeding

In both farms, natural mating was practiced. The bull was kept together with the herd. Table 4 shows the distribution of bulls, cows and calves at two farms.

In Tapah farm, the farmer only kept one breeding bull. The bull to cow ratio for this farm was 1:46. In Taiping farm, two bulls were used for breeding. The bull to cow ratio was 1:75.

The main criteria for bull selection in Tapah farm was milk yield of the dam. The bull was selected within the herd and other sources. In Taiping farm, the bull was selected based on faster growth rate and gross appearance of a meat producer.

In both farms, the replacement bulls were selected at the age of 2-3 years old.

Milking practices

The buffalo cows in Tapah farm were milked by hand. The udder were clean by using gunny sack before milking. There was no application of disinfectant to the udder after milking. Stimulation of milk let down was by letting the calves suckle the dam for a few minutes before milking.

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Health

Generally, the buffaloes in two farms were on good bodily condition. There was no serious diseases ever reported since the farm established.

In adults buffaloes, in both farms, wounds was the major problems. The type of wound were mainly slashed wound. The other type of diseases accounted in this farm which occure in lesser frequency are lameness, dermatitis, diarrhoea and retained placenta. These disease conditions are sporadic cases. In Tapah farm, collison with moving vehicles caused fracture and sprain to the buffalo. In serious cases, the animal usually die. The other type of disease conditions presence in this farms are similar as in Taiping except retained placenta.

Emaciation and diarrhoe is the major problems among the calves in both farms. The farmers claimed it was due to helminthiasis.

There was no vaccination programme carried out in both farms. In Tapah farm, all health problems were attended by the veterinarian from the Jabatan Haiwan Daerah.

In Taiping farm, the farmer practiced traditional method of treatment. Medications were purchased from local sources.

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Waste disposal

In Tapah farm, the faeces was removed daily. In Taiping farm the faeces was not consistently removed. There was a long period of faeces accumulation. There was no drainage system present in both farms.

Marketing

a) **livestock**

In both farms, the farmers were able to sell their buffaloes through out the year with un limited number. The demand for buffalo meat was high especially during Muslim festivals. The buffaloes were mainly sold to butchers and individuals. In Taiping farm, the number of buffaloes sold each year was between 30-40 heads with the price ranging from $800.00 to $1200.00 per head.

b) **Milk**

In Tapah farm, marketing of milk is limited. The farmer was unable to sell all the milk produced. The demand for buffaloe milk has declined recently due to the increasing demand for fresh milk from the dairy cattle.

The farmer has his owned established clients, mainly Indian restaurant and domestic housedhold. The amount of milk sold each day was 10.8 liters with the price of $ 2.00 per liter. The balance milk which are not sold was used for home consumption.

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FARM PERFORMANCE

Reproductive

Reproductive parameters were shown in Table 5. The age at first calving for the majority of the buffaloes in Tapah was 4.3 years. The average calving interval for this farm was 495 days. At Taiping farm, the age at first calving among the buffaloes was 3.5 years. The average calving interval was 420 days. The calving percentage for the buffaloes in Tapah and Taiping farm was 58.7% and 45% respectively.

The range liveweight of buffaloes at various ages at two farms were shown in Table 6. The live weight of buffaloes at the age of 24 months in Tapah farm ranging from 250-290 kg. The post weaning daily gain up to 24 months for . the buffaloes at this farm was 0.23 kg. In Taiping farm, the live weight of the buffaloes at the age of 24 months ranging from 280-320 kg with the post weaning daily gain of 0.27 kg.

Milk production

Table 7 show the milk production of various breeds of buffaloes at Tapah farm. Milking was done once daily. Among the breeds, the swamp-river crosses have the, highest milk production (average 2.8 liters). The average lactation period of the buffaloes in this farm is ranging from 220 to 280 days. This farm also kept river and swamp buffaloes.

The milk production from this breed was not available during the study because the cows were in drying period. However, the farmer reported that the milk production the river buffaloes ranging from 2.5-3 liters and 1-2 liters for the swamp.

mortality

At Tapah farm, calf mortality was as high as 50%. Mortality rate was reported to be higher in the river buffalo calves than in swamp and swamp-river crosses. However, with proper management this farm has reduced the calf mortality rate to less than two percent per year. This year, the calf mortality rate was 0%.

In Taiping farm, the annual calf mortality rate was maintained between 10-15%.

Economy

Costing

Financial analysis of two buffalo farm were given in Table 8. Total farm expenditure for Tapah farm was estimated to be $7298.10 per year. The operating cost contributed to 81% of the total expenditure cost. The farmer invested mainly on building which accounted for almost 32% of the total investment cost. Cost of labour was the highest item of the operating cost. The cost of unpaid labour was calculated to be $2690.00.

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In Taiping farm, the total farm expenditure was estimated to be $14600.00 per year. 88.4% of the total farm expenditure was derived mainly from the operating cost and the remaining was from the cost of investment. The farm spent 60% of the operating cost on feed and spent less cost on building which accounted for 14% of the total cost of investment.

The cost of unpaid labour for this farm was calculated to be $2190.00.

Net farm income

In Tapah farm, the monthy net income was calculated to be $674.00. Income from the sale of milk contributed only 5.3% of the total net income and 94% from the sale of livestock.

The monthy net income for Taiping farm was calculated to be $1700.00. The net income was sole gained from the sale of livestock.

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DISCUSSION

Tapah buffalo farm is suitably situated. It is rather close to the main road. This is advantageous in terms of acessibility to marketing outlets. Since the grazing area was far from the farm the buffaloes have to spend more energy and time. Morever, crossing the road may predispose to the risk of road accidents. Taiping farm is also close to the main road. The farm layout for this farm was unsatisfactory because housing contruction close to the farm.

The Land use for Tapah farm was efficient. Buffalo rearing in oil palm plantation allowed the farmer to practise integrated farming system. Liang (1984) found that the buffaloes reared under oil palm plantation performed better in terms of growth. This is because of the varieties of legumes and forages grown in the plantation which are sources of feed. The temperature under the oil palm plantation was found to be cooler.

Education level for both farmers were poor. This was reflected in their difficulty in accepting innovations. Buffalo can be raised solely based on experience. It may be adequate but theories and technical knowledge in animal husbandry are vital for progresive animal farming.

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In Tapah farm, buffaloe manure is fully utilized for the oil plantation. It also reduced the cost of purchasing synthetic fertilizer. Selling of the buffalo manure can also provide additional income to the farmer.

The housing design for buffalo calves in Tapah was satisfactory because it provided better ventilation. Sastry (1987) observed that, calves which were reared under loose housing achieved better growth. Earth flooring is poor compared to wood flooring. It is very difficult to wash and disinfect earth flooring and predisposes multiplication of coccidial oocyst and other pathogenic organisms. Panchadcharan (1985) reported that the smallholder dairy buffalo calves reared under earth flooring had a high prevalence rate of coccidiosis and Sastry et al. (1981) observed that the buffalo calves showed poorer growth performance under this type of flooring. He further reported that earth flooring was also less hygienic.

Housing of buffalo calves in Taiping farm was poor because flooring was on earth and they were housed together with the adults. Diseases especially endoparasitism can easily transmitted from the adults to the calves. The calves acquired parasitism by ingesting the parasitic ova in the infected feces. Other diseases can be transmitted to the calves is through direct contact from the infected buffaloes.

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The availability of milking shed in Tapah farm is advantageous in terms of preventing exposer from direct sunlight. It is important to avoid heat stress during milking. Heat stress in buffaloes will cause decline in milk production and more marked in higher yielding animal (Cockrill, 1974).

In both farms, calf management during post natal is poor because birth took place in unclean environment. This predispose the newly born calves to infectious diseases. It is essential to apply iodine to the umbilical cord to avoid the risk of naval ill infection.

The farmers in both farms were unaware of the importance of colostrum to the calf. In Tapah farm, colostrum feeding for the calf was inadequate. According to Radostits and Blood (1985), approximately 25% of dairy calves may not involuntarily ingest sufficient colostrum even when they have been left with their mother for the first 24-48 hours after birth. Colostrum should be given at least for 3 days.

Colostrum feeding of the buffaloe calves in Taiping farm is considered adequate since the calves were not separated from the dam.

Deworming practices is more efficient in Tapah farm because appropriate anthelmintic drugs was used and it was done regularly.

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In both farms, milk feeding for the buffalo calves was disadvantageous because the amount of milk consumed by the calves was difficult to access. The may not get enough milk if the dam produced too little milk. This situation occured in Tapah farms where the swamp calf had to suckle the dam from river breed because of the swamp type did not have sufficient milk.

In Tapah farm, concentrate feeding of PKC to the buffalo calves was inadequate. The recommended feeding of concentrate feeding for buffalo calves is 1-2kg per head per day (Polikhronov, 1975).

Adequate feeding and excellent care of buffaloe calves are the important factors for growth and maturity. Thrifty well fed calves are more resistent to adverse conditions and disease than undernourished, stunted calves.

The type of native grasses found in both farms are of poor quality. These grasses are inadequate to meet the nutritional requirement for the buffaloes.

Although the total grazing time differs between the two farms, the actual grazing time for the buffalo is similar and also to that reported by Kassim and Baharin (1979) on grazing behaviour of the swamp buffalo.

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In Taiping farm, shed facilities were poor because no shed were provided. The buffaloes were directly exposed to heat thus predisposing to heat stress. In Tapah farm, the buffalo was less exposed to sunlight. Grazing under the oil palm plantation provided a cooler environment and also protection from direct sunlight.

Both farms did not provide wallowing facilities. Wallowing activities are important for buffaloes to accelerate heat loss since buffaloes were unable to dissipate excess body heat through sweating (Hafez and Shafei, 1954; Hafez et al., 1955) and it has been suggested that a wallowing area or shed should be provided (Kassim and Baharin, 1979).

In Taiping farm, supplementary feeding was provided. This is a good practice since the buffalo was under poor quality roughages. In Tapah farm, feeding of the adult buffalo was inadequate. In beef or dairy buffaloes sufficient feeding is important for the maintenance, growth and milk production. Feeding buffaloes with only poor quality roughages in the form of grasses is inadequate to meet the nutrients requirements of the animals.

In both farms, the bull to cow ratio is low. Bull to cow ratio has direct affect on conception rate and calving percentage. The optimum bull to cow ratio was found to be

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around 1:20. Reduce the ratio affected calf crop (Cameons, 1976). However, Liang (1987) in his study on Murrah buffalo suggested that one bull is able to serve 25 cows succeccfully.

The method of bull selection was better in Tapah farm. In Taiping farm, selection of bull within the same herd led to inbreeding. Although there was no information on the effect of inbreeeding in buffaloes, it can assumed that inbreeding increases the incidence of calf mortality, reduce birth weight, fertility, milk yield, growth performance (Johansson, 1962).

The method of milk let down practiced in Tapah farm was not satisfactory. Cockrill, (1974) found that this practice was wasteful and unhygienic. Presence of calves was also found unnecessary (Cameons, 1976).

Washing the udder with warm water was an effective way of providing stimulus but touch is the commonest initiator and massaging or tickling the udder and teat immediately before commencing to milk is a widespread practice (Cockrill, 1974).

In this farm, milking hygiene was poor since the udder is not been wash or disinfect. Washing and disinfecting the udder is particularly importance since the buffalo may have been wallowing in dirty water that has been contaminated.

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The health status in both farms was satisfactory since there is no occurence of serious diseases or disease outbreaks. Vaccination programme in both farms is poor because the buffaloes are not been vaccinated against any diseases. Vaccination against Haemorrhagic Septicemia (HS) is important since this disease is endemic in this country and caused high economic lost.

Waste disposel was better in Tapah farm. Regular removing of faeces is one of the way in preventing the occurence of diseases especially endoparasitism. In Taiping farm, fecal accumulation together with poor drainage and earth flooring constributed to parasitic infestation. According to Panchadcharan (1985), manure disposal is important in determining the amount of contamination as there is a significant increase in prevalence of helminthiasis and coocidiosis in farms which poor manure disposal system. Poor manure disposal system could also led to stagnantion of water which can contaminate the environment.

The calving interval in both farms are comparatively shorter than reported by respectively by Fadzil (1969) and Cameons (1976) for swamp buffaloes under smallholder conditions. However, these figures are similar to that reported by Liang, (1987) in his study on reproductive performance of Murrah buffaloes in Malaysia.

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The calving percentage in both farm was considerably lower compared to Liang, (1987) for Murrah buffaloes. He reported that majority of the buffaloes had calving percentage of over 65%. He further claimed that the calving percentage was highly influenced by the level of nutrition. He also suggested that low calving percentage (33%) of one of the farm studied was probably due to low bull to cow ratio. This could be the reason for the low calving percentage obtained in this study. The other reasons are inadequate feeding and the occurence of `missed heat'.

The buffaloes in Taiping farm had better growth performance. However, the growth rate for the buffaloes in this farm is lower that reported on swamp buffaloes grazing under oil palm plantation (Liang, 1984). The better growth performance of the buffaloes in Taiping farm was probably because the buffalo was a meat type and supplementary feeding.

Although the swamp-river crosses have the highest milk production, it does not suggest that this breed is the best milk producer. Several factors should be considered such as period of lactation and age of lactation of the buffaloes. Milk production from buffaloes is higher during the first 2-3 months of the lactation period but gradually reduced towards drying period. Older buffaloes which has been

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frequently calving produced lesser milk than the buffaloes which had calves once or twice.

The milk production for Tapah farm was comparatively lower to that reported by Liang, (1987) on Murrah buffaloes. However, the milk production is more or less similar to that reported by (Devendra and Mahindra Singh, 1974). The low milk production obtained in Tapah farm is probably due to inadequate feeding of lactating buffaloes. Liang, (1987) found that high milk production was obtained from the buffaloes which received supplementary feeding..

Calf mortality is high in Taiping farm. Poor calf mangement particularly housing, waste disposal and disease control were the predisposing factors that caused high calf mortality in the farm.

In Tapah farm, the swamp-river crosses and swamp buffalo calves have high survival rates compared to the river breed. This situation is probably because these breeds have adapted to the smallholder farm conditions and are more resistant to diseases.

The results from financial analysis indicates that both farms were economically profitable and viable. The Taiping farm achieved greater profits than in Tapah farm. This was due to better marketing for beef and less cost of

production consumed. Competition from fresh milk of cattle was the major limitation for the buffalo milk marketing.

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CONCLUSSION

It is important to take note that as smallholder, the expected level of production is not very high. They face various shortcoming particularly land constraint and limited resources. However, the buffalo farming for both farms, was profitable.

There are many aspects that need improvement particularly reproduction and nutrition to achieve maximum product. The factors which has been identified as suboptimal performance for both farms are low calving percentage, high calf mortality rate (Taiping) and low milk production (Tapah).

The low calving percentage for both farms was probably due low bull to cow ratio and inbreeding. The low milk production for Tapah farm was due to inadequate feeding for the lactating animals.

Several factors contribute to high calf mortality rate in Taiping farm. Management factors such as poor nutrition, poo housing, drainage and manual disposal and irregular deworming practiced all contribute to buildup of infectious in the calves.

In addition, the inadequate knowledge and poor education level is another factor which some how influenced the farm performance.

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As discussed earlier, beef buffalo rearing is more profitable and required less attention compared to milk buffaloes. This was mainly due to (1) better demand for beef, (2) marketing of milk is limited because buffalo milk is less preferred by Malaysian and limited utilization of buffalo milk and (3) Milch Buffaloes for milk product require higher nutrition level.

Finally, I am personally convienced that the buffalo industry particularly beef production has a great potential provided it received greater support from the goverment.

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RECOMMENDATION

The following recommendations are aimed to improve the current practices in the smallholder buffalo farm.

1. Farmer should improve their feeding of buffaloes by providing adequate nutritional requirement according to productivity and liveweight of the buffalo to achieve better performance.

2. Special attention should be given to young buffalo calves. They should be fed artificial diet for the first six month.

3. Reproductive performance could be improve by provided appropriate bull to cow ratio and good quality bull should be selected from outside sources to avoid inbreeding.

4. Calf mortality rate could be improve by providing proper management of calf such as proper housing, drainage, waste disposal and herd health programme.

5. A recording system for the quantity and quality of milk and meat should be introduced. This will provide a basis for selection.

6. Farmers should try to adapt to modern practices of management technique in order to improve the level of developement.

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7. Effort should be made by research Institution to carry out research works emphasising on the improve reproduction programme and increase the breeding potentioal of buffaloes. An artificial insemination system should be introduced.

8. Effort should be made to identify various feed resources available in particular region which is suitable for buffalo feeding.

9. The goverment, with the assistance of FAO, should established a National buffalo milk/meat production research and training centre.

10. Dissemination of technology to target farmers should be improve in order to educate the farmer with modern method of buffalo farming.

11. Most of the idle land belonging to the state should be utilized for the smallholder farms.

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TABLE 1: BUFFALO POPULATION OF MALAYSIA

STATES	BUFFALO	
	SWAMP	RIVER
PERLIS	2,741	23
KEDAH	32,846	36
PULAU PINANG	1,148	38
PERAK	20,203	1,047
SELANGOR	289	1,235
W. PERSEKUTUAN		36
NEGERI SEMBILAN	10,977	0
MELAKA	8,880	0
JOHOR	3,484	11
PAHANG	16,594	0
TERENGGANU	18,488	0
KELANTAN	23,794	64
TOTAL	139,444	2,490
GRAND TOTAL	141,934	

SOURCE: DEPARTMENT OF VETERINARY SERVICE (1986)

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TABLE 2. SPECIES OF NATURE PASTURE FOUND IN THE GRAZING AREAS AT TAPAH AND TAIPING

SPESIES
Axonopus compresess *
Axonopus affinis
Paspalum conjugation *
Ottochloa nodosa *
Bracharia mutica
Imperata cyclindrica

* Mainly found in Taiping

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TABLE 3. GRAZING TIME AND DISTANCE COVERED BY ANIMALS IN THE FARMS

	TAPAH	TAIPING
Total grazing time (hours)	8	12
Actual grazing time covered (hours)	6.5	7
Distance covered (km)	3-4	0.5-0.8

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TABLE 4. DISTRIBUTION OF BULLS, COWS AND CALVES AT TWO FARMS

	TAPAH a	TAIPING
HERD SIZE	74	220
BULLS	1	2
COWS	46	150
CALVES (UP TO 3 YEARS)	27	68
RATIO OF ENTIRE MALES : BREEDABLE FEMALE	1:46	1:75

a - calving percentage $\frac{27}{46} \times 100 = 58.7\%$

b - calving percentage $\frac{68}{150} \times 100 = 45\%$

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TABLE 5: REPRODUCTIVE PARAMETERS OF BUFFALO IN TWO FARMS

PARAMETER		TAPAH *		TAIPING *
Age at first calving (month)	(42-60)	51	(36-48)	42
Gestation length (days)	(300-330)	315	(285-315)	300
Days open	(150-210)	180	(90-120)	105
Calving interval (days)		495		405

* - The parameters are evaluated values.

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TABLE 6: LIVEWEIGHT (KG) OF BUFFALOES AT VARIOUS AGES AT TWO FARMS

Age (month)	Tapah (range)	Taiping (range)
6	(140-150)	(140-160)
12	(170-190)	(190-210)
18	(230-250)	(250-270)
24	(280-290)	(310-290)

(Personel Observation)

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TABLE 7 DAILY MILK PRODUCTION OF THE VARIOUS BREEDS AT TAPAH FARM (14/11 - 17/11/1988)

BREED MALE X FEMALE	MILK PRODUCTION (LITER) 14/11	15/11	16/11	17/11	MEAN + SD.
RIVER X CROSSBRED **					
COW 1	2.79		2.52		2.66
COW 2	1.68		1.77		1.73
COW 3		2.72	3.3		3.01
COW 4		2.47		2.59	2.53
COW 5		2.17		2.00	2.09
COW 6		1.38		2.40	1.89
					2.32
RIVER X SWAMP CROSS **					
COW 1		1.00		1.81	1.41
COW 2			1.80	2.23	2.02
COW 3				1.56	1.56
					1.66
RIVER X F1 *					
COW 1		2.16	2.03	2.26	2.15
COW 2	2.12		2.23	1.75	2.03
SWAMP X RIVER					
COW 1	2.55	2.77		2.61	2.64
COW 2	3.10		3.00		3.05
					2.84
CROSSBRED X SWAMP CROSS					
COW 1		1.62		1.00	1.31
F1 X RIVER					
COW 1	2.54		1.96	2.12	2.21
FI X SWAMP					
COW 1	2.71	1.97	3.00	2.67	2.59
Overall mean					2.15 + 0.52

* = Swamp X River
** = Generation unidentified

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TABLE 8: FINANCIAL ANALYSIS OF TWO BUFFALO FARMS (1988)

ITEMS	M$ TAPAH *	M$ TAIPING **
INCOMES		
SALES OF MILK	7884	
SALES OF LIVESTOCK	7500	35000
TOTAL INCOME	15384	35000
COST		
INVESTMENT COST		
BUILDING INVEST. COST	450	
MACHINERY INVEST. COST	13.1	
ANIMAL INVEST. COST	940	1500
LABOUR COST		
FAMILY LABOUR	2920	2190
MAINTENANCE COST	200	1950
OTHERS		
FEED COST	480	3960
WATER COST	360	480
MEDICINE COST	60	360
FUEL COST	1825	2920
VEHICLES COST		1000
MISCLLANEOUS	50	40
OVERALL COST OF PRODUCTION	7298.1	14600
ANNUAL NET PROFIT	8088	20400
MONTHLY NET PROFIT	674	1700

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* - Milk production

** - Beef production

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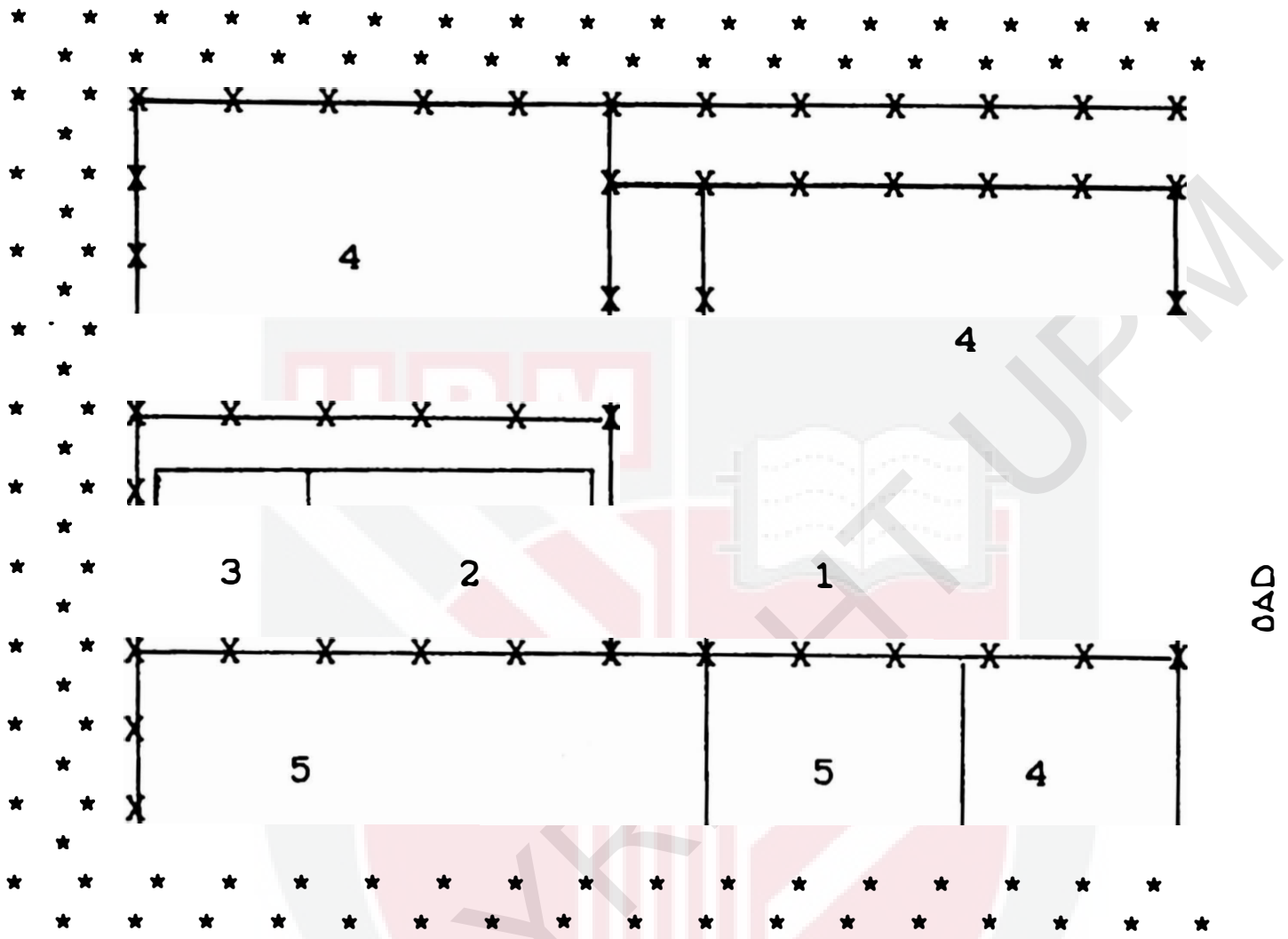
FIGURE 1. FARM LAYOUT FOR TAPAH



keys

1. Farmer's house
2. Milking shed
3. Calf housing
4. Oil palm plantation
5. Adult buffaloes housing

Fences

Jungle fringes

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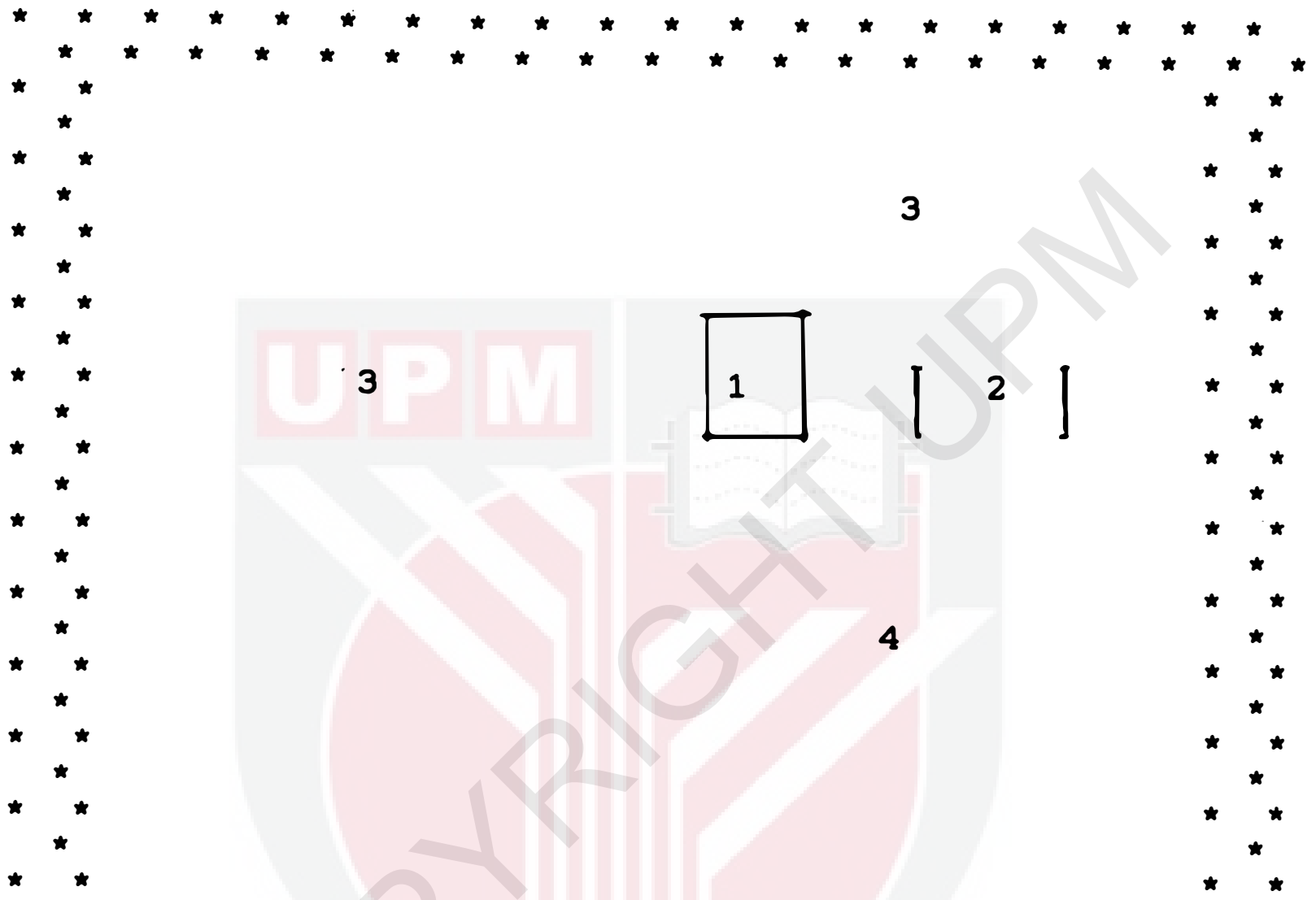
FIGURE 2. FARM LAYOUT FOR TAIPING



Keys

1 Farmer's house

2. Buffaloes housing

3. Grazing area

4. Housing developement area

Jungle fringes

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REFERENCES

AZNAM, Z. and JALALUDIN, S. (1983). Oil palm by product as feedstuffs for ruminant. Proc. 2nd. Asean Workshop on Technology of Animal Feed Production and Utilization Food Waste Material, Singapore.

BARADAT, H. (1960). Crossbreeding the Swamp with the Murrah buffalo. Commun. Vet., 4:81-90.

BATTACHARYA, P. (1953). Annual RPT., DIV. Anim. Genet., I.V.R.T, Izatnagar.

CALKINS, R. H. and DI PIETRE, D. D. (1983). Farms business Management: Succesful Decision in Changing Environment. Mac. Millan Publishing Co., New York. p 9.

CAMEONS, J. K. (1976). The buffalo in Malaysia. Ministry Agr. Malaysia Bull. No. 145, Kuala Lumpur, Malaysia.

CASTILLO, L. C. (1975). Production, Characteristic and Processing of Buffalo Milk. The Asiatic Water Buffalo. Compiled by Food and Fertilizer Technology Centre for Asean and Pasific Region, Taipei, Taiwan.

COCKRILL, W. R. (1974). The husbandry and health of Domestic Buffalo. FAO, Rome. Food and Agriculture Organization (FAO) of the United Nation.

CHUTIKUL, K. (1975). Ruminant (Buffalo) Nutrition. The Asiatic Water Buffalo. Compiled by Food and Fertilizer Technology Centre for Asian and Pasific Region, Taipei, Taiwan.

COPLAND, J. W. (1985). Evaluation of Large Ruminant for the Tropics, Proc. of an International Workshop help at SIRO Rockhampton, Queensland, Australia, 19-23 March 1984. ACIAR Proc. series No. 5, p 178.

DEVENDRA, C. and MAHINDRA SINGH (1974). Kajian Veterinaire, Malaysia. 6,(1):52-57.

FADZIL, M. (1969). A study on the calving frequency and age at time of calving of Malaysian swamp buffaloes. Malay. Agric. J., 47:203.

FISHER, H. (1960). Crossbreeding the swamp with the murrah buffalo. Commun. Vet., 4:81-90.

FRUTCHEY, F. P. (1967). Evaluation: What it is. Evaluation in extention. Devision of extension Research and Training. pp 1-5.

GRANT, R. (1973). Ph.D. thesis, Cornell University, Ithaca. Cited by J.K. Cameonn 1974. The Buffalo in Malaysia, Ministry Agric. Malaysia. Bull. No. 45, Kuala Lumpur.

HAFEZ, E. S. E. and SHAFEI. M. N. (1954). Sweating mechanism in the domestic buffalo. Nature. 174:1181-1182.

HAFEZ, E. S. E., BADRELDIN, A. L. and SHAFEI, M. N. (1955). Skin structure of Egyptian buffaloes and cattle with particular reference to sweat glands. J. Agric. Sci. Camb. 46:19-30.

HILL, D. H. (1967). Cattle breeding in Brazil (with a note of buffalo). Anim. Breed. Abstr. Rev., 35:545-564.

HILMI, M. (1984). Buffalo. In: Pravee Vichulata, Tuan Ariffeen and Mohammad Mahyuddin Dahan (ed.). Animal Production in Malaysia. Faculty of Veterinary Medicine and Animal Science. Uni. Pertanian Malaysia, Serdang, Selangor, Malaysia. p 21.

JAINUDEEN, M. R. (1977). Reproduction in the Malaysian Swamp buffalo (Bubalus bubalis). Proc. of the First Joint Conference on Health and Production of Australia and Local Cattle in South-east Asia, Ministry Agric. Malaysia. Bull. No. 146, pp 162-169.

JAINUDEEN, M. R. and HAFEZ, E. S. E. (1986). Cattle and buffalo. In: Reproduction in farm animals (5th edition), S. E. HAFEZ (ed.) Lea and Febiger, Philadephia.

JAINUDEEN, M. R. (1983). The water buffalo. Pertanika, 6(Rev. Suppl.):133-151.

JAINUDEEN, M. R. (1989). Buffalo farming in Malaysia: A Country Report. Paper compiled by M.K. Vidyadaran, T.I. Azmi and M. Hilmi. Symposium on buffalo Genotype for small farms in Asia held at Kuala Lumpur, Malaysia, 15-19 May 1989. Centre for Tropical Animal Production and Disease studies (UPM). International Developement Research centre (Canada).

JALALUDIN, S. (1985). Current status of Buffalo Breeding Programme in Malaysia. In: J. W. Copland (ed.). Evaluation of Large Ruminant for the Tropics. Proc. of

an International Workshop help at SIRO Rockhampton, Queenland, Australia, 19-23 March 1984. ACIAR Proc. series No. 5, p 178.

JOHANSSON, I. (1962). Genetic aspects of dairy cattle breeding. Edinburgh, Oliver and Boyd. p 259.

JOHL, S. S. and KAPUR, T. R. (1979). Fundamentals of farm business management. Kalyani publisher, Ludhiana, New Delhi. p 375.

KASSIM, H. and BAHARIN KASSIM. (1979). Grazing behaviour of the swamp buffalo (Bubalus bubalis). Pertanika, 2:125-127.

KALEFF, b. (1942). The Buffalo for Livestock Breeding. Z. Tierzucht. Zucht. Biol., 24:390-408.

LIANG, J.B. (1984). Economics of using buffalo to haul FFB in oil palm estate. Mardi Report No. 90.

LIANG, J. B. (1987). The reproductive performance of Murrah buffaloes in Malaysia. In: proc. of International Symposium on Milk Buffalo Reproduction. Mac. 1978. Islamabad, Pakistan. pp 458-468.

LIPPINCORT, W. A. (1948). Poultry production. Lea and Febiger, Philladephia. p 278.

LIVESTOCK CENCUS. Department of Veterinary Service (1966).

LIVESTOCK CENCUS. Department of Veterinary Service (1986).

MARSH, T. D. and DAWSON, (1948). Animal husbandry in Malaya - The buffalo in Malaya. Malay. Agric. J., 31:102-114.

M. R. de GUZMAN, Jr. (1980). An overview of recent developements in buffalo research and management in Asia. In: Milagros H. Tetangco (ed.). Buffalo production for small farm. Food and Fertilizer Technology Centre (FETC) Book series No. 15. Taiwan. pp 1-20.

M. R. de GUZMAN, Jr. (1975). The Water Buffalo - Asia's beast of burden and Key to Progress. The Asia Water Buffalo. Food and Fertilizer Technology Centre, Taiwan. pp 1-22.

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MAHENDRNATHAN, T. (1985). The role of the smallholder in beef and milk parasitisme. Proceeding of the symposium on smallholder livestock production and developement. Ministry of Agric. Bull. No. 144:16-28.

PANCHADCHARAN, C. (1985). Gastrointestinal parasite in murrah buffalo calves and it's relation to management of smallholding in Selangor and Perak. Animal Industry Project Paper, Faculty of Veterinary Medicine and Animal Science, UPM. pp 18.k.

POLIKHRONOV, D. S. (1975). Report on the Livestock Developement Survey Malaysia in Buffalo Production. United Nations Developement Programme. Food and Agriculture Organization of the United Nations, Rome.

RADOSTITS, O. M. and Blood, D. C. (1985). Herd health. Philadephia, London, Toronto, Mexico City Rio de Jeneiro, Sydney, Tokyo. p 136.

SASTRY, N. R. S., YADAV, R. S. SHARMA, V. B. and JUNEJA, i. j. (1981). Influence of type of floor and individual versus group housing on growth and parasitic load and some other aspects of Murrah buffalo heifers. Haryana agric. Univ. J. Res. 11:452.

SASTRY. N. S. R. (1987). Housing requirement of Buffaloes in Semi-Arid Regions of India. In: Proc. of International Symposium on Milk Buffalo Reproduction. Mac. 1987. Islamabad, Pakistan. pp 433-457.

SYED ALI BAKAR, (1980). Buffalo production and developement in Malaysia. In: Milagros H. Tetango (ed.). Buffalo production for small. Food and Fertilizer Technology Centre (FETC) Book series No. 15. Taiwan. pp 1-20.

TOELIHERE, M. R. (1971), Constribution to biology and pathology to reproduction in Buffaloes in Indonesia. Research Report. Bogor. Agric. Univ.

TOELIHERE, M. R. (1975). Physiology of Reproduction and Artificial insemination of water Buffaloes. The Asiatic Water Buffalo. Food and Fertilizer Technology Centre, Taiwan. p 34.

UNGKU, C. (1987). Outline of Methodology for farm Evaluation (Outline of Method C). UPM.

WAHID, A. (1973). World Animal Review. No. 7:22.

Appendix 1

The 3 categories used for evaluation were as follows:

Poor	Medium	Good
Inadequate	Partially adequate	Adequate
Inexperience	Partially experience	Experience
Inefficent	Partially efficient	Efficient
Unsiutable	Partially suitable	Suitable
Suboptimum	Fairly optimum	Optimum
High	Moderate	Low

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