

# A Financial Study of Cattle Integration in Oil Palm Plantations

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## ABSTRACT

*In the context of government efforts at reducing beef imports, integrated cattle rearing in oil palm plantations is a useful method for producing cattle locally. FELDA and ESPEK and some other organizations are recent participants of the cattle-under-oil-palm programme. Oil palm plantations with trees of seven years or older can produce 500 kg per hectare per year of dry matter, which is sufficient to justify grazing by cattle. One animal requires about 2.5% to 3% of its body weight in grass uptake and an animal which is one to two years old, requires about 3 ha of oil palm area for grazing. This animal is controlled from straying about by electric fencing. Each enclosure of about 4 to 6 ha requires two workers to manage.*

*This study shows that, in the cases of three estates that were studied, cattle rearing under oil palm can be pursued successfully. The average weight gain of cattle aged between one to two years old was 250 g to 300 g per head per day. The calving percentage was more than 50%, while the mortality rate was below 5%. The average cost of maintenance was low. An average price of RM 5.50 per kg live weight was obtained during normal times but increased to RM 6.50 per kg during festive seasons.*

*Prices of RM 4.00/kg, RM 4.50/kg and RM 5.00/kg live weight were used to account for the final stock value, depending on the age and sex of the animal. The IRRs obtained from integrated cattle rearing in oil palm plantations, ranged from 25% to more than 50% and the reduction in the cost of weeding ranged from 17% to 38%. That was an additional benefit from the production system adopted.*

## INTRODUCTION

Beef is an important source of protein in the Malaysian diet. The national beef consumption is forecast to increase with the expected rise in disposable personal income and population growth.

The domestic beef industry is, however, rudimentary and not reflective of the size of household demand. The local beef industry has failed to grow because of its relatively high-perceived domestic resource cost (DRC) (Ministry of Agriculture, 1992). The cost may

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be reduced if beef production enterprises can economize on the use of resources.

One of the major cost items in beef production is land, but this can be lowered if such production can be shared with other enterprises. A good option is to rear cattle under oil palm. This will increase the intensity of land use, while at the same time reducing the cost of oil palm maintenance. Under this integrated farming system, both enterprises, *i.e.* oil palm and cattle, will together provide higher total returns to each hectare of land resource used.

Domestic beef production through cattle-oil palm integration is potentially a good venture especially during the current difficult economic situation. The relatively low rate of exchange for the Malaysian Ringgit making saving foreign currency through import substitution more attractive. In 1997 alone, Malaysia incurred RM 418.4 million in foreign exchange through importing beef and live cattle. The *Majlis Tindakan Ekonomi Negara* (MTEN), a high-powered committee formed by the

government to formulate policies and strategies to fight the current economic problems, identified integrated cattle rearing as a possible foreign exchange saving option. This paper analyses the financial viability of the integrated cattle-oil palm farming system and determines a suitable management system. The effect of cattle rearing under oil palm on the cost of oil palm management is also evaluated.

### OVERVIEW OF THE BEEF INDUSTRY

The cattle population of Peninsular Malaysia increased by 86% from 1980 to 1997, reaching 630 000 animals producing some 20 000 t of beef (*Figure 1*). The latter only accounted for about one-fifth of total national beef demand.

Local beef cattle production can be categorized into five groups: (i) traditional farms; (ii) organized small farms with a feed-cutting system managed by government agencies, (iii) feedlot operating farms; (iv) large-scale commercial farms; and (v) Department of Veterinary Services (DVS) farms.

The majority of operators (90%) are traditional small farmers who contribute a significant share to the domestic beef production (Mohd Fauzi and Ibrahim, 1993).

### Marketing of Domestic Live Cattle and Domestic and Imported Beef

Fauzi and Ibrahim (1993) found that live cattle marketing is not well developed due to the small, scattered and unorganized nature of cattle farms in Peninsular Malaysia. Trading in live cattle is small and conducted in a haphazard manner. The trade in live animals is mainly confined to cattle for slaughter. The trade in breeders is negligible.

The marketing agents involved in beef retailing have direct outlets for the sale of fresh beef. It is very common to find beef retailers and wholesalers procuring their supplies straight from the farms. The main local beef outlets are the organized wet markets (including farmer markets) and the informal night markets (*pasar malam*). The local beef market has little or no linkage with modern retailing outlets such

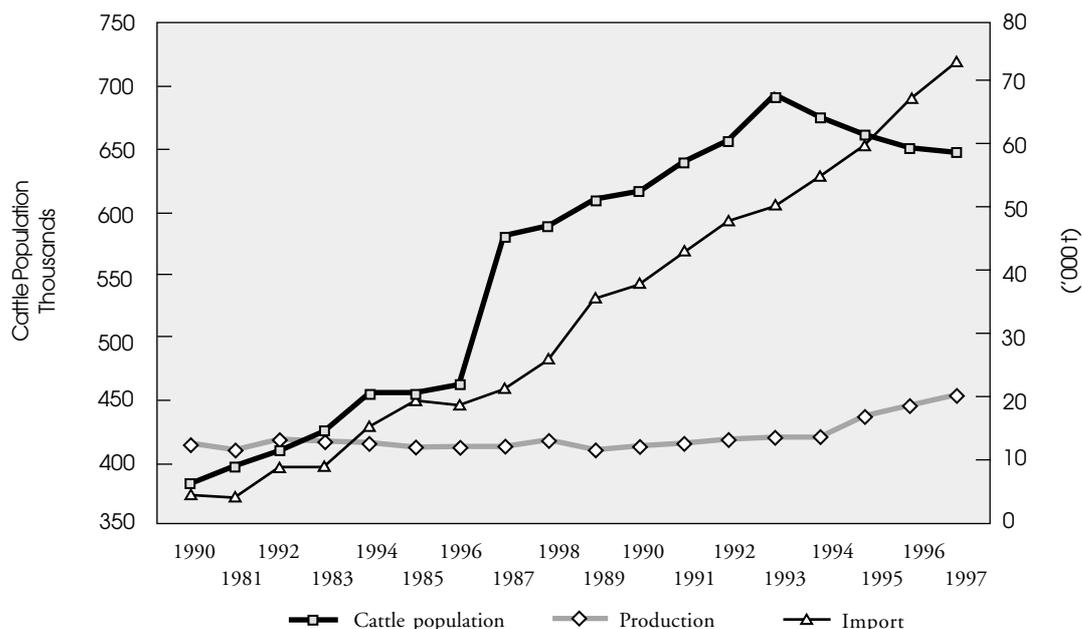


Figure 1. Cattle population and beef production and imports, Peninsular Malaysia 1980-1997.

Source: Jabatan Perkhidmatan Haiwan, Malaysia (1998).

as supermarkets, hotels, restaurants as well as food processing industries. The growth of these institutions has contributed much to the expansion of the imported beef market, with the volume of frozen beef imported into Peninsular Malaysia increasing from 2981 t in 1980 to 73 254 t in 1997 (Figure 1). Imported beef is largely sourced from India, with the tremendous increase in imports from this source being largely attributed to its highly competitive price compared to beef from Australia or New Zealand. Imported frozen beef has also penetrated the wet markets, and competes directly with local fresh beef.

Table 1 shows that the average price of imported frozen beef is less than half the price of local fresh beef. Substitutes for beef like chicken and fish are also much cheaper.

#### Cattle Rearing Under Oil Palm

A sunlight intensity of 40%-60% through oil palm fronds is necessary for a reasonable amount of grass and other cover to develop under oil palm trees for cattle to graze comfortably. Cattle grazing are suitable even when the area has only 60%-70% grass cover. The types of plant usually available under oil palm trees are *Ottochloa nodosa*, *Axonopus compressus*, *Mikania scandens* and *Asystasia intrusa*. Many grass varieties contain nutrients comparable to commercially farmed grasses (Suboh 1997).

The dry matter yields of natural forage decline over time in relation to the closure of the tree crop canopy, which reduces light transmission. However, the nitrogen content of tropical grasses increases with shade intensity. Feeding studies have indicated that there is no negative effect of shading on the intake and digestibility of tropical forages. (Wong and Chin, 1998). Nutritionally, the edible forage feed resources in plantations are adequate

TABLE 1. AVERAGE ANNUAL RETAIL PRICES OF SELECTED LIVE-STOCK PRODUCTS IN PENINSULAR MALAYSIA (RM/kg), 1980 - 1997

Item/year	1980	1985	1990	1995	1996	1997
Local beef	7.87	9.45	9.89	11.60	12.31	14.40
Imported frozen beef	4.91	2.24	4.00	5.00	6.05	7.00
Mutton	7.82	10.63	10.79	13.5	14.15	15.00
Chicken	3.55	3.75	3.90	4.15	4.66	4.85
Fish	2.81	2.53	-	-	-	-

Source: Jabatan Perkhidmatan Haiwan, Malaysia (1998).

for some cattle grazing, and provide a daily live weight gain of 250 g/head. Hence, integration of beef cattle is also suitable in mature oil palm areas, where light penetration is much less than when the trees are young. Oil palm plantations with trees aged seven years or older can produce adequate grass for cattle grazing with a dry matter production of 500 kg/ha/yr.

The suitable stocking rate for cattle depends both on types of animal and on grass varieties available under the oil palm (Ariff, 1998). Normally, a one-to two-year-old animal can be reared on 3 ha of oil palm. Electric fencing should be used to control the movement of the cattle and restrict them from straying between fields.

#### Status of Cattle Integration Under Oil Palm

In 1994, the number of cattle reared under oil palm was 46 789 head. In 1997, 56 178 head of cattle were reared by systematic integration under plantation crops in Malaysia, using electric fencing (Jabatan Perkhidmatan Haiwan Malaysia, 1998), an increase of about 20%.

The main parties farming cattle under oil palm are the settlers in FELDA schemes, but many oil palm companies have recently embarked on cattle rearing under oil palm. Hence, the cattle output is expected to increase in Peninsular Malaysia. The known companies integrating

cattle under oil palm are shown in Table 2. Apart from the FELDA settlers, FELDA Farm Products Sdn. Bhd. and the ESPEK division of RISDA are the two organizations with substantial cattle rearing under oil palm (Rosli, 1998).

#### METHODOLOGY

The cost-benefit analysis (CBA) approach was employed to evaluate the financial costs and returns from integrated cattle rearing under oil palm. Various measures of project worth were employed, namely net present value (NPV), internal rate of return (IRR) and benefit-cost ratio (B-C ratio) using data sourced from three case studies. Sensitivity analyses evaluating the IRR and B-C ratios at various beef prices were undertaken to highlight the resilience of the project to changes in important market parameters.

The NPV measure indicates the discounted future cash inflow less the discounted cash outflow at the present time, with positive values indicating that the project is viable. Amongst alternative projects, those with higher NPVs are preferred.

The IRR indicates the rate of discount at which the net cash flow collapses to zero. When the IRR is better than the opportunity cost of funds, it shows that the project is financially sound. The B-C ratio compares the ratio of discounted cash inflow to outflow, and a sound project is indicated by a B-C ratio of better than unity.

TABLE 2. OWNERSHIP OF OIL PALM/CATTLE MIXED FARMING BY PRACTICING SYSTEMATIC INTEGRATION IN MALAYSIA, 1997

Owners	State	Number of estates involved	Number of cattle (heads)*
1. FELDA settlers	Peninsula	300 blocks	29 087
2. FELDA Farm Products Sdn. Bhd.	Peninsula & Sabah	38	8 761
3. ESPEK Livestock Sdn. Bhd.	Peninsula	19	8 655
4. Syarikat PROLIP Sdn. Bhd.	Terengganu	1	111
5. Terengganu Development Sdn. Bhd.	Terengganu	3	462
6. Ladang Rakyat	Terengganu	2	574
7. LPP Jerangau	Terengganu	1	109
8. Ladang Jabor Velly	Terengganu	1	267
9. PASFA Bukit Kerisik	Pahang	1	927
10. LPP Gambang	Pahang	1	1 200
11. Mengkebang Estate	Kelantan	1	619
12. Johor Tenggara Oil Palm	Johor	1	2 866
13. Pertubuhan Peladang Negeri	Johor	1	1 100
14. Ladang Tabung Haji	Johor	1	200
15. Ladang Yayasan Pelajaran	Johor	1	602
16. Estate Plantation Agency	Johor	4	600
17. KUB Agrotech Sdn. Bhd.	Johor	1	38
<b>Total</b>		<b>300 blocks &amp; 78 estates</b>	<b>56 178</b>

Note : \*excluding stray cattle.

Source : Jabatan Perkhidmatan Haiwan, Malaysia (1998).

## BACKGROUND OF ESTATES USED AS CASE STUDIES

### Estate A

Estate A was planted with oil palm from 1977 to 1989, and in 1997 had a mature area of 1929 ha. It is located in Terengganu Tengah, in the state of Terengganu. This estate is drained, by the Sungai Apu Kiri which eventually flows in to the Sungai Paka. This river and drains are the main sources of water for the cattle to drink. Three-quarters of the estate area has flat to undulating topography, and is considered suitable for cattle rearing. Being a riverine valley, this area is very fertile and covered with plenty of grasses, soft creepers and other weeds which are suitable as cattle feed. The types of grasses and weeds that are utilizable by cattle in this location are *Paspalum conjugatum*, *Ottocloa nodosa*, *Asystasia intrusa* and *Mikania micrantha*.

### Estate B

Estate B is in Negeri Sembilan and in 1997 had a total area of 1918 ha planted with rubber and oil palm since 1985. Its topography ranges from flat to undulating, and it has the same grasses and weeds as in Estate A. The sources of water for cattle to drink are from three farm drains.

### Estate C

Estate C, also in Negeri Sembilan, was established in 1985 and had 738 ha of mature area of oil palm in 1998. It is situated about 20 km from Estate B, and has the same grasses and weeds as in estates A and B. This estate has no proper water supply, and drinking water has to be transported in containers to the field.

Each of the three estates has one manager looking after both the crop and cattle enterprises.

## TECHNICAL ANALYSIS

Cattle rearing is associated with small profit margins. Hence, management of the enterprise needs to be precise with little margin for error, since improper management may result in financial losses. Background data on the cattle enterprises of each estate are calculate from Jusoh (2002).

### Animal Arrangements at the Estate Level

The managers of Estates A and C looked after two commodities simultaneously, *i.e.* oil palm and cattle, while the manager of Estate B had the extra task of looking after rubber in addition to oil palm and cattle. Cattle rearing and oil palm cultivation require completely different skills, and using the same team to manage both enterprises may result in reduced management efficiency. However, this problem

may be partially solved by assigning specialized workers to the cattle rearing section of the business.

Two workers are needed to manage 300 to 600 head of cattle. The task of the workers was to transfer cattle from one grazing paddock to another at a pre-determined time interval. The paddock was constructed using insulated steel rods with a strand of electric wire to form an electrified fence. Estate A enlisted the services of a veterinary officer to monitor the growth of the cattle. The estate conductor also made daily checks on the cattle.

The cattle breeds used were Kedah-Kelantan (KK), Brahman cross with KK, Brahman and Drought Master. The KK breed is the most suitable for farming under oil palm since it is well suited to the climatic conditions.

### Cattle Populations

Estate A started cattle rearing under oil palm with 293 heads of cows and three heads of bulls, and increased to 372 heads of cows and eight heads of bulls, in 1997. There is an average annual increase of 11 cows (Jusoh, 2002). Estate B began with 176 cows and 40 bulls. In the second year, 31 cows and 24 bulls were transferred to another estate, and 11 bulls were sold. The number of cows increased to 199 by 1997. Estates A and B belonged to the same agency, and the top management had targeted a total of 10 000 heads of cattle for all its estates by the year 2000, which explains the yearly increases in the number of cows. Estate C started with 90 cows and the numbers increased only slightly to 108 heads in 1998.

### Animal Management

The cattle needed constant attention and certain regular chores are detailed below:

- Daily treatment of wounds caused by ticks and accidents. The workers normally carry out such treatment themselves. However if the wounds required antibiotic treatment, the services of a visiting veterinarian, or the local Veterinary Department were needed;
- Calving needs special attention, and complications were normally attended to by the veterinarian;
- A veterinarian, with the help of the local Veterinary Department, carried out vaccination for foot and mouth disease, once a year;
- Deworming of the animals was done twice a year.

The *stocking rate*, which is the number of cattle that can be reared in a hectare of land over a period of one year, is higher when the oil palm is young but gradually reduces as the supply of grass decreases with the age of oil palm. This is due to the decline in dry matter yield of grass owing to reduce in light penetration as the oil palm age increases.

On Estate A, which started cattle farming when the oil palm trees were 11 years old, the average stocking rate at that stage was 0.30 head per hectare. The rate increased to 0.50 head per hectare (2.02 ha per animal) in 1997 after seven years, owing to the increasing number of cattle. On Estate B, which started cattle rearing when the oil palm was nine years old, the stocking rate began at 0.15 head per hectare or 6.48 hectares per animal and increased to 0.25 head per hectare or 4.08 hectares per animal in the fifth year of cattle rearing. Estate C which started cattle rearing when its oil palm was the same age as on Estate B, started off with 0.14 head per hectare or 7.40 hectares per head. This increased to 0.30 head per hectare or 3.40 hectares per head after four years of cattle rearing activity (Jusoh, 2002).

The *calving percentage* is a very

important parameter to gauge the performance of cattle rearing ventures. In Estate A, the percentage increased from 42% in the first year to 80% in the seventh year. The percentages on Estates B and C averaged 50% and 40% respectively.

The *mortality rate* of animals on Estate A averaged between 2% to 5%, with the highest rate recorded in 1992 when many animals died of attacks from tigers and deaths at birth. The mortality rate on Estates B and C was only about 1.5%.

The average *weight gain* of cattle aged between one to two years was 250 to 300 g/day, or 91.3 kg to 109.5 kg/year on all estates studied.

Most of the cattle were *sold directly* to butchers and wholesalers, with the buyers being constantly in touch with the cattle unit of the estate. The cattle were sold at a weight live price of RM 5.50 per kg during normal times, although the price sometimes increased to RM 6.50 per kg during the festive seasons, especially Hari Raya Haji. The weight of a male at sale was about 200 kg and above.

### FINANCIAL ANALYSIS

The fixed and variable costs and expenses of cattle integration in oil palm estates are shown in *Appendix 1, 2 and 3*.

#### Fixed Cost

Fixed costs are the costs that do not vary with the output. These include staff salaries, maintenance and repairs, depreciation, *etc.* It should be noted that the salaries of the manager and conductor are not included in the analysis. The fixed costs also comprise the following:

**Breeding cows.** Each estate cattle project had to start in the first year by purchasing breeding cows as shown in *Appendix 1, 2 and 3*.

**Control yard.** This is an enclosure to hold the cattle for performance

monitoring and for regular veterinary treatment and disease prevention. The cattle are subjected to such treatment once every three months. The cost of building the control yard on Estate A was RM 15 000, with a capacity of holding 2000 head of cattle at any one time. The costs for Estates B and C were somewhat lower because the control yards in Estates B and C were smaller compared with that in Estate A (*Appendix 2 and 3*).

**Electric fencing.** This had to be changed every other year, although the precise need varied between the estates. The costs for electric fencing equipment in 1997 are shown in *Table 3*.

#### Variable Costs

These are the costs for labour, drugs, veterinary services and utilities. The average variable cost of cattle per head per year was relatively low in all the estates studied, but was dependent on the number of cattle. The annual average variable cost was RM 64.41/head/year, with a range of RM 36-RM 122/head/year (Jusoh, 2002). Labour or stockmen, were needed to look after the cattle. The unit cost of labour was relatively high when the number of cattle was below 200 head. Although the herd was controlled from wandering by electric enclosure, a minimum of two workers was still needed for the operation, making small stocking rates very costly. On Estate A, during the first year the labour cost was RM 20 855 but in the seventh year, the labour cost almost doubled because of the doubling of workers (*Appendix 1*). Details for Estates B and C are given in *Appendix 2 and 3*.

**Drugs and other treatment.** These were required to keep the cattle healthy, and had substantial cost implications. In addition, food

Equipment	Cost per unit (RM)	Total units	Total cost (RM)
i. Battery 60N	130	2	260
ii. Energizer	750	1	750
iii. Insulated steel rod measuring 1.5 m in length and 1 cm in thickness	3	130	390
iv. Poly wire - 500 m/roll	120	2 - 4	240 - 480
v. Voltmeter Tester	190	1	190
<b>Total</b>			<b>1 830 - 2 070</b>

Source: Estate A.

supplements, such as vitamins and minerals, needed to be administered. The administration of drugs and food supplements were normally undertaken in the control yard.

In Estate C, as mentioned earlier, drinking water needed to be transported to where the cattle were kept. Hence, there was an extra cost for water transportation (*Appendix 3*). In other estates the cattle consumed water from the estate drainage systems.

#### PROJECT BENEFITS

In this study, it was found that the cumulative income from the sales of cattle was generally inadequate to cover the costs because the percentage of cattle sold was small compared to the number of cattle the estates owned. The average sale of cattle was less than 10% of the total cattle stock. The income from the sales of cattle is shown in *Appendix 1, 2 and 3*.

**Cows and bulls must be culled.** Cows and bulls must be culled when they are no longer productive but the prices fetched for old cows and bulls were low at RM 3.50 to RM 4.50 per kg live weight. Estate A started to sell culled animals in the fourth year after project commencement while on Estate B, the sale of culled animals started in the fifth year

(*Appendix 2 and 3*).

**Stock of cattle.** This is the total number of cattle reared in the estates where these animals are weighed regularly with the total weight of stock used to indicate performance. Thus, the stock of cattle indicates the value of the business and shows the income expectations. The stock at the end of the period of cash flow was valued at a prices of RM 4.00, RM 4.50 and RM 5.00 per kg, and details is given by Jusoh (2002).

One of the key objectives of these cattle ventures under oil palm was to use the animals as a biological instrument for weed control. In this study, integrated farming was found to reduce weeding costs from RM 23.04 to RM 8.00 per hectare per year (*Appendix 1, 2 and 3*).

#### RESULTS AND DISCUSSION

##### Economic Evaluation

The profitability of integrating cattle under oil palm depends among other factors on the number of cattle that are sold. It is important that some cattle be retained to provide offspring for the continuation of the enterprise. Stocks sold should be at least 200 kg in weight, with bulls given greater priority for sale in Estate A. The result of this study shows that a satisfactory level of profitability may

be obtained when at least some 25% from total of the cattle are sold annually. At that rate of cattle sale, the project provided Estate A with an IRR of 13% before the closing of stock at the end of the each year period was taken into account (*Appendix 1*).

The calculated profit of the enterprises needs to take account of the values of their final stock, savings from the reduced weeding cost and incomes from the sale of cattle. Three prices, RM 4.00/kg, RM 4.50/kg and RM 5.00/kg live-weight were assumed in this study to account for the final stock value. A discount rate of 4% and 10% were used in the discounted cash flow analysis. A four percent discount rate was applied if subsidised funds were obtained from the *Fund for Food Programme*, while 10% was the market interest rate charged by the commercial banks on loans. Sensitivity analyses were undertaken using these prices and discount rates. The data gathered from Estate A covered seven years, Estate B five years and Estate C four years. Some of the results for Estates A, B and C shown in (*Appendix 1, 2 and 3*), with a summary of all the results given in *Tables 4, 5 and 6*.

### Yield of FFB

The cattle rearing had no negative effects on the yield of FFB (*Table 7*). The yields from Estate A at 11 years old and 12 years old before cattle were reared were 17.56 tonnes/ha and 17.05 tonnes/ha respectively. After first year cattle rearing, the yield declined to 16.98 tonnes/ha but for the second year to the fourth year the yields increased to 17.45, 18.24 and 17.52 tonnes/ha of FFB per hectare per year, respectively.

The yields of FFB from Estates B and C were relatively low due to a moisture deficit in the dry seasons. The yield obtained from Estate B was 11.16 tonnes/ha and 7.84 tonnes/ha respectively for oil palm of seven and eight years old before the cattle were reared. When the cattle were reared, the yield increased from 14.5 tonnes/ha/yr in first year to 16.6 tonnes/ha/yr in the fifth year. This increase in yield of oil palm was due to by the increase in oil palm maturity. Cattle integration was not observed to reduce the oil palm yield.

In Estate C, the yield situation was similar to what was obtained in Estate B. Two years before cattle were

introduced and when the oil palm were nine and ten years old, the yields were 7.3 tonnes/ha/yr and 12 tonnes/ha/yr respectively. When the cattle were reared, the yield increased to 13.2 tonnes/ha/yr in the first year and 16.6 tonnes/ha/yr in the fourth year.

### CONCLUSION

The study indicated that if properly managed, an integrated cattle- oil palm system of farming is financially viable. An average live weight gain of between 250g to 300g per day was achieved for one-to two-year-old cattle. An average calving percentage of greater than 50% was obtained, while the mortality rates were found to be less than five percent. The cost of cattle maintenance was found to be relatively low, averaging RM 66 per head per year. The expected IRR and NPV measures for Estates A, B and C (*Tables 4, 5 and 6*) indicate financial viability. As part of this, integrating cattle with oil palm reduced the plantation-weeding cost by about 17% to 38%. It appears from this analysis that oil palm can be successfully integrated with cattle in Malaysia.

A survey of oil palm terrain in

TABLE 4. PROFIT AT DIFFERENT EXPECTED PRICES  
(Estate A - per kg)

Items	Price RM/kg live		
	RM4.00	RM 4.50	RM 5.00
NPV @ 4% (RM)	547 733	598 322	648 911
NPV @ 10% (RM)	294 937	327 236	359 534
BCR @ 4%	2.09	2.19	2.29
BCR @ 10%	1.67	1.75	1.82
IRR (%)	25	26	27

TABLE 5. PROFIT AT DIFFERENT EXPECTED PRICES  
(Estate B - per kg)

Items	Price RM/kg live		
	RM4.00	RM 4.50	RM 5.00
NPV @ 4% (RM)	662 578	690 584	718 589
NPV @ 10% (RM)	473 656	493 658	513 661
BCR @ 4%	3.64	3.75	3.86
BCR @ 10%	3.10	3.19	3.28
IRR (%)	65	66	67

TABLE 6. ESTATE C - PROFIT AT DIFFERENT EXPECTED PRICES (Estate C - per kg)

Items	Price RM/kg live		
	RM4.00	RM 4.50	RM 5.00
NPV @ 4% (RM)	124 619	142 421	178 923
NPV @ 10% (RM)	73 186	86 635	114 210
BCR @ 4%	1.67	1.77	1.97
BCR @ 10%	1.44	1.52	1.68
IRR (%)	25	29	32

TABLE 7. YIELD OF FFB BEFORE AND DURING CATTLE REARING

1. Estate A									
Item/ year	Before cattle rearing		During cattle rearing						
	1989	1990	1991	1992	1993	1994	1995	1996	1997
Age of oil palm (yr)	11	12	13	14	15	16	17	18	19
FFB yield (tonnes/ha/yr)	17.56	17.05	16.98	17.45	18.24	17.67	17.52	17.02	17.00
FFB yield (+/-)	-	17.31*	-0.32	0.15	0.93	0.37	0.22	-0.29	-0.31
2. Estate B									
Item/ year	Before cattle rearing		During cattle rearing						
	1991	1992	1993	1994	1995	1996	1997		
Age of oil palm (yr)	7	8	9	10	11	12	13		
FFB yield (tonnes/ha/yr)	11.16	7.84	14.51	16.61	16.98	15.85	16.50		
FFB yield (+/-)	-	9.50*	5.01	7.11	7.48	6.35	7.07		
3. Estate C									
Item/ Year	Before cattle rearing		During cattle rearing						
	1992	1993	1994	1995	1996	1997			
Age of oil palm (yr)	9	10	11	12	13	14			
FFB yield (tonnes/ha/yr)	7.3	12.03	13.20	14.50	16.21	16.57			
FFB yield (+/-)	-	9.66*	3.54	4.48	6.55	6.91			

Notes : \*average two year.

Increase/decrease (+/-) yield = yield that year - average yield before cattle.

Source : Estates A, B and C.

1999, showed that 60% of the area of estates was suitable for cattle rearing. The estimated planted area of oil palm and the projected numbers of cattle that can be integrated from 2000-2005 under various land use assumptions are detailed in *Table 8*.

A projection of the consumer demand for beef in Malaysia for the years 2000,2005 and 2010 indicate that self-sufficiency will only be achieved if all oil palm areas are farmed on an integrated basis with cattle. However, this is not fully possible because cattle rearing is not

suitable on steep terrain. But the production capacity of the oil palm areas suitable for cattle integration may be enhanced if the system is changed from the pure integration system described in this study to a mixed integration - feedlot system. This system works on a programme whereby cattle at six months old are switched over to a feedlot system until sale.

The feedlot system will be even more viable because of the possibility of using oil palm biomass, mainly oil palm fronds and palm oil milling waste, including

silage as cattle feed. Nine-year-old and older oil palm can produce over 7300 kg /ha/yr of oil palm fronds (Osman *et al.*, 1999), and a study by MARDI indicates that a third of the fronds may be used as cattle feed. A feed formulation incorporating 50% oil palm fronds and 50% palm kernel cake (PKC) was found to provide sufficient nutrient to enable a cattle to gain weight at about 600 g to 700 g per day for the KK cattle variety. If the palm fronds are converted into silage and mixed with PKC on one to one ratio, a hectare of oil palm can support

TABLE 8. HISTORICAL AND FORECASTED OIL PALM AREAS INDICATING THE POSSIBLE CATTLE POPULATION THAT CAN BE REARED UNDER VARIOUS LAND USE ASSUMPTIONS

Year	Planted area (ha)	Areas and numbers of cattle					
		5% from total area	Number of cattle*	10% from total area	Number of cattle*	50% from total area	Number of cattle*
2000	3 376 664	168 833	56 278	337 666	112 555	1 688 332	562 777
2001	3 499 012	174 951	58 317	349 901	116 634	1 749 506	583 168
2002	3 547 900	177 395	59 132	354 790	118 263	1 773 950	591 317
2003	3 661 900	183 095	61 032	366 190	122 063	1 830 950	610 317
2004	3 776 100	188 805	62 935	377 610	125 870	1 888 050	629 350
2005	3 889 800	194 490	64 830	388 980	129 660	1 944 900	648 300

Note : \*based on three hectares of land/head of cattle.

Source : MPOB ( forecast for year 2002-2005).

the food requirement of two heads for cattle annually. These latter possibilities need to be explored in another study.

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**Appendix 1**

**CASH FLOW ANALYSIS OF BEEF CATTLE PRODUCTION UNDER OIL  
PALM ON ESTATE A, 1991-1997**

Item/year	1991	91	92	93	94	95	96	97
	-	1	2	3	4	5	6	7
<b>Benefits</b>								
Sale of culled cows	-	-	-	-	1 550	2 750	3 650	4 964
Sale of male cattle	-	13 600	21 600	29 600	30 600	27 000	49 500	137 477
Total Sale	-	13 600	21 600	29 600	32 150	29 750	53 150	142 441
Saving from herbicide reduction (Rm/yr <sup>-1</sup> )	-	44 444	53 568	67 727	58 391	74 729	98 475	92 611
<b>Total benefit</b>	-	<b>58 044</b>	<b>75 168</b>	<b>97 327</b>	<b>90 541</b>	<b>104 479</b>	<b>151 625</b>	<b>235 052</b>
<b>Expenses</b>								
Cows	290 070	-	-	-	-	-	-	-
Bull	4 875	-	-	-	-	-	-	-
Electric fencing	-	1 500	-	2 000	-	-	2 500	-
Control yard	15 000	-	-	-	-	-	-	-
Drugs and treatment	-	4 515	5 114	5 817	6 206	6 563	6 878	8 315
Labour	-	20 855	23 620	2 669	28 664	34 560	31 768	38 413
<b>Total cost</b>	<b>-309 945</b>	<b>26 870</b>	<b>28 733</b>	<b>34 686</b>	<b>34 869</b>	<b>41 123</b>	<b>41 145</b>	<b>46 727</b>
Profit/loss	309 945	31 174	46 435	62 641	55 672	63 357	110 480	188 324
Cumulative profit/loss	-309 945	-278 771	-232 336	-169 694	-114 022	-50 666	59 815	248 139
Internal rate of return (IRR)	13%							
Net present value (NPV) at 4%	143 018							
Net present value (NPV) at 10%	36 548							
BCR @ 4%	1.28							
BCR @ 10%	1.08							

## Appendix 2

CASH FLOW ANALYSIS OF BEEF CATTLE PRODUCTION UNDER OIL  
PALM ON ESTATE B, 1993-1997

Item/year	1993 0	93 1	94 2	95 3	96 4	97 5
<b>Benefits</b>						
Sale of culled cows	-	-	-	-	-	9 110.00
Sale of heifers	-	-	-	-	2 115.00	-
Sale of male cattle	-	11 636.50	23 557.50	21 387.00	49 407.00	111 087.20
Saving from weeding cost	-	83 605.62	81 399.92	147 475.02	140 033.18	13 668.76
<b>Total revenue</b>	<b>0.00</b>	<b>96 242.12</b>	<b>104 957.42</b>	<b>168 862.02</b>	<b>191 555.18</b>	<b>259 865.96</b>
<b>Expenses</b>						
Cows	144 031.00	-	-	-	-	-
Bulls	24 374.60	-	-	-	-	-
Electric fencing	1 988.25	-	-	-	1 472.22	-
Control yard	11 240.00	-	-	-	-	-
Drugs and treatment	-	8 731.23	7 106.35	9 702.35	6 441.10	8 836.25
Labour	-	6 311.39	6 933.54	9 176.71	10 582.52	14 624.86
<b>Total expenses</b>	<b>181 633.85</b>	<b>15 042.62</b>	<b>14 039.89</b>	<b>18 879.06</b>	<b>18 495.84</b>	<b>23 461.11</b>
Profit/loss	-181 633.85	81 199.50	90 917.53	149 982.96	173 059.34	236 404.85
Cumulative profit/loss	-181 633.85	-100 434.35	-9 516.82	140 466.14	313 525.48	549 930.33
Internal rate of return (IRR)	57%					
Net present value (NPV) at 4%	438 533					
Net present value (NPV) at 10%	313 634					
BCR @ 4%	2.75					
BCR @ 10%	2.39					

## Appendix 3

CASH FLOW ANALYSIS OF BEEF CATTLE PRODUCTION UNDER  
OIL PALM IN ESTATE C, 1994 - 1997

Item/year	1994	94	95	96	97
		1	2	3	4
<b>Benefits</b>					
Sale of male cattle	-	-	-	-	53 750
Saving from weeding cost	-	18 450	36 900	38 376	48 708
<b>Total revenue</b>	<b>-</b>	<b>18 450</b>	<b>36 900</b>	<b>38 376</b>	<b>102 458</b>
<b>Expenses</b>					
Cows	117 000	-	-	-	-
Bulls	5 600	-	-	-	-
Electric fencing	-	1 352	1 352	1 352	1 352
Control Yard	12 500	-	-	-	13 800
Drugs and treatment	-	360	480	900	914
Utility (water and POL)	-	2 640	2 640	2 640	2 640
Labour	-	7 800	7 800	7 800	7 800
<b>Total expenses</b>	<b>135 100</b>	<b>12 152</b>	<b>12 272</b>	<b>12 692</b>	<b>26 506</b>
Profit/loss	-135 100	6 298	24 628	25 684	75 952
Cumulative profit/loss	-135 100	-128 802	-104 174	-78 490	-2 538
Internal rate of return (IRR)	-1%				