THE GOVERNMENT OF MALAYSIA
THE STATE OF SARAWAK

MIRI-BINTULU

REGIONAL PLANNING STUDY

SUPPORTING REPORT

No. 2

AGRICULTURE
PART V
THE DEVELOPMENT OF INLAND FISHERIES AND LIVESTOCK

—1974—

HUNTING TECHNICAL
SERVICES LTD. LONDON

HOFF AND OVERGAARD
COPENHAGEN

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TABLES (Con't)

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Corrigenda

For National Livestock Industry Board (NLIB)

read National Livestock Corporation (NLC)

CONVERSIONS

Imperial	Sarawak
1 pound equals	.75 kati
1 ounce equals	.75 tahil
1.33 pounds equals	1 kati
	1 kati equals 16 tahils
133 pounds equals	1 picul
	1 picul equals 100 katis
1 ton equals	1680 katis
1 ton (2240 lbs) equals	16.8 piculs

Metric	Imperial	Sarawak
1 kilogram equals	2.205 pounds equals	1.653 katis
1 metric ton equals	0.964 tons equals	2.932 katis

THE DEVELOPMENT OF FISHERIES

CHAPTER 1

PRESENT SITUATION

1.1 INTRODUCTION

The consumption of adequate quantities of protein foodstuffs is vital for efficient physical and mental activity in human beings. The quantity of protein consumed directly relates to the quality of life that is enjoyed by the individual and the nation as a whole. Nutritional surveys in Malaysia have shown that traditonal carbohydrate starvation is unknown, but that a concealed form of hunger, malnutrition due to protein deficiency, is widespread particularly among the rural populations. The most popular and readily available protein food is fish. An increase in the supply and consumption of fish is vital for the welfare of the nation.

1.2 FRESHWATERS

The Study Area is well supplied by several major rivers and a great number of smaller streams. There are large areas of freshwater swamps, several ox-bow lakes and one large semi-permanent lake, Loagan Bunut.

In the same way that people often assume that lush tropical vegetation must indicate great land fertility, so people also wrongly assume that fish must abound in any piece of suitable water. The key to productivity, whether on land or in water, is the availability and supply of nutrient salts. Under a dense cover of vegetation such as occurs in Sarawak, nutrient salts that become available from the decay of rock minerals and plant materials are very rapidly taken up by living plants with the result that the cycle of nutrients is almost completely closed and very little reaches the streams in run-off. This situation is further complicated by the low pH typical of Sarawak waters which inhibits the development of decay bacteria with the result that any leaves or vegetable material entering the water tends to accumulate and become preserved as peat, effectively locking up any nutrients this material might contain. This is the situation prevalent in most fresh water bodies in Sarawak and they have a low fish productivity. There is however, a specialised fish fauna developed in Sarawak which relies on its food coming from outside the aquatic medium. These species feed on the large numbers of insects and fruits that occur in the forests, and fall into the water from overhanging trees. These fish may be locally abundant and are often considered a delicacy.

The outstanding exception to general low production is the large semi-permanent lake, Loagan Bunut, which has an unusally high fish productivity for no very clear reason.

A characteristic of this lake is its periodic rise and fall in water level, sometimes to almost total dryness.This fluctuation does not follow a fixed cycle. When the lake level falls the bottom is exposed and dries out, allowing oxygenation and decay to take place so that, upon refilling, large quantities of nutrients are released into the water boosting its fertility. The ox-bow lakes and freshwater swamps never dry up, with the result that any nutrients in the pond muds are locked away forever.

The indigenous peoples fish the rivers and lakes, not in a systematic manner but in periodic bursts of activity linked to feast days and other auspicious occasions. Their fishing methods often involve the use of fish poisons which decimate the populations of certain species. Other species, notably air breathing fish, are more resistant to fish poisons and it is not unusual for stretches of river to contain nothing but air breathing species.

Forest clearing and agricultural development may result in soil erosion and a heavy silt load in the rivers which disrupts the natural fish population by altering the feeding habits. In general the natural freshwaters have,and will continue to have a low potential for direct fisheries exploitation, with the notable exception of Loagan Bunut.

1.3 LOAGAN BUNUT

This is a large freshwater lake situated on a tributary of the Tinjar river. The lake is of special interest because of the relatively large quantities of fish produced from the channel draining the lake. The lake is considered by the Berawan people to belong to them and only they have any rights to the fish from it.

Although the water level fluctuates it is in general a very shallow lake. At least once a year, and occasionally twice, the level falls and the lake is reduced to a few pools of water. Fishing in the lake is not important but it is in the channel draining the lake when the channel flow is low the local people operate large fish traps with lift nets called 'selambau'. It is an inefficient catching method but even so large quantities of fish are caught and the surplus is stored alive in large cages placed in the water. It is not unusual for fish to remain in the traps for up to three months without any supplementary food being given. Their condition is poor and they fetch low prices. When there is sufficient water in the channel the cages are moved either to Long Teru or Marudi where the fish is sold to local traders or used to repay debts incurred in purchases of household goods and alcoholic drinks.

The main fishing effort is when the level of the lake is falling. The fish have the urge to move out into the river and at this time they are in prime condition, having fattened in the lake. It seems that relatively little breeding by fish stocks takes place in the lake and it is believed that re-stocking of the lake comes from a migration of fingerlings from the main rivers when the lake refills, partly by a reverse flow from the flooded rivers.

At present the lake fisheries are inefficient and fish quality is very poor. The Berawan people are more backward than the Iban peoples and are very superstitious. They are also highly suspicious of any suggestions to improve fishing methods and to control the fishing effort. This may not be a bad thing in that present methods ensure replenishment of parental stocks and continuity of production. It would be very easy to introduce efficient fishing methods that could catch every fish in the lake and put an end to further production. It is better to leave the present fishing methods and the amount of fishing effort alone for the time being at any rate until research has clarified the biological behaviour of fish in relation to the fluctuation of lake level. Improvements should however be made in the handling of the fish caught so that better quality produce can be sold at times that take advantage of better market prices.

1.4 AQUACULTURE

In the Study Area, as in other parts of Sarawak, the Inland Fishery Division of the Department of Agriculture has done pioneer work on the promotion and application of aquaculture techniques, with the result that fish culture ponds are quite common in the Study Area and those close to towns are efficiently and profitably operated. Those situated in more remote areas have not been so successful in increasing food supplies because the operation and ownership of these ponds is regarded more as a status symbol than a source of food and income. The number of extension personnel and fry multiplication stations is adequate for present requirements but will need expanding before new developments can take place.

1.5 BRACKISH WATERS

Sarawak, as a whole, has large areas of brackish waters formed by the long estuaries of large rivers. However, the Study Area has only very small areas of brackish water, highly influenced by water draining from peat swamps and of very low potential for development at present. There are fish species which can be cultured in brackish water peat swamps, but production is low and it is better to use the available manpower resources on more promising sites.

1.6 MARINE FISHERIES

Although a detailed study of the marine fisheries lies outside the Terms of Reference for the Study, brief mention is necessary to complete the overall picture of the Study Area.

At present the fishermen operate in the inshore waters and are centered in Miri and Bintulu with much smaller casual fishing effort from other coastal villages. Fishing boats and gear tend to be small and owner-operated. They can only operate when the sea is not too rough and the tides allow boats to enter and leave the river mouths. The most frequently used gear is drift gill nets and bottom gill nets, both exploiting the pelagic fish population, while less commonly used are the trawl nets mostly used for prawn fishing. Any demersal fish are caught unintentionally with the prawns.

Approximately 1 000 tons of fish and prawns are landed annually in Miri. Unlike the fisheries in temperate waters, which largely consist of a single species, the fish landed in Miri show a great diversity of species. This suggests that no one species occurs more commonly in inshore waters than any other, nor is it found in large discrete populations - rather a random distribution of small populations.

Scientific data giving rates of fish caught per hour of fishing effort for different species using different types of gear are not available for Sarawak waters. Such a study is required before recommendations concerning the development of the fishing industry can be made. It is apparent that there are good resources of fish both inshore and offshore as indicated by the presence of an increasing number of foreign fishing boats in the area, notably Thai and Taiwanese vessels. Their catches are marketed in Singapore or in their home ports. Larger and more sophisticated vessels can only be introduced with improved port facilities and fish handling arrangements. At present ice is expensive and only sparingly used in the preservation of fresh fish, so that supplies of fresh marine fish to the interior are limited and often of deteriorating quality. When the resource data becomes available plans can be considered for fish processing plants both for human domestic consumption or export and for livestock feedstuffs. This will help to stabilise domestic market prices which at present fluctuate greatly, influenced mainly by the weather conditions.

CHAPTER 2

THE MARKET FOR FISH

That rice is the staple food in the Malaysian diet is an accepted fact; it is not so well known that fish is by far the greatest source of protein food. In this Study no detailed analysis of consumption and expenditure on fish has been undertaken. Without such a survey the actual per capita consumption in Sarawak is difficult to estimate. It has, however been investigated by numerous surveys in West Malaysia and a useful FAO study has estimated 66 pounds of fish per head per annum. This compares well with an estimate derived from the amount of fish landed in Miri port which gives a per capita consumption for people in Miri District of 75 pounds per head per annum or 1.4 pounds per week. Not all the fish landed in Miri is consumed in Miri and considerable quantities are exported to Brunei, Kuching and Kuala Lumpur. At the same time the port landings of fish do not include any of the fish produced from freshwater fish culture or the natural fresh waters.

The Miri town supplies of fish can be considered sufficient, but it should be remembered that the rural areas have the greatest need. Here the supply of fresh fish from marine sources is often small and the quality poor compared with the town supplies. Due to poor handling it often happens that the wholesomeness of marine fish is greatly reduced by the time it reaches distant kampongs. As a result rural people often rely more on dried marine fish, and to some extent they have developed a taste preference for it. However, the nutritive value of fish is much reduced by drying and salting processes, which destroy vitamins and can render some of the proteins unavailable to the human digestive system. The big advantage of freshwater fish culture is that prime fish are raised close to the areas where they are to be consumed; furthermore rural people are already familiar with freshwater fish so that there is no sales resistance to this commodity.

The market for freshwater fish is in two main categories:-

i) Rural domestic demand for fresh fish, mainly smaller sized and locally bred;

ii) The speciality urban fish market linked to the restaurant and special occasion trade.

II MARINE FISHERIES

Although a detailed study of the marine fisheries lies out-

[illegible]

CHAPTER 3

THE ENVIRONMENT-SUITABILITY FOR FISHERY DEVELOPMENT

3.1 CLIMATE

The range of temperatures prevailing in Sarawak are ideal for aquaculture. The annual rainfall pattern indicates that a drought period is likely at one time of the year though it may only be of short duration. For year-round operation of ponds a perennial water supply is required. The supply usually comes from a stream, a flow of one cusec will provide two acre feet of water per day. Most streams likely to be selected for aquaculture development will yield far more water than this throughout the year. Indeed because of the steep terrain of much of the Study Area, resulting in very rapid runoff after rainfall, the danger from flooding is more serious than drought. Adequate drainage channels must be provided to remove this danger on sites liable to flood.

3.2 SOILS

For pond construction the soil should have an adequate clay or silt content to hold water; 40 per cent clay or more is suitable. The nutrient status of the soil is not important as it is only the surface one centimeter of soil that takes part in ionic exchanges with the water. The nutrients required for pond production must be added. Because of this, acid sulphate soils normally useless for agriculture due to excessive acidity can be made into very productive fish ponds. Organic soils with high loss on ignition percentages should be avoided for most kinds of aquaculture. Any attempt to improve the cation status of peat water will result in decay of the organic matter and deoxygenation problems.

3.3 SITING OF AQUACULTURE ENTERPRISES

Site selection depends on many factors such as soil and water supplies which have already been discussed. Water supply is the key factor. Suitable sites without a running water supply can still be used for small scale schemes: rainfall will be adequate for most of the year but they may dry up if the drought is prolonged. In this case short term crops can be taken.

Gently sloping valleys make very good fish pond sites with the drainage channel moved to one side of the valley. Steep catchments and those inadequately protected against erosion should be avoided because of the risk of excessive silt. Marshy swamp land is excellent for the construction of large scale ponds, but in Sarawak swamp land is particularly liable to flash flooding.

The pond operator's house should be close by the pond site as this will help discourage human poachers and predation by otters and monitor lizards. And when the house is near the ponds there is less chance that fish will suffer neglect.

CHAPTER 4

AQUACULTURE

4.1 GENERAL CONSIDERATIONS

Although the selection of ideal sites may often be difficult, the quantity of land and water available in the Study Area gives a good general potential for aquaculture development. Fish ponds can be constructed on land and soils with little or no value for agriculture. A pond is a closed system and added fertilisers are more efficiently used than they are on land crops. With phytoplankton (algae) feeding fish there is an almost linear relationship between phosphate fertiliser added and the yield of fish harvested. The traditional use of animal manures in fish culture requires re-examination. Animal manures are a complete fertiliser, rich in long term breakdown products which have beneficial effects on soil structure but some of which may be detrimental in aquaculture. They are therefore best used on the land. Furthermore by not using animal dung fish culture produces a product which is acceptable to people whose religious beliefs preclude the use of any products that have come into contact with certain animals.

4.2 INPUTS FOR AQUACULTURE SCHEMES

4.2.1 Pond Construction

As a general principle the larger a pond the more productive and easier it is to manage, up to a maximum of three acres. Ponds larger than this are difficult to manage, considerable quantities of water being required for filling, and emptying and harvesting are complicated. Because of the living space effect, which is that fish grow larger and faster in large ponds, ponds less than half an acre in size should only be used for special purposes. Very small ponds are often seen in rural areas, but their productivity is very low and this often prejudices farmers against the further construction. A one-tenth of an acre pond should be considered the minimum size but preferably half an acre. For easier management ponds should be rectangular in shape with their long sides at least twice the length of their short sides.

As each site for aquaculture is unique and sites vary greatly as to the work required to construct a pond, so actual costs for construction are difficult to project. The current figures for pond construction that are available from the Fishery Division are usually for the construction of a single pond. Frequently the major item in the cost of pond construction is getting men and machinery onto the site in the first place. Thus in Sarawak costs quoted tend to be high. It is much cheaper to construct a series of ponds in one area before moving to another. A depth of water between three and four feet is required, but it is never necessary to excavate to this depth. Partial excavation will produce enough material to build bunds to retain this depth of water. A maximum cost for pond construction is taken as $3 000 for a half to one acre pond. On a suitable site the cost of construction should be only half this figure, which is the one given for the low cost situation. Smaller ponds are more expensive to construct per unit area than large ponds.

4.2.2 Fertiliser and Lime Application

After exhaustive experimentation in Malaysia it has been shown that only phosphate and calcium (lime) of the four major nutrients need be added to fertilise freshwater ponds. Potassium is highly soluble and only very rarely deficient in water. Phosphate in the form of double or triple superphosphate boosts the production of the blue-green group of algae. These algae are capable of fixing dissolved atmospheric nitrogen so that the whole pond becomes enriched as the fixed nitrogen passes through the food chain and nitrogenous fertilisers are not required. Indeed the addition of nitrate inhibits algae development.

In some of the aquaculture schemes outlined later the application of phosphate is very high and, under normal conditions, would causes eutrophication (excessively enriched water) and eventual deoxygenation of the water. These schemes are designed for very frequent harvests; in this way nutrients are removed and excessive levels are not allowed to build up. Triple-superphosphate costs $11 for a 60 pound bag. The phosphate should be applied in small weekly or monthly doses. As the surface layers of pond water are the most productive, the phosphate should be placed in cloth or perforated plastic bags tied to stakes just below the water surface and allowed to dissolve slowly. If thrown into the pond it sinks to the bottom where some of the ions are rendered unavailable by the clay complex.

Lime, besides providing calcium which is an essential constituent of all animal and plant bodies, also neutralises acidity. High acidity inhibits aquatic respiration and results in a low production of algae. The main effect of lime is to provide bicarbonate ions from which aquatic plants obtain carbon dioxide essential for photosynthesis. Lime is available in two forms as calcium oxide (quick lime) and calcium carbonate (limestone dust). Quick lime has the advantage of being highly soluble and has twice the calcium content for the same bulk of limestone dust. The disadvantage of quick lime is its powerful reaction with water which eliminates planktonic inocula. Limestone dust is recommended as it is safer to apply; but it is expensive in Miri because of the transport charges and costs $150 per ton. With acidic water supplies, a normal application of limestone dust would be one ton per acre per annum.

4.2.3 Supplementary Feeding

It is good management practice to give supplementary food to newly stocked fingerlings, particularly in new ponds which have not yet built up supplies of natural food. For small fish the supplementary food must be finely divided, and the most readily available and most frequently used food is rice bran. Very little work has been done to find alternatives; but the analyses below suggest that both soya bean flour and fish meal flour would be more valuable than rice bran.

	Total dry matter	Total digestible protein	Total digestible nutrients	Fibre
	Per cent	Per cent	Per cent	Per cent
Soya bean flour	92.9	40.2	82.0	5.0
Fish meal flour	92.0	53.6	70.8	0.9
Rice bran	90.8	8.4	67.4	11.6

Macrophyte (leafy plants) feeding fish such as the grass carp and lampan jawa will soon consume all the natural water weeds grown in a pond and will require supplementary feeding. A wide variety of young green leaves are acceptable to many fish, but experience has shown that the young leaves of sweet tapioca or young grass are the most satisfactory. Napier grass has been found to give very good results as the young leaves are highly platable and easily produced. The best variety is Uganda Hairless which can be grown along the bunds and on land adjacent to the ponds.

Outlined in the section on aquaculture schemes are two for raising small fish which can themselves be used as supplementary food for pigs, poultry and freshwater turtles.

4.2.4 Labour

Because of constraints on development such as the scarcity of extensive suitable sites and the lack of management skills, it is not expected that aquaculture will often be a full time occupation. Aquaculture schemes have a low labour requirement which can often be performed by women or other members of the family. Aquaculture can provide both food and income while a settler or small-holders main crops are maturing. A fish crop can be obtained six months after initial pond construction. For this type of part-time enterprise the social cost of labour is estimated at present to be $3.00 per day on the basis of its opportunity cost in traditional agriculture activities.

It may be that, with suitable sites and sufficient management skills, some small-holders will make aquaculture their full time occupation. One man working full time can operate seven acres of ponds with casual labour required at harvest time. With part-time assistance from other members of his family one man could operate ten acres of ponds.

4.2.5 Miscellaneous Equipment

The amount of equipment required is very flexible and containers such as household buckets are useful in pond management. Nets are the major item; for harvesting, for transfer of stocks, and special fine mesh nets for holding fish fry. Tin or plastic containers are required for transporting fish fry, large earthenware jars are useful for holding fry and also for salting sepat siam. All the equipment required is cheap and very readily available. For a half acre scheme a cost of $203 is estimated.

4.2.6 Stock for Aquaculture

There are a great number of fish species which have been stocked in ponds. However in the schemes outlined below only well tried and readily available stocks have been recommended, with the exception of the scheme for raising Taiwan turtles. This is a new venture in Sarawak, although the Inland Fishery Division has been multiplying turtle stocks for some years. A few notes follow on each of the main fish stocked:

Tilapia mossambica: This is the common tilapia of cultivation. It is a very hardy species and under proper management can attain a weight of one pound in six months. It feeds on phytoplankton and ponds stocked with this species need only be fertilised. A serious fault with the species is its precocious and uncontrollable breeding and, if both sexes are stocked, this results at the end of six months in a great mass of small fish each weighing nearly one ounce. This fecundity is exploited in the schemes to raise trash fish for livestock feed, and with continuous harvesting a very large production is possible. Fortunately the sexes are easily identified and it is preferable that only males are stocked in ponds for raising fish for human food. They grow faster and to a larger size than females.

Tilapia nilotica: This species is also a phytoplankton feeder, but is much slower at reproducing. It is therefore suitable for mixed stocking in houselot ponds.

Puntius javanicus lampan jawa: This fish is very popular eating with local people. It is a macrophyte feeder (leafy plants) and therefore requires continuous supplementary feeding with soft grasses and tapioca leaves. With good management it can attain a weight of one and a half pounds in nine months.

Cyprinus carpio Lee koh: This is the common carp, probably the best known fish for aquaculture. It is an omnivorous feeder and thrives best on a diet of high grade supplementary feeding, such as groundnut cake or maize meal. However at low stocking rates it thrives well in mixed stocking ponds and can attain weights of two to three or more pounds in a year.

Trichogaster pectoralis Sepat Siam: This species belongs to the family commonly called gouramy whose members all breathe atmospheric air to supplement dissolved oxygen in the water. It is an omnivorous feeder but prefers a rich periphyton and, in well fertilised ponds, it attains maturity and a maximum weight of six ounces in six months. Despite its small size, when salted and dried it is a delicacy and fetches a good price.

Helostoma temmincki Biawan: Commonly called Kissing gouramy, this species is also omnivorous but rather a slow grower, attaining a weight of about eight ounces in six months and, exceptionally, one pound in one year.

The above species are called "locally bred varieties" as they are produced (along with some other species) in great numbers at the various state fish hatcheries and provided free to pond operators.

The following species are all Chinese carp, which at present can only be bred in Malaysia with great difficulty, and supplies of local bred stocks are non-existent. Currently these species are imported as fingerlings from China via Hong Kong and Singapore and are usually available from commercial dealers. However world demand for these fingerlings is increasing, they are relatively expensive and may be in short supply in the future,

FINGERLINGS:	Silver carp	- Lian Hu	- 70 cents each
	Grass carp	- Chow Hu	- 70 cents each
	Big-Head carp	- Song Hu	- 80 cents each

Hypopthalmichthys molitrix - Lian Hu - the Silver carp: This species is a phytoplankton (plant plankton) feeder and thrives well in ponds fertilised with phosphates. If conditions are good remarkable rates of growth are possible, up to eight pounds or more in one year.

Aristichthys nobilis - Song Hu - The Big-Head carp: This species is a zooplankton (animal plankton) feeder and does very well in ponds receiving animal manures as well as phosphate fertilisers. It is usually less productive than the silver carp, but fetches the highest prices in the market and is therefore the most popular with pond operators.

Ctenopharyngodon idellus - Chow Hu - the grass carp: This species, as its name suggests, is a macrophyte (leafy plants) feeder and has an enormous appetite. It is easily fed on young soft grasses (napier grass being very suitable) or tapioca leaves. Provided enough food can be obtained very good growth is possible - up to eight pounds in one year.

At present only two non-fish species are used for freshwater aquaculture in Sarawak; these are the freshwater prawn and the Taiwan turtle.

Macrobrackium rosenbergii - Udang galah - the giant freshwater prawn: This species is native to most of the Sarawak rivers. The natural stocks are very vulnerable to pollution, and, as they breed in brackish waters, both adults and juveniles have to enter the lower, and most polluted, reaches of rivers. Fortunately the Inland Fishery Division is successful in artificially spawning and rearing juveniles which can then be stocked in ponds. Prawns are omnivorous, with a preference for dead animal and plant tissues. In well fertilised ponds they can weigh three ounces each after six months and, with low stocking rates, eight ounces each in one year. At present juveniles are provided free to pond operators; but, as the cost of their production is quite high and good profits can be made, it is suggested that a charge of $1.00 per 100 is made.

Amyda sinensis - the Taiwan soft shell turtle: This turtle is a native of Taiwan and only recently introduced into Sarawak. It attains a maximum of about four pounds in weight and is wholly carnivorous. There is a local Sarawak soft shelled turtle but this is a quite different animal, being partly herbivorous and attaining weights in excess of ten pounds. Because of its slow growth rates and large size the local turtle is less suitable for pond culture. The stock of Taiwan turtles imported are already domesticated and breed readily in captivity.

The Taiwan turtle becomes sexually mature at approximately two years of age under Sarawak conditions. The females lay batches of six to eight eggs, four to five times a year. At first the eggs are rather small, but hatchling percentage is good, usually 80 per cent. As the turtles grow older the number of eggs per batch increases to around twelve, the eggs are larger and produce larger hatchling turtles.

Eggs are laid at night in damp sand or any soft earth above the water level but in a shady place where they will not dry out. Next day the eggs can be removed and placed in an incubator where they will be safe from predators. The incubator can be a simple box containing sand in which the eggs are buried and the sand is kept moist. The box is placed in the shade to maintain an even natural temperature; in Sarawak no artificial heat being required.

Depending on the temperature, the eggs hatch out in from 50 to 60 days. The hatchling turtles make immediately for water, and a tray containing a few inches of water should be placed in the incubator just below the level of the sand.

In a batch of eggs it is usual to get three males for every two females. The sexes of the hatchlings can only be determined after they are two months old by differences in the outline of the shell, the thickness of the body and the length of the tail.

Throughout their lives Taiwan turtles are carnivorous, even when very hungry they do not appear to consume any vegetable matter. The young hatchlings for the first two months are best fed on live tubifex worms or chironomid larvae, both of which are easily obtainable from most drains. Frog tadpoles and chopped giant African land snails are also excellent food during the early stages and they will readily take raw chopped fish flesh and chicken entrails as a staple diet. Turtles should be fed in the mornings with an unlimited quantity of food, but any uneaten food must be scrupulously removed next day or serious fouling of the water will occur.

The growth rates of both sexes is more or less equal but females look smaller because they have a deeper body. With good feeding they can easily attain a weight of two pounds in a year; which is a good marketable weight.

4.2.7 The Use of Animal and Poultry Manures

The use of animal manure to fertilize fish ponds is a long-established tradition. However, its use is not without hazards and disadvantages when compared with the use of chemical fertilisers. All manures contain undigested materials which on entering the water decay and, if in excessive quantities, can cause deoxygenation. Manure is a complete fertiliser, but in a pond phosphate is required to boost productivity. The other nutrients in manure produce quantities of undigestible algae which collect on the pond surface in thick scums. Where alternative uses for animal manure are possible and mineral fertilisers are available, then phosphate fertiliser will give more satisfactory results.

The use of animal manure is very much better than no fertiliser at all. Pig and poultry manures are preferable to cattle manure because they are less bulky and are higher in nutrients A one acre pond can use up to 500 pounds of pig manure or 100 pounds of poultry manure per week. This can involve a great deal of labour both in collection and distribution. Eventually further labour will be required to remove the large quantity of debris which will accummulate during each production cycle. If cattle and pig manures is run into settling tanks and only the liquid used in the pond then the solids can be spread on the land. Poultry manure is a different material and is eaten directly as food by certain fish, prawns and turtles. As poultry manure is rich in nitrogenous substances it can very easily turn the pond water foul and a watch on the colour of the water should be kept and further application withheld if the pond becomes too rich. It can be if advantageous to keep some chickens in cages built over the ponds, especially those raising the giant prawn.

4.3 AQUACULTURE SCHEMES

4.3.1 Production of Fish Protein for Livestock Feed

The key to efficient farm livestock production lies in the supply and quality of the feedstuffs available. Currently in Sarawak almost all feedstuffs commercially available are imported, and therefore relatively costly.

The following notes outline a scheme whereby a small-holder farmer might be able to raise his own protein feed supplement for feeding to pigs, poultry, fish and turtles. Reference should be made to section 4.2 for general technical requirements.

Bearing in mind that this scheme is for small scale farmers and that large pieces of flat land are not generally available, a one-tenth acre unit has been chosen; but a small-holder might operate several units, depending on local circumstances and his requirements. Convenient measurements of a one-tenth acre pond are 15 yards by 30 yards and the cost approximately $200. The Fishery Department gives a cash subsidy for pond construction of $20 per one-tenth acre pond.

The scheme aims to achieve a high production of small fish from a small unit of water. This can only be obtained if the water conditions are very favourable, and especially a neutral or slightly alkaline pH. Natural waters in Sarawak are almost all acid, therefore a new pond will require an initial dressing of 120 pounds of limestone dust, at a cost of $8. Thereafter each time fresh water is added to the pond more limestone dust should be applied. With the removal of fish crops the reserve of calcium is further depleted and additional periodic dressings of limestone dust should be given according to the operator's experience. This will probably amount to another 60 pounds applied in small doses throughout the next twelve months.

High productivity can only be obtained where the chain from raw chemical nutrients to fish flesh is the shortest, this is best obtained using phytoplankton feeding fish.

$$\text{chemical nutrients} \longrightarrow \underset{\text{(algae)}}{\text{phytoplankton}} \longrightarrow \text{fish}$$

<u>Tilapia mossambica</u> is ideal for this type of production: it is a phytoplankton feeder, it matures at an early age and is a very ready and prolific breeder in captivity.

In order to obtain a high production of phytoplankton a phosphate fertiliser is required besides lime. Triple-super phosphate is the best and most soluble form and 10 pounds per month in four weekly doses of 2.5 pounds should be applied. In a year a total of 120 pounds of triple-super phosphate would be applied costing $22.

In this one-tenth acre pond are placed 50 pairs of breeding tilapia. If they are well fed they will commence spawning almost immediately and produce 100 young every two months or less. This will give an annual production of 30 000 fry. Under good conditions they can attain a weight of one ounce in three months when they can be harvested. In five months they are sexually mature and will commence breeding. It is essential therefore that these fish are removed when they attain a weight of one ounce to provide space for further production. In this way, three months after the initial breeding, some 312 pounds of fish can be removed. Under crowded conditions not all fish grow at the same rate, but a pond that is working well and highly productive can yield 3.5 pounds of fish per day or about 1 250 pounds of fresh fish per year (20 000, one-ounce fish).

Costs of Production

0.1 acre pond	Dollars
Pond construction - low cost situation	200 (- $20 subsidy)
- high cost situation	600 (- $20 subsidy)
Lime - initial dressing 120 pounds	8.00
Phosphate fertiliser - 2.5 pounds per week - 120 pounds per annum	22.00
Miscellaneous nets and equipment	50.00
Labour, including pond maintenance, 13 man days per annum	-

Yields

Fresh fish (20 000) - 1 250 pounds
Dried fish (assuming 33 per cent drying loss) - 825 pounds

4.3.2 Half-Acre Pond Raising Fish Protein for Livestock Feed

Costs of Production

0.5 acre pond 2 420 square yards (approximately 35 by 70 yards)	Dollars
Pond construction - low cost situation	1 500
- high cost situation	3 000
Lime - initial dressing 10 cwt	75
- further dressing throughout year, 2 cwt	15
Phosphate fertiliser - 12 pounds per week 650 pounds per annum	130
Miscellaneous nets and equipment	50
Labour, including pond maintenance, 28 man days per annum	-

Yields

Fresh fish per 0.5 acre 6 500 pounds (2.9 tons) per annum
Dried fish per 0.5 acre 4 334 pounds (1.9 tons) per annum

4.3.3 One-Tenth Acre Pond Raising Locally Bred Fish, Harvested After Six Months

The town market for local freshwater fish is very poor. Despite its freshness there is a preference for the less bony, firmer fleshed marine fish. This scheme is, however, justified where a village is remote from a town or without good communications to market. The fish would provide food for the operator's own family and occasionally for the local market. Because such a scheme is not strictly for commercial purposes it is important to keep costs down and make use of all locally available materials. As the production is very variable so are the costs of production.

Costs of Production

	Dollars
Pond construction:	
Taking advantage of a suitable valley, a low cost situation	260 (- 20 subsidy)
Less suitable sites requiring machine operation can cost	600 (- 20 subsidy)
Lime - initial dressing 120 pounds	8.00
- annual dressing 30 pounds	2.00
Phosphate fertiliser - 15 pounds per annum	3.00
Rice bran for supplementary feed, 1 picul per annum	10.00
Miscellaneous nets and equipment	50.00
Labour, including pond maintenance, 13 man days per annum	-

Stocking

50 Lampan jawa
20 Biawan
20 Monosex tilapia
10 Lee koh
100 provided free by Fishery Department

Yields and Returns - Farm Gate Prices	Katis per six months
45 Lampan jawa at 1 kati each	45
18 Biawan at 0.5 kati each	9
18 Tilapia at 0.75 kati each	14
9 Lee koh at 2 katis each	18
	86

Most of these will be consumed by the pond operator's family, and after six months the fish will be large enough for the table. Sold on the local market they could fetch:-

	Dollars
Lee koh at $1.00 per kati	18.00
other fish at $0.75 per kati	51.25
or at $0.50 per kati	34.00

4.3.4 Half-Acre Pond Raising Giant Freshwater Prawns and Locally Bred Fish

Note The giant prawns cannot be kept in the same pond with tilapia as the latter will be eaten, but they can be kept with some local species and also with certain Chinese carp.

Costs of Production

	Dollars
0.5 acre pond 2 420 square yards (approximately 35 by 70 yards)	
Pond construction - low cost situation	1 500(- 100 subsidy)
- high cost situation	3 000(- 100 subsidy)
Lime - initial dressing 10 cwt	75
- further dressing throughout the year, 2 cwt	15
Phosphate fertiliser - 150 pounds per annum	30
Miscellaneous nets, sprays, tools	100
Labour, including pond maintenance, 28 man days per annum	-

Stocking:

100 Silver carp at \$0.70 each	70
100 Lampan jawa - free from Fishery Department	-
10 000 prawn larvae approximately 4 per square yard at \$1.00 per 100	100

Yields and Returns - Farm Gate Prices

	Dollars
90 Silver carp at 4 katis each at \$1.40 per kati	504
90 Lampan jawa at 1 kati each at \$0.75 per kati	68
5 000 prawns at (50 per cent survival) 3 tahils each → 940 katis at \$1.00 per kati	940
	1 512

4.3.5 One-Tenth Acre Pond Producing Sepat Siam and Freshwater Prawns

Object Dried Sepat Siam is considered a delicacy by all races when prepared as an appetizer. Imported from Thailand, it fetches \$2.00 a kati in the dried form in the market.

Note Sepat Siam has been introduced into Sarawak and thrives well. A member of the gouramy family, it breathes atmospheric oxygen and can tolerate high stocking rates and rather unfavourable water conditions, that is water with low levels of dissolved oxygen. Sepat Siam is mainly a surface and mid-water feeder; therefore to make fuller use of pond potential, additional stocking with the giant prawn, which is a bottom feeder, is recommended.

Costs of Production	Dollars
Pond construction - low cost situation	200 (- 20 subsidy)
- high cost situation	600 (- 20 subsidy)
Lime - initial dressing 120 pounds	8.00
Phosphate fertiliser - 15 pounds per annum	3.00
Rice bran supplementary feed, 0.5 pound per day	20.00
Salt for salting and drying fish, 1 picul	20.00
Miscellaneous equipment (this includes equipment for salting and drying fish)	100.00
Labour, including pond maintenance, 13 man days	-

Stocking:

Sepat Siam 50 pairs per 1/10 acre, free from Fishery Department

2 Udang galah (giant prawn) per square yard = 1 000 at $1.00 per 100 — $10.00

Yields and Returns - Farm Gate Prices

50 adult pairs of Sepat Siam produce 100 young each pair = 5 000.

in 6 months 2 500 reach 1.5 tahil) 7 500 tahil or
in 12 months another 2 500 reach 1.5 tahil each) 470 katis wet fish

Loss of head and drying, one third weight lost = 313 katis

Farm gate price of $1.00 per kati — $313.00

1 000 Udang galah at 50 per cent survival = 500
each weighing 3 tahils each = 93.75 katis

Farm gate price $1.00 per kati — $ 93.75

Total return from 1/10 acre pond — $406.75

4.3.6 The Production of Dried Sepat Siam and The Giant Freshwater Prawns in a Half Acre Pond

Costs of Production

	Dollars
0.5 acre pond 2 420 square yards (approximately 35 by 70 yards)	
Pond construction - low cost situation 1 500(-	100 subsidy)
- high cost situation 3 000(-	100 subsidy)
Lime - initial dressing 10 cwt	75.00
- further application as required, 2 cwt	15.00
Phosphate fertiliser - 150 pounds per annum	30.00
Miscellaneous nets, sprays, salting jars	100.00
Salt for salting and drying fish, 1 picul	20.00
Rice bran supplementary feed, 3 piculs	30.00
Labour, including pond maintenance, 28 man days	-

Stocking:

Sepat Siam 100 adult pairs, free from Fishery Department.	
2 giant prawns per square yard = 5 000 Cost at approximately $1.00 per 100	100.00

Yields and Returns - Farm Gate Prices

100 adult pairs of Sepat Siam will produce a minimum of 100 young per pair, which are harvested at 2.25 tahils each giving in a year 1 410 katis approximately fresh fish	
With loss of head and water from salting and drying - 33 per cent = 945 katis of dried fish	
At a low farm gate price of $1.00 per kati	945.00
5 000 prawns stocked at 50 per cent survival = 2 500	
Each attain a weight of 3 tahil = 468 katis	
Farm gate price of $1.00 per kati	468.00
Total gross return from 0.5 acre per annum	1 413.00

4.3.7 Half-Acre Pond Raising Chinese Carp

Object One annual crop of mixed Chinese carp to produce fish for the restaurant and special occasion trade.

Note Because these species have the potential to grow to a large size which is only attainable in a large pond area (because of the living space effect), the minimum pond size for Chinese carp raising should be half-acre.

Costs of Production	Dollars
0.5 acre pond 2 420 square yards (approximately 35 by 70 yards)	
Pond construction - low cost situation 1 500 (- 100 subsidy)	
- high cost situation 3 000 (- 100 subsidy)	
Lime - initial dressing 10 cwt at $4 per 60 pounds	75.00
- further applications, 2 cwt	15.00
Phosphate fertiliser - 150 pounds per annum at $6 per 30 pounds	30.00
Miscellaneous nets, sprays, tools	100.00
Cost of rice bran supplementary feed for first month after stocking 20 pounds would be sufficient	2.00
Labour, including pond maintenance 28 man days	-

Stocking

100 Big Head carp fingerlings,	$0.80 each	80.00
100 Silver carp fingerlings,	$0.70 each	70.00
75 Grass carp fingerlings,	$0.70 each	52.50
		202.50

Yields and Returns - Farm Gate Prices
(90 per cent survival rate)

90 Big Head carp	4 katis each at $1.80 per kati	720
90 Silver carp	4 katis each at $1.40 per kati	560
68 Grass carp	4 katis each at $1.40 per kati	420
		1 700

In addition to the above fish stocking, it is considered feasible to stock the freshwater prawns at a low stocking rate of two per square yard. This would yield:-

4 840 prawns stocked at 50 per cent survival at 3 tahils each (545 katis)
Prawns have an estimated farm gate price of $1.00 per kati — $545

4.3.8 One Acre Pond Raising Chinese Carp

Object One annual crop of mixed Chinese carp usually harvested for restaurants.

Costs of Production

One acre pond 4 840 square yards (approximately 50 by 100 yards)

	Dollars
Pond construction - low cost situation	3 000 (- 200 subsidy)
- high cost situation	6 000 (- 200 subsidy)
Lime - initial dressing 20 cwt at $4 per 60 pounds	150
- further application, 4 cwt	30
Phosphate fertiliser - 330 pounds per annum, $6 per 30 pounds	66
Miscellaneous nets, sprays, tools	125
Cost of rice bran supplementary feed for the first two months, 1 picul	10
Labour, including pond maintenance, 35 man days per annum	-

Costs of Fish Stocks

200 Big Head carp fingerlings at $0.80 each	160
200 Silver carp fingerlings at $0.70 each	140
150 Grass carp fingerlings at $0.70 each	105
	405

Yields and Returns - Farm Gate Prices (85 per cent survival rate)

170 Big Head carp at 6 katis in weight at $1.80 per kati	1 840
170 Silver carp at 5 katis in weight at $1.40 per kati	1 190
128 Grass carp at 4 katis in weight at $1.40 per kati	720
	3 750

4.3.9 One Acre Pond Raising Giant Freshwater Prawns and a Low Stocking of Chinese Carp

Object Giant prawns are in great demand and only rarely appear on the market stalls as they are bought in advance by restaurants. Young stock can be artifically raised and, with an increasing production of juveniles, widespread pond stocking can be established.

Note The giant prawns feed mostly on detritus, periphyton and vegetable matter. To use up the planktonic production silver carp are introduced, whose faeces are in turn valuable feed for the prawns.

Costs of Production

	Dollars
One acre pond (approximately 50 by 100 yards)	
High cost situation	6 000 (- 200 subsidy)
Low cost situation	3 000 (- 200 subsidy)
Lime - initial dressing 20 cwt at $4 per 60 pounds	150
- further application, 4 cwt	30
Phosphate fertiliser - 330 pounds per annum at $6 per 30 pounds	66
Miscellaneous nets, sprays, tools	125
Rice bran for supplementary feeding, 3 piculs at $10 per picul	30
Labour, including pond maintenance, 35 man days per annum	-

Costs of Stock

200 silver carp	140
50 Grass carp	35
100 200 juvenile prawns at $1.00 per 100	200

Yields and Returns - Farm Gate Prices
(85 per cent survival rate)

190 Silver carp at 5 katis in weight at $1.40 per kati	1 330
43 Grass carp at 4 katis in weight at $1.40 per kati	240
20 000 prawns at 50 per cent survival = 15 000 each weighing 3 tahils = 1 875 katis at $1.00 per kati	1 875
Total returns	3 795

4.3.10 Turtle Scheme

This scheme is designed for small-holder farmers or estate workers. The amount of time involved is small and could be undertaken by the householders' family.

Initial Requirements

The turtle under consideration is the Taiwan turtle, which is completely carvivorous. The cheapest and most suitable form of protein feed is fish. To catch enough fish from natural sources would be very time consuming and it is therefore proposed to raise fish for turtle feeding in a pond (see Section 4.3.1 on protein feedstuff from ponds). A one-tenth acre pond produces 3.5 pounds fish daily or 1 250 pounds per annum.

As the raising of turtles will be a new occupation, it is proposed that the small-holder is guided under close supervision from the fishery officer for the first year. Also, as stocks of turtles are in relatively short supply, it is suggested that the small-holder is provided with 20 two month old turtles. These the farmer will keep for one year, while learning how to look after them and how to manage his one tenth acre fish pond. To keep his 20 young turtles he will require initially one 1/400 acre pond (approximately 3 yards by 4 yards) with only one foot depth of water. The pond should have steep banks and, preferably, be drainable. As turtles are very adept at escaping it is advisable to construct ponds on heavy clay soils as they can burrow through soft mud or sandy soils. The ponds must be made escape-proof by split bamboo or wooden planking (billian) driven into the bund all around the pond but the desire to escape is reduced by good feeding and adequate space. A place where the turtles can climb out of the water must be available as sun bathing is important for their health. At the same time a simple atap shade must be placed over part of the pond to provide a cool place during very hot weather. This pond is constructed with the farmer's own labour and from materials readily available in the forests.

Turtle Farming

After one year the turtles should have grown to an average of about two pounds in weight. They should then be returned to the Fishery Department who replaces them with sexually mature breeding turtles, four females and two males. It is important that the males should be at least as large as, and preferably larger than, the females.

The initial 1/400 acre pond will now be used as the breeding pond and will require a mound of soft sand in which the female turtles can lay their eggs. This mound of sand should be shaded and kept smooth so that after turtles have laid their eggs it can be easily seen by the disturbed sand. The eggs are then removed and placed in the incubator for hatching.

moistened with water and kept in the shade, they can survive for a number of days out of the pond. As they will bite any handler and each other, they must be packed individually in re-useable baskets for transportation. At present none of these turtles has appeared on the local market so that the price they might fetch is difficult to estimate. There is a good demand for the local soft shell turtle in Kuching and Sibu where they are usually bought in advance by restaurants. It is unusual for any to be available for home consumption, and in any case most of the local turtles are too large for a family. The Taiwan turtle would have an initial novelty value and would also appeal to the housewife as a two pound turtle would be suitable for one family. The local soft shell turtle sells in Kuching for $1.50 per kati and it is expected to fetch twice this price in Singapore and Kuala Lumpur. In Hong Kong and Japan turtles are not only a source of food, but medicine is made from the blood and bile of turtles and they are apparently in great demand. They might fetch $6 per kati in these countries.

Costs of Production		Dollars
0.11 acre (5 ponds)		
Pond construction		310
Fertiliser application		42
Miscellaneous turtle equipment		23
Labour, including pond maintenance 44 man days per annum		-
Yields and Returns - Farm Gate Price		
158 turtles of 1.5 katis each at:	$3.00 per kati	711
	$4.00 per kati	948

CHAPTER 5

FISH PRESERVATION AND MARKETING

The marketing arrangements will depend on the size of the supplies. Where supplies are good, either from fishing natural populations or from fish ponds, it should be possible to organise co-operative marketing. Such co-operative societies could buy their members' fish and market it, retaining a commission for the service. Such a system would ensure that individual farmers get the best possible prices. At present catches are bought by middle men and farm gate prices are often only half the market prices.

Fish is a highly perishable product and requires preservation when the supply to the market is in excess of the immediate demand or when markets are far from the source of supply. Fish may be preserved in many ways; salted, smoked, dried, iced, frozen, canned or turned into fish powder. In Sarawak the usual methods are icing for temporary preservation and salting and drying for long term preservation. Usually the harvesting of freshwater fish can be arranged so that they are sold in the freshest possible state.

It may be necessary to chill the fish with ice if distances to market are considerable. Shaved or crushed ice is the most effective form, and at least twice the weight of ice is required for a given weight of fish. For preservation up to 24 hours no other preparation is required; but for a longer period the fish must be gutted and have their gills removed. Well packed fish can last for two to three days; for longer storage periods freezing is required.

For salting and drying, especially the Sepat Siam, the fish must have their heads and guts removed first. In the case of larger fish species they must also have scales removed and be split in half. The fish are placed in earthenware jars or wooden barrels and packed in layers and covered to keep out atmospheric moisture which will otherwise spoil the salt. Small fish require only two days in the salt, larger fish need three or more days. They are then removed and spread out in the sun to dry on split bamboo mats. If the weather is hot and dry and the fish are turned once or twice per day, the fish will soon be sufficiently dried to pack into clean gunny sacks or clean wooden boxes. Cleanliness and the exclusion of moisture will result in a high quality product almost without odour. If the fish smells it is insufficiently dried.

With the operation of fish ponds becoming more widespread, the production of fish, prawns and turtles will slowly exceed local demand; but these products can be exported and will find ready markets in Kuala Lumpur, Brunei, Singapore and Hong Kong. Marine prawns are currently frozen and exported from Miri, and the giant freshwater prawns could be treated in a similar way. In Sarawak the domestic market prefers whole fish, but in overseas markets pieces and fillets are quite acceptable. This means that pieces of large Chinese carp could be frozen and exported whereas at present very large carp are difficult to sell.

There is a domestic and export market for canned fish products; such preparations as canned carp are imported to Malaysia from China as are also large quantities of small fish in oil and tomato sauce. In time Sarawak may produce surpluses of a wide range of agricultural produce. This could form the basis of a canning industry and quantities of Chinese carp, Sepat Siam and the freshwater prawn could be supplied for canning from ponds.

CHAPTER 6

POLLUTION CONTROL AND CONSERVATION OF STOCKS

6.1 FRESHWATERS

In Sarawak, with its high rainfall and rapid runoff, almost anything liquid or soluble dumped on the land finds its way eventually into the streams and rivers. Polluting agents come in three broad categories; increase in silt load due to interference in natural vegetation for agricultural and forestry purposes; effluent from agricultural and domestic sources, mostly organic matter; chemicals and byproducts from industrial processes such as rubber and oil palm plants and forest product industries. Not all pollution is necessarily harmful; Sarawak waters are very infertile and a boost from nutrient salts can greatly increase fish production.

Increased silt load in rivers is inevitable with the clearance of forest for agricultural development, but it is usually only a temporary condition while the soil is bare. With replanting the rivers improve and return more or less to their original condition. However, severe damage to the aquatic environment may have taken place. Whole populations of fish and prawns may have been eliminated. These may become restocked from further upstream, but if the headwaters are effected then this could be impossible. Restocking of rivers while carrying heavy silt loads is almost useless and should be postponed until the river recovers.

Pollution with sewage effluents is more controversial. Human sewage, if properly treated, can be useful in improving the nutrient status of rivers and greatly increases fish yields. But there is always a danger of inadequate treatment and the spread of cholera germs. The presence of treated sewage in rivers does not preclude using the rivers for domestic drinking water, although it does lessen its aesthetic appeal. Byproducts from animal enterprises, particularly pig sty washings and chicken manure are valuable for agricultural crops and should never be allowed to go to waste in rivers.

Within the Study Area the most likely industrial wastes will be from rubber and oil palm factories and from sawmills. The products from all these plants, whether as liquid sludges or sawdust or tannins, are complex molecules which are slow to breakdown under bacterial decay. Some are directly poisonous to aquatic life, others cause death through suffocation due to removal of dissolved oxygen or by simply blanketing respiratory surfaces of aquatic organisms. Of the three categories of river pollutants this group is the most dangerous and its effects can be ameliorated only slowly once a river is contaminated. Therefore these waste products require special disposal treatments. Some, such as oil palm sludge, can be used on land to improve soil structure and plant nutrition; sawdust and wood waste can be used in other industrial processes.

6.2 BRACKISH WATER AND COASTAL ENVIRONMENT

The coastline of Sarawak is in effect a large shallow curving bay; it receives freshwater from many large rivers and in places there are extensive areas of brackish water. These areas and the river estuaries are ideal nursery grounds for juveniles of many fish and crustacea species. The brackish water areas are characterised by mangrove and, to lesser extent, nipah palm vegetation. While these areas are very extensive in parts of Sarawak, in the Study Area they are limited to the river estuaries.

The brackish water areas are threatened in several ways. A direct threat is from the destruction of mangrove trees for chipping for paper and rayon manufacture. Rotational cropping is possible, but at present it is a once only crop. Indirectly the brackish waters become polluted from several sources. Most important is the increasing silt load in rivers due to soil erosion after land clearance. The silt, upon reaching saline water, is flocculated and deposited in brackish estuarine conditions. The deposition covers up periphyton (attached algae) and smothers young stages of settled molluscs and delicate free swimming crustacea larvae. Serious pollution of the brackish water would ultimately lower the catches of prawns and fish offshore.

Ultimately the estuarine areas also receive all pollutants from industrial sources. In some estuaries down stream from sawmills the cockle fisheries have been destroyed.

As some areas are more important than others, the most important areas should have special control measures applied to them. The Fishery Department already records a large drop in the productivity of the inshore fisheries.

6.3 CONSERVATION OF FISH STOCKS

With the gradual increase in human population and consequent riverside development the natural fish population of many rivers in these lower reaches has been decimated. A traditional fishing method, using tuba root fish poison, is controlled by a licence issued by the District Office. However, the poisoning technique is so simple and difficult to detect that it is widely practised on a small scale. As a fishing method it is totally destructive, killing very young fish along with the adults and it also destroys crustacea and molluscs alike. In several estuarine areas the population of oysters has been completely killed. It is obvious that a total ban on the use of tuba root would not be effective; control can only come through education and a change in attitudes. The Inland Fishery Division is confident that this can be achieved through publicity and increasingly stringent control over the licensing of tuba fishing.

It is a characteristic of native fisheries that, as catches become smaller and more difficult to obtain, so the mesh sizes of the nets used are also reduced. This, of course, aggrevates the situation by removing junevile stocks. Fishery officers have noticed a tendency to reduce mesh sizes in Fourth Division. At present there is no legislation concerning mesh sizes, but if such controls were introduced they would be likely to succeed once the co-operation of the longhouse headman was obtained. What is required is largely a public-relations exercise making personal contact with the headman who could decisively influence the mesh size of nets made in their longhouses. But controlling mesh sizes and tuba fishing will not stop a slow decline in fish catches, which is inevitable due to increase fishing by a growing population and the slow destruction of the aquatic environment through land clearance. But some of this decline can be remedied by restocking.

6.4 RESTOCKING

The giant freshwater prawn is very vulnerable to over fishing and pollution and it has been eliminated from whole stretches of rivers, notably the Baram River. This is because the prawn has to breed in brackish water and, therefore, enters the areas with the highest degree of pollution. Once pollution is controlled the prawns respond very well to restocking, and after stocking maintain their numbers by breeding. In this way the prawn has been introduced into the Hawaian streams and rivers where it is not indigenous.

Restocking with fish in Sarawak is more difficult as the object of restocking is that thereafter fish should maintain their numbers. In Sarawak the fish best suited to the rivers are not species which are easily bred in confinement, so that stocks of fry for release cannot be build up. Wild caught fry from some rivers can be collected and released into other rivers and it is the present policy in Fishery Division to release in this way any surplus fish fry bred in their fry multiplication stations. This is locally beneficial, but frequently the species released are not suited to riverine conditions and would perhaps be better for stocking swamps, ox-bow lakes and reservoirs.

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CHAPTER 7

RECOMMENDATIONS AND CONCLUSIONS

7.1 NATURAL FRESH WATER BODIES

Open water systems, such as rivers, streams and ox-bow lakes, cannot be exploited in the same way as a fish pond. Some work can be done to "improve" natural waters by stocking, control of pollution, eradication of weeds, reduction of predators; but is obvious that the measure of control which can be exercised over the fish stocks and their environment is very much less than with restricted bodies of water. Any work on the "improvement" of natural water requires an integrated programme of research including:-

a) faunistic surveys to analyse present stocks;

b) comprehensive ecological investigation of the water, including algology, hydrology and fish biology;

c) estimation of the optimum density of stocking of fish and the rates at which they should be fished.

Once basic information is available steps can be taken to develop a programme for the best use of the waters.

In the Study Area major land development schemes are planned and massive pollution in the lower reaches of streams and rivers is inevitable. It is hoped that this pollution will only be temporary and that more stable conditions will return. In the meantime it is difficult to recommend any effective measures for the natural waters except monitoring the extent of the changes, and limiting the levels of pollution so that the aquatic environment is not irreversibly altered. When more stable conditions return then perhaps restocking can be considered. At present it is the policy to rough release any fish fry surplus to the requirements for pond stocking. This should continue; but, rather than spreading the releases over a wide area where any benefit would be dissipated, rough release should be concentrated where the danger from pollution is less immediate.

7.2 LOAGAN BUNUT

There has been an investigation by the DID to construct a sluice in the channel draining the lake to control and stabilise its level. The study has shown that no more than three feet of water can be maintained by a single sluice on the channel as any deeper water will be lost through other drainage channels. The idea of maintaining a year round water level in the lake requires serious re-examination. The reason why this lake is more productive than other lakes and swamps in the area may be due to its annual drying out. As the lake muds dry, so oxygen gets into the mud and rapid reoxygenation and decay take place. Also a considerable mass of grasses and other vegetation grows along the lake margins, and when the lake refills the submerged vegetation decays and the nutrients in the lake mud enter the water. This gives rise to a rich population of phytoplankton and zooplankton upon which the small fish feed and develop. In swamps and ox-bow lakes this drying out never takes place so that nutrients are permanently locked in the mud. A sluice to maintain the lake water levels could greatly reduce the drying out period with a subsequent fall in production and fish catches. The sluice could also upset the fishing in the channel and would certainly be a barrier to the movement of fingerlings from the river to the lake.

At present very little is known about the lake - the source of its productivity, how much fish it produces, and the movements of the fish population. All these questions and others require answering before any attempt is made to alter the current regime on the lake. A trained fishery biologist should be stationed for a full year by the lake to carry out proper observation on it and the biology of the fish populations. At the same time he should observe the fishing methods of the Berawan people, estimate the current production of fish from the lake and train the people to handle their catches in a better way.

Better handling can only be achieved by some other means of storage than keeping cages. While the total annual quantity of fish may be large the supply is extremely irregular. To ensure that the fish are preserved in the peak of condition, they require treatment as soon as possible after being caught. In this case it is preferable for the fisherman or his family to dry the fish. If the fish are carefully prepared for drying by being split open, guts, gills, and scales removed and initially salted before drying, then they will remain in good condition for three months or longer. The end product is lighter and easier to transport than fresh fish and sells for a higher price than poor quality fresh fish. Currently Sarawak imports quantities of dried fish from Thailand and Hong Kong, and so there should be no problem in selling the dried fish from Loagan Bunut. The drying of fish will never be a success unless the 'towkay' (Chinese middleman) is convinced that it will mean more money for him. At present the people do not dry any fish, but related people in adjacent areas do so. There is no suitably trained person now available in Sarawak who could undertake the proposed work programme at the lake and it would be difficult to recruit a local person to take on this assignment. Instead it would be preferable to employ an expatriate - for example a properly qualified peace corps volunteer.

7.3 AQUACULTURE

The popular idea of fish culture is a subsistence activity where every rural household has a few square yards of pond in the backyard. Small household ponds do not have the capacity to give good yields and the operators can become disillusioned with the whole idea of pond culture. A better use of resources and the extension service is achieved if fish culture is in the hands of fewer specialist operators.

In any development area an initial target of ten per cent of all settlers should be engaged in aquaculture on a part time basis. As facilities such as roads, land clearance and the extension service improve; the number of people engaged in aquaculture may be increased. Extension will largely be governed by the availability of suitable sites and the enthusiasm of the extension service.

Aquaculture is a versatile technique and only a few of the more suitable systems have been outlined in Section 4. These systems are reviewed below according to their suitability for different types of operators.

7.3.1 For Settlers

Always the constraints on the kind of development that can take place are land and water. However it is usually possible in any 10 acre block of agricultural land to find at least one suitable site for a tenth of an acre pond.

With a tenth of an acre site there are several choices available; the labour requirement is low and small schemes are a spare time occupation. For the settlers' own food supply locally bred fish can be stocked, and if the giant prawn is also stocked they can be readily sold. If food for home consumption is not important then the production of Sepat Siam for salting and drying, together with the giant prawn, is very profitable. If the farmer is interested in livestock production, small fish can be raised to feed to turtles or to pigs and chickens.

7.3.2 For Small-Holders - Independent Farmers

Small-holders would probably prefer to get the highest profit from their ponds and to purchase their food requirements. In this case they will not be very interested in locally bred fish species, which in general give lower returns. They will want larger ponds than one-tenth of an acre. However should only a small area be suitable then he can produce dried Sepat Siam and prawns for sale or raise small fish to feed to turtles. If his land allows the construction of larger ponds (half an acre or more), he can practise a wide range of fish culture techniques, but the most profitable would be keeping Chinese carp and giant freshwater prawns.

7.3.3 For Estates

Where an estate has relatively large pieces of land unsuitable for the main crop but suitable for pond construction, it could produce fish either for sale to the workers or for town markets. For feeding estate workers the demand is for small whole fish, so that locally bred fish species should be stocked, whereas, for town markets, whole or pieces of large Chinese carp are in demand. It is a general principle that the larger the pond the more successful the fish culture up to a maximum of a three acre pond.

7.3.4 For Commercial Fish Farmers

Full time fish farmers can only operate in places where the land and water supplies are ideal, and it is likely that in our Study Area there will be very few such farmers for many years. They are only interested in the most profitable schemes, and these would be raising of Chinese carp and giant prawns as the main crop. Subsidiary crops of turtles might be raised using the miscellaneous small fish which are inevitably produced at the same time.

7.4 TRAINING AND EXTENSION SERVICES

The proper development of fishery management and efficient aquaculture practices is impossible without the full support of Government Departments. In Sarawak an extension service has been created, whose task is to maintain constant touch with the fish farmers and advise them on the techniques of management. It has also been necessary for the Government to give direct financial assistance to potential fish farmers in developing their land for fish culture. The Government has also established hatcheries and a system for the distribution of fish stocks.

At present there are two fish hatcheries in the Study Area, but their full potential is hampered by poor water supplies. A fish culture training centre is under construction as a part of a new Farmers Training Centre on the Sungei Sebiu, ten miles east of Bintulu. The Inland Fishery Division wants to start a new fish hatchery in the Study Area and are seeking a suitable 50 acre site.

Currently specially trained assistant agricultural officers attached to the Inland Fishery Division undertake the extension work. In 1974 a fully trained Fishery Officer will be appointed and based in Miri with responsibility for the administration of all existing and new developments in Fourth and Fifth Divisions. He will also administer the subsidy scheme to new farmers; this provides:-

i) a cash subsidy of $200 per acre for excavated ponds and $100 per acre paid for valley type ponds;

ii) materials including drainage pipes, cement, wire netting for screens, lime to the extent of $100 per acre;

iii) fish fry; Chinese carp at a rate of 200 fry per acre are provided free. Locally bred fish fry are issued free at the recommended stocking rates.

This subsidy scheme has worked exceedingly well, but perhaps the form of assistance could be revised with advantage to bear closer relation to the capital costs and potential productivity, particularly of larger schemes. Getting started in fish culture, and particularly the cost of pond construction, discourages many would be pond operators; but, once established, the daily running of a fish pond is very inexpensive. Firstly no ponds smaller than one-tenth of an acre should receive any subsidies; the farmer should be encouraged to make a larger pond. From one-tenth to one half of an acre, which is a useful size for subsistence operation, the existing subsidy scheme works well, providing the materials to keep in operation. However, with ponds larger than half an acre, which are potentially very profitable but initially very costly to construct, a loan could be made to cover three-quarters of the total costs, to be rapid in five years with a low rate of interest. It could be at the farmer's own discretion to repay his loan sooner. Most farmers with large ponds raising Chinese carp have paid off the costs of their initial investment after only two harvests.

It is very useful if the extension officers adopt one fish pond in each development area as a demonstration pond. This pond would not take the place of an initial short training period given to potential pond operators, but it will act as a practical reference point close to other farmers ponds. In this way at least one pond in a given development unit will be properly looked after and given all the necessary inputs. Other operators in the area will be able to compare their own results with this pond.

As it is expected that the majority of fish culture enterprises will be spare time occupation, it is vital that the extension officer makes his visits at weekends or outside normal working hours. Otherwise any extension effort is totally wasted, the officer will require financial encouragement and leave in lieu for the time he works outside office hours.

7.5 CONCLUSIONS

In the Study Area there are a number of important constraints on the immediate development of large scale aquaculture activities. These are a lack of management experience and a relatively small domestic market. Nevertheless the prospects for part time aquaculture enterprises are good. Aquaculture can provide food and an income supplement during the often lengthy period before a settler's main crop comes into yielding. Eventually, with improved communications and flood control measures, settlers showing particular aptitude for aquaculture can be encouraged to expand their operations onto larger pieces of land. In this way high rates of economic returns are possible from land which may be unsuitable for other forms of agricultural activity.

THE DEVELOPMENT OF LIVESTOCK

SUMMARY AND RECOMMENDATIONS

1. A short review is provided of factors in the physical environment that affect the development of the livestock industry in the Study Area.
2. The existing structure and operations of the livestock industry within the Study Area are reviewed in some detail. It is evident that at present non-ruminant livestock constitute the more important sector of the industry.
3. Requirements for a possible devèlopment strategy for the livestock industry are reviewed on the assumptions that it must be based on likely future demand for animal products and on the economic availability of resources that can be used for development purposes.
4. In order to expand the buffalo industry it is recommended that the Government should:-
   - subsidise the distribution of breeding buffaloes
   - create a marketing organisation empowered to purchase, sell and exchange livestock.
   - train field extension workers in buffalo husbandry.
5. It is apparent that if an economic cattle industry is to be developed it will have to be deliberately created and detailed project proposals planned to achieve this purpose are outlined and discussed in Chapter 11.
6. As the climatic environment is not particularly favourable for the husbandry of goats and sheep it is recommended that apart from additional extension assistance, particularly with regard to the control of internal parasites and improvements in existing management, no major action should be taken to develop these industries.
7. It is suggested that the commercial pig industry is perfectly capable of developing at a rate that will satisfy all increased demands for pork, without Government financial assistance. The industry does, however, need some restructuring in order to increase the efficiency of its operations and it is therefore recommended that:-
   - Efforts be made by the Government to encourage the evolution of specialised, privately owned breeding units, producing both purebred and crossbred boars and gilts and to end the wasteful use of boars by the smaller pig farmers. In order to accomplish the latter purpose the Pig Breeders Association should be encouraged to organise an artificial insemination service around Miri for which the Government would provide specialist assistance and high performance boars.
   - Any investigational programme planned for the pig industry should concentrate on nutritional research and particularly on methods of incorporating cheap carbohydrate feeds such as sago and tapioca flours into pig rations and on the provision of a cheap, high protein concentrate feed that could be used by the small scale rural pig industry.

- Extension service should concentrate on demonstrating to rural pig farmers simple managerial improvements that will help reduce piglet mortality and the high incidence of internal parasitism, simple methods of selecting breeding stock and the use of high protein rations to supplement local feeds and ensure more adequate live-weight growth.

8. Like the pig industry, the commercial poultry industry appears to be capable of developing at a rate compatible with likely increased demand without Government financial assistance but it does need to improve the efficiency of its operations. It is therefore recommended that:-

   - The Government extension service should sponsor the formation of a Commercial Poultry Industry Association and that in co-operation with this association it should formulate plans for the restructuring of the industry.

   - A chick-sexer be trained overseas for employment by this Association.

   - Any investigational programme planned for the poultry industry should concentrate on nutritional research and in particular on the production of least-cost rations.

   - Any attempt by the extension service to improve rural poultry production should be conducted on a village and not on an individual owner basis.

   - A special effort should be made to popularise duck keeping, particularly in areas where swamp padi production is being promoted.

9. As the forests could provide an additional source of meat, from wild game, it is recommended that the Government should not only consider legislation that would immediately restrict the hunting of endangered species, but also take positive measures to restock suitable forests. Two species, the feral water buffalo and feral Bali cattle, should be considered as suitable for any restocking investigations.

10. Recommendations on the development of forage supplies are given in Chapter 13.

11. Possible sources of by-product livestock feeds within the Study Area are the coconut, oil palm, cocoa, padi, tapioca, sago and pulse crops, dried forage, the rubber plantations, the wild illipe nut crop, the fishing industry and abattoirs. Some details are provided as to the type and amounts of by-product feed that may become available from these sources. It is suggested that potential by-product feeds are so important for the future economic development of the livestock industry that it is recommended that the Department of Agriculture should establish a special committee to investigate the possible use of these feeds and to recommend how investigations into their feeding value should be organised and financed.

12. It is recommended that legislative and administrative control of the feeding stuff industry by the Government should be strengthened in order to ensure the maintenance of adequate nutritional standards in the commercial pig and poultry industries.

13. The projections of demand for livestock feeds suggest that consideration should be given to the establishment of a livestock feed mill at Miri. It is recommended that an economic feasibility study of the possibility for siting a new livestock feed plant at Miri should also include the economic feasibility of a major feed complex that could include a palm kernel extraction plant, possibly an illipe nut cracking plant, a rubber seed oil extraction plant and a cocoa pod and forage drying plant that would not only produce by-product feeds for inclusion in local feed mixes but also products for export such as palm kernel oil, illipe nut oil and high quality dried forage.

14. It is recommended that a new marketing system for beef animals and their products should form an integral part of any development plan for the beef industry. The merits and demerits of the various possibilities are discussed in Chapter 11. It is recommended, however, that private enterprise should be allowed to retain its present interest in the marketing of pigs and poultry and their products and that the municipalities should continue to provide slaughter facilities for pigs. Additional legislation may, however, be required to protect the legitimate interests of farmers and consumers and these aspects should be further investigated.

15. On account of limited investigational resources and the dearth of information generally available it is recommended that the Department of Agriculture should restrict investigational work to two major topics; economic feasibility trials concerned with the problems of beef animals and forage husbandry and the development of low cost feeds for pigs and poultry.

16. It is recommended that it will be in the best interests of livestock development in Sarawak, and particularly for the future integration of livestock and crop husbandry, that veterinarians and their subordinate staff should continue to serve as an integral part of the Department of Agriculture establishment, and that all aspects of forage production should be administered by the Livestock Division of the Department of Agriculture.

17. As a very considerable emphasis will have to be placed on farmer training in livestock and forage husbandry, it is recommended that this training should be centred on the proposed Livestock Production and Animal Husbandry Training Centre that the Government plans to establish in the Sungai Karabungan area. Training in pig and poultry production should, however, be centred in Kabuloh.

THE PHYSICAL ENVIRONMENT

Details of the physical environment are given in Supporting Report I and it will only be discussed in this Report in so far as it specifically affects the livestock industry.

8.1 TOPOGRAPHY AND SOILS

The terrain and soil constraints to agricultural development are considerable as there is a paucity of flat or gently sloping land, in the range of 0 to 20 degrees, possessing deep soils. Under these circumstances, every endeavour should be made to locate pastures on the shallower soils as it is probable that many of these are only really suitable for the development of pastures or forestry. One advantage of advocating the development of pastures on areas of shallower soils is that completely clean clearing of the forest is often unnecessary for pasture production, indeed it will be argued in a later Section that it is frequently neither ecologically or economically desirable.

Although peat swamp areas have been excluded from selection for agricultural development the possibility that some of these swamps may ultimately be found suitable for pasture production should not be overlooked. Somewhat similar areas are being used for pasture in other regions of the humid tropics and subtropics.

8.2 CLIMATE

The Study Area possesses a hot, wet climate with constantly high relative humidities and temperatures and no distinct dry season. This climatic environment favours the year-round growth of forage, is physiologically disadvantageous to free-grazing ruminant livestock, encourages internal parasitism in all classes of livestock, promote rapid reproduction of very many insect pests, can be economically advantageous for the management of pigs and poultry and increases the cost of transporting and storing animal products.

Although forage can be grown in abundance all the year round, the physiological disadvantages suffered by free-grazing ruminant livestock create major problems in the efficient utilisation of this forage. A hot, humid climate is more unfavourable in these respects for some types of domestic ruminants than it is for others. Generally it is more suitable for water buffaloes and beef cattle than for goats, and wooled sheep. It is also unfavourable for dairy cattle, but it may be economic under certain circumstances to ameliorate the climatic conditions for this class of livestock by the provision of suitable housing and careful selection of breed. Additional and sometimes expensive protection must be provided for all types of domestic livestock against internal parasites and insect-borne diseases.

Only minimal housing and limited heating is required for the rearing of young pigs and chicks in a humid tropical environment, compared with requirements in the temperate zone. In addition, mean temperatures around 80°F provide optimal conditions for the growth and efficient utilisation of feed by pigs growing to approximately 120 pounds liveweight.

In any assessment of the effect of the climatic environment it must not be forgotten that immediately outside the Study Area there are higher altitude lands suitable for the development of pasture, and at present inhabited by Kelabits and Muruts who possess some knowledge of livestock husbandry. As mean annual temperatures decline approximately 3°F for every 1 000 feet rise in altitude, these montane areas are markedly cooler than the coastal regions and could eventually become centres for the breeding of highly productive cattle, that could be used, employing artificial insemination techniques, for crossbreeding purposes in the lower altitude regions. These possibilities will be discussed in a later section.

CHAPTER 9

THE EXISTING SITUATION

Estimates of total livestock numbers in Sarawak during the decade 1962-71 are given in Table 9.1. It is apparent that there are relatively few ruminant livestock and that non-ruminants constitute the more important sector of the livestock industry. Total numbers of ruminants have tended to slowly decrease during the decade. There are at present approximately equal numbers of buffaloes, cattle and goats but few, if any sheep. Pig numbers have fluctuated from year to year, as might be expected. There are little accurate data on poultry numbers, but it is assumed that the national poultry flock has increased during the decade. Any concentrations of ruminant livestock are to be found in the rural areas while the pig and poultry industries tend to be centred around the coastal urban communities.

The estimated livestock populations within the Study Area in 1970 are shown in Table 9.2. There is some importation of buffaloes and cattle and perhaps of goats, mainly for slaughter. These animals are imported either from Indonesia, often illegally, or from Sabah, Brunei and other Divisions of Sarawak. In particular, buffaloes are imported from the Fifth Division, where more than three-quarters of all buffaloes raised in Sarawak are to be found. It is likely that the number of buffaloes and cattle slaughtered in the Study Area are under-estimated in the official statistics. If the estimate in Table 9.3 for the number of buffaloes and/or cattle required to maintain the 1970 per capita beef consumption is compared with the number of recorded slaughterings (Table 9.2), then it would appear that some 12 per cent of slaughterings of cattle and buffaloes remain unrecorded. Goat slaughter is not usually recorded.

There are two different types of pig and poultry industry; commercial units and the rural industry. Until recently there has been some export of commercially produced pigs, especially to Brunei, but this trade has now virtually ended. There is still some export of day-old chicks to Brunei but this trade is declining and will probably end this year (1973).

Estimates have been made of projected total requirements of the population in the Study Area for beef, pork and poultry meat in 1990, using the population projections made in Supporting Report 5. The results are shown in Table 9.3. These suggest that if meat supplies are to be derived from local resources even this lower level of estimated population will require the slaughter of approximately three times as many buffaloes and/or cattle, four times as many pigs and five times as many fowls than are slaughtered at present. Meat could also be exported to other parts of Sarawak or to adjacent countries, so that even larger livestock populations could develop.

TABLE 9.1 ESTIMATED LIVESTOCK POPULATION OF SARAWAK, 1962-71

Year	Buffaloes	Cattle	Sheep	Goats	Pigs	Poultry
1962	12 310	10 151	No data	11 371	287 518	-
1963	6 743	10 605		10 465	302 982	-
1964	8 463	9 766		10 219	278 712	-
1965	7 861	7 082		8 224	218 277	-
1966	7 503	6 648		6 864	227 931	-
1967	7 768	8 296		7 454	225 219	-
1968	8 630	7 978		8 136	206 705	-
1969	7 460	8 730		7 480	196 380	-
1970	8 441	8 939		7 566	211 790	2 250 000
1971	7 642	5 023		7 721	55 838+	-

Notes: * This is an estimate and only includes fowls.
+ These data are obviously inaccurate.

TABLE 9.2 ESTIMATED LIVESTOCK POPULATION, IMPORTS, EXPORTS AND SLAUGHTERINGS WITHIN THE STUDY AREA DURING 1970

	Total number	Imports	Exports	Slaughtered
Buffaloes	900	80	Nil	288(1)
Cattle	1 000	140	Nil	53(1)
Sheep				
Goats	720	Nil	Nil	No data
Pigs(2)				
- commercial	10 000		1 500	10 000(1)
- rural	12 000		Nil	3 400
Poultry	140 000		175 000(4)	115 000(5)

Notes: (1) Recorded slaughtering, there are also undoubtedly unrecorded slaughterings.
(2) Estimated.
(3) Fowls only.
(4) Day-old chicks only.
(5) Includes culled layers, broilers and village fowls.

Sources: Department of Agriculture, 1971.

TABLE 9.3 ESTIMATED BEEF, PORK AND POULTRY MEAT CONSUMPTION PER ANNUM AND THE TOTAL NUMBERS OF LIVESTOCK REQUIRED TO PROVIDE THIS MEAT IN 1970 AND 1990, ASSUMING TWO LEVELS OF POPULATION GROWTH WITHIN THE STUDY AREA

	TOTAL POPULATION	
	1970	1990
Meat consumption (thousand pounds)	115 000	275 000
- Beef	156.4	472.2
- Pork	1 910	8 690
- Poultry	457	2 622
Animal requirements		
- Cattle/Buffaloes (1)	390	1 230
- Pigs	13 400	62 000
- Poultry	115 000	664 000

Notes: 1) Assumption that the carcass weighs 400 pounds.

Sources: Department of Agriculture Annual Reports 1970.

9.1 BUFFALOES

Within the Study Area there are no major concentrations of buffaloes. It is generally believed that the ancestors of the present buffalo population were introduced from the Fifth Division of Sarawak, Sabah, Bruneì and Kalimantan in relatively recent times. They may have been introduced by Murut settlers. There is at present a trade in buffaloes between Lawas and Miri and some of the buffaloes imported from Lawas undoubtedly originate in Kalimantan, being imported across the border at Bario or Bakalalan and then trekked to Lawas via Long Semado. Apart from the buffaloes imported from Lawas for slaughter or for sale to local farmers, buffalo beef is imported into Miri by air from Bario.

The animals are generally Southeast Asian swamp buffaloes of medium to small size, similar to the type found elsewhere in the island of Borneo. There is some evidence, however, of very limited crossbreeding with Murrah buffaloes, particularly along the Baram river, and it has been stated, though not confirmed, that Murrah or Murrah crossbreds were introduced into this area in the nineteen fifties. Contrary to the situation in the majority of Southeast Asian countries there do not appear to be any albino buffaloes.

Management is minimal and very elementary within the Study Area but good management occurs in the Fifth Division and in Bario. The Consultant believes that the managerial systems in these areas should be studied as a basis for any future development of the buffalo industry within the Study Area.

In the Trusan river area of the Fifth Division buffaloes are grazed on the swamp rice stubbles after harvest, or otherwise within crudely fenced enclosures the year round and in Long Semado they are grazed on the swamp rice stubbles after harvest and within enclosures on the hills for the remainder of the year.

Only in Bario are some grazings properly managed and weeded. In Long Semado there is evidence that buffaloes are spreading desirable grasses such as Axonopus spp. over the hill lands suggesting that the buffalo might be used as a pioneer animal in the establishment of rough grazings. Around Miri buffaloes are occasionally tethered and in Long Semado it is a normal practice to tether the bulls used for breeding close to the village.

There is no castration of bulls; indeed buffalo owners are understood to lack knowledge of, and instruction in, castration.

Herd size varies from a minimal of one to a maximum of 60 animals, but it is likely that the overall size of herds has diminished. The evidence of one owner in the Trusan river district showed that although his father has owned more than 100 buffaloes he only owned 30 and that all his neighbours owned smaller herds than their fathers had owned in the past. Even under these better conditions productivity is low, with the average breeding cow producing one calf every two years; bulls and cows at five or six years of age kill out at approximately 500 and 300 pounds respectively.

The buffaloes are used for a variety of purposes, depending on the cultural values of their owners. Within the Study Area, in Bario, Long Semado and in the Lawas District they are ultimately slaughtered for meat purposes, but they are also occasionally used for work purposes in logging operations. Murut and Kelabit people not only utilise fresh but also dried and fermented meat. The dried meat, known as narar in the Murut language, is eaten either salted or unsalted. In order to produce the fermented product, known as talu or sinamu in the Murut language, fresh meat is mixed with salt and cooked rice and sealed in tins, jars or bamboos. This product will keep for at least one month. In the Trusan river area buffaloes are used for a primitive form of field cultivation. As many as 30 buffaloes are used at any one time on as much as five acres of flooded padi field. They are led round and round the field in order to trample the weeds into the mud. This elementary cultivation practice is carried out twice; once immediately before rice transplanting and one month previous to transplanting. Buffaloes are also important amongst the Murut and Kelabit people as they constitute a form of easily cashable investment; they are used as gifts in marriage ceremonies according to extremely complicated customs; they provide a form of inheritance that is easily divided; and they are killed and eaten at various ceremonies.

It is remarkable that buffalo production in the past, and to a considerable degree even today, should be almost entirely confined to the Murut and Kelabit peoples and that it should not have spread to any extent to their closest neighbours, the Ibans.

9.2 CATTLE

Within the Study Area there are some minor concentrations of cattle along the banks of the river Baram, near Bintulu, on the coast at Tengurong and around Sibuti. Outside the Study Area there is a small concentration of cattle around Bario, the main market for these being Miri.

The few cattle in the Study Area are of diverse origin. The majority are the 'Kelantan' type, though this does not imply that their ancestors originated in northern Malaysia. Cattle of this type are found throughout the island of Borneo. They appear to be descendants of an ancient crossbred between <u>Bos indicus</u> and <u>Bos taurus</u> cattle types. They are small, hardy, light-boned and long-legged. Their coat colour is varied though the majority possess a light fawn or reddish coat while the switch is always black. The hair is short and the skin pigmented. Horns are usually small and curve upwards. Males possess cervico-thoracic hump which is never large; the hump is almost always absent in females. Both sexes possess an appreciable dewlap. In addition, there are cattle that apparently possess some Bali genes, as they exhibit the typical black line along the back and other minor features of the Bali breed, and there are others that apparently possess Guernsey and Red Sindhi blood. It is known that there were Bali cattle in Sarawak in the past (Dunsmore and Ong, 1969; Wong, 1973) and there are Bali cattle in Kalimantan at present. Some of these or their crossbreeds may be imported from time to time via Bario or Bakalalan. Guernsey cattle were introduced into Brunei in the past and some Guernsey crossbreds have undoubtedly been imported into Sarawak. The Department of Agriculture has been crossbreeding Red Sindhi and Kelantan cattle at Tarat and distributing breeding stock throughout the country under the PAWAH Scheme (see Supporting Report 2 Part III).

Management of cattle is varied but generally elementary. In Bario cattle are grazed in enclosures.In a few areas, particularly along the Baram river and at Bintulu they are herded during the day and kept in enclosures at night. At Tengurong the cattle move freely night and morning between the longhouse and the coconut plantation grazings. In Department of Agriculture's PAWAH Schemes the cattle usually graze within a fenced enclosure. Where cattle are enclosed at night it appears usual to burn their dried manure on slow fires to combat biting flies and mosquitoes. Occasionally cattle receive small quantities of salt. This is placed in a short length of bamboo, that has had the outer peel removed and holes punched in it. The bamboo is dampened and hung in a convenient place for the cows to lick. Castration is not practised.

Cattle are kept for status reasons, as a form of investment and for meat production. They are rarely milked or worked. They appear to be gaining in popularity over buffaloes, probably because they are more fertile, producing on average one calf a year. Apart from the calving rate, productivity is low. Mature cow carcasses weigh approximately 300 pounds, whilst mature bull carcasses are a little heavier. Cattle hides are usually wasted.

The Department of Agriculture has attempted to encourage cattle production by providing a subsidy of $80 per bull for the purchase of crossbred Red Singhi x Kelantan bulls, and by operating a cattle development subsidy scheme known as PAWAH. Under this scheme the Department provides 10 breeding females and one bull for a group of 10 farmers, together with a grant of $250 for the purchase of feeds and fencing materials and for the building of a cowshed. This subsidy is conditional on the farmers possessing 30 acres of suitable land and planting a specified acreage of fodder crops and improved pasture. When the first male calf produced is sold, half the proceeds go to the farmer and half to the Department of Agriculture, whilst the farmers must return to the Department of Agriculture the first female calf born, when it is a pregnant heifer.

9.3 GOATS

Almost all the goats in Sarawak are found in the Malay villages, with very small numbers scattered around longhouses and Chinese owned farms. This is certainly the case within the Study Area, though there are limited numbers reared at longhouses along the Baram river and elsewhere. The largest flock seen was at the Iban coastal village of Tengurong.

In the Malay villages individuals rarely keep more than one or two goats at any one time, but it is likely that total numbers are underestimated in official statistics because the majority of goats are slaughtered in the villages and records are not maintained. Goat meat is favoured in the Malay diet and goats are also killed for ceremonial purposes. Goat skins are often wasted but some are used for drum manufacture.

The Sarawak goat is similar in type to the Kambing Katjang breed of Western Malaysia and Indonesia. It is not given any specific breed name in Sarawak, simply being called 'Kambing'. It is a small goat with a relatively large head and short limbs. The coat colour is white, brown or black or a combination of these colours. Both sexes are normally bearded and horned. Males possess a larger beard than females.

Management of goats in the Malay villages is minimal. The goats simply exist, scavenging beneath the houses on the mud flats at low tide and/or browsing on weeds. Where goats have been introduced into Iban villages, slatted floor housing is sometimes provided and occasionally they are fed forage in these houses. Otherwise they scavenge and forage around the longhouse compound.

Productivity of goats is obviously low. Although fertility is high and at least 80 per cent of births are multiple, goat numbers do not increase very rapidly due to a high kid mortality. This high mortality is probably mainly due to a high incidence of internal parasitism but, as stated previously, the climatic environment is not particularly favourable for goat raising and it is likely that many young kids die from pneumonia. Females are precocious and first kid at six to eight months of age even before they are well grown. Growth is slow, mature goats measuring 16 to 18 inches in height at the shoulder and weighing 33 to 40 pounds at one and one half to two years of age.

9.4 PIGS

As will be seen from Tables 9.1 and 9.2, pigs are the most important class of livestock both in the country and within the Study Area. The pig industry may be divided into three sectors. A traditional industry still predominates in the longhouses, utilising indigenous pigs and locally produced feeds. A commercial pig industry, mainly Chinese operated and owned, is located close to the coastal towns and utilises exotic pigs and commercially produced feeds, while a developing industry in some longhouses and in the more remote Chinese settlements, utilises crossbred pigs and both local and commercially produced feeds.

The indigenous or longhouse domestic pig is said to be a direct descendant of the wild pig Sub vittatus (Rumich B,1967), still extant in the Sarawak forests. If this so, then it has a very different ancestry to the exotic pigs. This indigenous pig has quite a distinctive appearance, being rather small, with a long head, thin body and moderately long legs. The head is very narrow between the eyes and the ears. The neck is short and the ears small and erect. The back is slightly concave and there are coarse bristles along the backline that are erected when the pig is frightened and/or angry. The belly is convex but does not drag on the ground as it does in some Chinese-type pigs. Females possess 10 or more teats. The tail is high set, is comparatively long and ends in a tassel of white hair. The normal coat colour appears to be black or black and white. Rumich (1967) stated that the normal colour is grey and that the present coat colours are due to crossbreeding with exotic pigs. However the only grey coloured pigs seen at the longhouses were captive wild pigs or crossbreds between wild pigs and the indigenous domestic pig. Furthermore, the number of black and white pigs seen varied in inverse ratio to the accessibility of the district, and the black and white pigs demonstrate no specific conformational characteristics of exotic pigs. Where exotic pigs have been introduced the crossbreds exhibit an extraordinary diversity of conformational characteristics, the coat colour for instance ranging from black through chocolate to white.

At present the majority of commercially managed pigs in the Study Area are crossbreds of the Berkshire or Large White type. There are some indications of crossbreeding with Tamworth and Landrace, although neither breed is now favoured as the Tamworth is not as productive as the other exotic breeds and Landrace tend to suffer from a weakness in the hind legs. There have obviously been many importations of different exotic breeds into the country during past years; the two most recent importations being Berkshire, Tamworth and Large White from Australia in 1962-63 and Large White and Landrace from Australia in 1969. Within the Study Area pure and crossbred exotic pigs are distributed by the Department of Agriculture from the Kabuloh Agricultural Station; purebred Large White were introduced into this station in 1970. At present on the commercial farms the Large White is mainly used for crossbreeding and upgrading. In some longhouses Berkshire, Tamworth and Large White crossbreds have been used in the past for upgrading the indigenous domestic pig, but at present the emphasis is on using Large White crossbreds for upgrading purposes.

Pigs are comparatively numerous in the longhouses. On average each family appears to own four to five pigs. For example, in one longhouse containing 40 families, 250 pigs were counted and there were so many that there was a surplus over village consumption and some could be sold away from the longhouse.

The longhouse pigs are managed in a variety of ways. The most primitive is a system where all the pigs roam loose, scavenging under and around the longhouse on kitchen refuse and human faeces and in the adjacent gardens. One consequence of this system is that at longhouses where no sanitary conveniences are provided, the surroundings are exceptionally clean and free from flies. Usually, but not always, the pigs are also fed some other food once or twice a day. In a variant of this system the majority of the pigs roam loose, being fed once or twice daily, but a few are penned under lavatories erected above ground level. A system favoured and promoted by the Medical Department and Department of Agriculture is one in which the pigs are penned at all times and fed once or twice a day within the pens. Obviously this system reduces opportunities for the spread of tapeworms within the human population and is a first step towards generally improved management. Usually the pens are built with bush timber. They are often elevated and possess a slatted floor and a thatched roof. Faeces and urine fall through the floor and are often directed into fish ponds or towards fruit trees. In one Iban longhouse all the pig pens were built on piles in the middle of fish ponds. There are many variants of these basic systems and the people demonstrate considerable ingenuity in the management of their pigs.

Women usually accept responsibility for managing and feeding pigs. If the pigs are allowed to roam and scavenge, this means that while the owner feeds her own pigs someone else has to keep all other pigs at bay. Thus two women are required to feed the family pigs. They normally feed them from shallow, wooden troughs either within or outside a pen. Standards of feeding hygiene are usually quite good, the troughs being thoroughly washed before feeding commences. Suckling piglets are also often fed separately with more nutritious feed than the older pigs. The feeds used vary according to the district and seasonal availability. They include rice bran, broken rice, tapioca (Manihot utilissima), yams (Discorea spp.) (Colocasia spp.), sago (Metroxylon spp.), banana stems, green leaves, (particularly tapioca and tannia (Xanthosoma spp.)) and kitchen refuse. In remoter areas, if there is a surplus of rice, whole rice grain is sometimes fed. Rice, roots and leaves are often cooked together and the resulting wet mash poured over rice bran in the troughs. In the easily accessible areas and where crossbred pigs are reared a small quantity of commercial pig feed is used. Usually this does not amount to more than 10 per cent of the total feed intake.

There is no control of breeding in scavenging pigs but the pigs are marked by cutting their ears, so that they can be identified by their owner. Breeding can be controlled where pigs are penned but apart from the use of exotic crossbred breeding stock for upgrading purposes there does not appear to be any selection of breeders.

The major part of the commercial industry within the Study Area is located in and around Miri. The structure of this industry in 1972 is shown in Table 9.4. It will be seen that 86 per cent of the pig farmers owned five or less sows, that the majority of sows were owned by farmers managing between three and five but that more than 20 per cent of the sows were managed on quite large holdings. The Table also shows that on the smaller holdings an excessive number of boars were held.

TABLE 9.4 STRUCTURE OF THE PIG INDUSTRY IN AND AROUND MIRI IN 1972

	Number sows per holding					
	Less than 2	3-5	6-10	More than 11	Total	Mean number per holding
Number holdings	73	70	16	8	167	
Number holdings as a per cent of total	44	42	10	4	100	
Number sows	115	252	115	127	609	3.6
Average number sows per holdings	1.6	3.6	7.2	15.9		
Number sows as a per cent of total sows	19	41	19	21	100	
Number holdings with boars	33	70	16	8	127	
Number boars	33	76	25	23	157	1.2
Average number boars per holding	1.0	1.1	1.6	2.9		
Number boars as percentage total boars	21	48	16	15		

Source: Department of Agriculture, 1972.

Almost all the pigs were crossbred, with Large White type crosses predominating. There are no specialist breeders, farmers purchasing their breeding boars from the Department of Agriculture or exchanging crossbred boars.

Housing is usually simple but utilitarian, incorporating easily washed concrete floors, wooden, metal or concrete pen divisions, wooden uprights and various types of roof, including thatch. The provision of feeding and dunging passage is normal and some housing includes farrowing pens and other refinements. The pigs are usually cleaned out daily and the manure is either used in fruit and/or vegetable gardens or is dried on specially constructed drying floors and sold. At present the price of dried manure is $5 per sack of 87 pounds (65 katis) and it is a valuable by-product of the industry. Effluent from washing is often run into fish ponds or into fruit orchards.

Piglets, growers and breeding stock are fed different types of ration and restricted feeding is generally practised. The majority of farmers only feed purchased commercial feeds and those that have attempted to feed sago and root crops stated that in their experience the practice is uneconomic and that pigs fed on sago produced a leaner carcass with a softer fat. Another difficulty cited is that second grade sago flour has a moisture content of approximately 10 per cent and is consequently difficult to store on the farm. If sago or root crops are fed they are normally used in the ratio of one part to four parts of commercial feed. The Department of Agriculture has reported the results of two feeding trials (Department of Agriculture, 1970, 1971). More than these experiments are needed for valid conclusions to be drawn on the relative merits of local and imported proprietary feeds and on the usefulness of sago in the rations.

Some aspects of the productivity of both the commercial and the longhouse pig industries are shown in Table 9.5. There may be little difference in the average number of pigs born per sow but the commercial operators wean approximately twice as many piglets. Mortality of piglets from birth to weaning in the longhouse industry is very high. Commercial operators wean as early as possible in order to ensure that their sows will produce two litters each year while in the longhouse industry there is no control of the breeding cycle. The growth of the pigs after weaning is very much better in the commercial industry and longhouse pigs seldom attain as high a mature weight as the commercial pigs. Poor growth of the longhouse pigs is mainly due to poor feeding, and in particular to a shortage of high quality protein in the feeds, and to a high incidence of internal parasitism. As a consequence there is considerable variation in the size of mature longhouse pigs, with the estimated weight of mature sows with litters varying between 50 and 120 pounds. Disease is generally quite well controlled in the commercial herds and internal parasitism appears a minor problem.

At present the Department of Agriculture assists the commercial industry by providing extension advice and by the distribution of purebred and crossbred exotic breeders to pig farmers from the Kabuloh Agricultural Station. The price for breeding pigs is subsidised, being $1.13 per pound liveweight. There has also been a rural pig subsidy scheme. Farmers assisted by this scheme receive up to three crossbred weaners, $50 for the construction of a pig pen and $150 for the purchase of commercial feeds. In the Fourth Division, in 1972, 44 farmers received this subsidy and a total of 132 weaners were distributed. Overall the scheme is not considered very successful because it is seldom that a farmer actually uses the stock for building up a larger herd. Usually the weaners are merely fattened then sold or slaughtered.

TABLE 9.5 ESTIMATE OF SOME ASPECTS OF THE PRODUCTIVITY OF COMMERCIAL AND LONGHOUSE PIGS

	Commercial	Longhouse
Average number born per litter	10	less than 10
Average number weaned per litter	8	4-5
Average age at weaning (days)	45	?
Average weaning weight (lb)	33	?
Mortality; weaning to slaughter (per cent)	2	?
Average age at slaughter (months)	8	12-24
Average weight at slaughter (lb)	210	50-150
Average feed conversion efficiency (lb feed per lb liveweight gain)	4.0-4.5	?
Average number litters per year	2	more than 1
Average age of gilts at first service (months)	8.5	12-24

Note: An economic analysis of commercial units is given in Appendix II.

9.5 POULTRY

Only fowls are of economic importance within the Study Area at the present time. There are a few ducks and other types of poultry. The poultry industry can be divided into two sectors. A commercial sector concentrated around the coastal towns, particularly around Miri and Bintulu, and a rural sector. There is some specialisation within the commercial sector including independent hatching, broiler and laying units, but there are also many non-specialised units. There are three hatcheries in the Miri district hatching eggs from stock imported mainly from the United States of America, via Singapore. The largest of these has a capacity of 17 000 eggs. Although at present an unsexed day-old chick is sold at $0.55 compared with an average imported price of $0.65, the commercial future of this hatchery is uncertain due to a dwindling export market in Brunei and competition from sexed and unsexed day-old chick imports. During the first half of 1973 the production of chicks from the hatchery declined.

No accurate data are available but it is estimated that the average sizes of the specialised broiler and laying units are 400 to 600 and 350 to 500 birds, respectively. The specialised laying units usually import sexed chicks at an average cost of $1.70 per chick.

Virtually every family from every community in the rural areas keeps a few fowls, as do many families in the towns, and with rare exceptions these fowls are allowed to scavenge around the house for their feed and roost in any convenient location. A minority of householders supplement the feed intake of their fowls by providing some grain or purchased commercial feed.

Management in the commercial sector is varied and generally conventional, there being major differences in the efficiency of different operators. Housing is cheaply constructed but usually utilitarian. Most laying units utilise wire cages in batteries. The cage is locally manufactured and at present costs $2.

Average standards of productivity within the commercial sector have been estimated from data obtained from the producers and from the Department of Agriculture and these are shown in Table 9.6. Commercial feeds are normally fed. If locally produced feeds such as sago flour and copra are introduced into the rations, mortality apparently increases. In addition, experiments at Semongok suggest that when sago flour replaces maize flour in the ratio of broilers, liveweight gain and the efficiency of feed conversion progressively decline with an increase in the percentage of sago flour. For example, in one experiment in 1970 fowls gained 2.1 and 1.1 pound with feed conversions of 7.6 and 9.8, respectively, when a commercial feed and one containing 40 per cent sago flour were used.

The Department of Agriculture has attempted to subsidise small scale fowl production in the rural areas. Recipients of the subsidy numbering approximately 50 within the Study Area, have all received 50 day-old chicks together with some feed. The scheme has not been very successful.

TABLE 9.6 ESTIMATES OF FACTORS CONCERNED WITH THE PRODUCTIVITY OF THE COMMERCIAL POULTRY INDUSTRY WITHIN THE STUDY AREA

	Broilers	Layers
Age at slaughter (days)	80-90	600
Weight at slaughter (lb)	2.5-3.5	4
Mortality to slaughter (per cent)	5-10	30
Age at first-lay (days)	-	150-170
Mortality to first-lay (per cent)	-	15
Laying (per cent)	-	65
Average egg weight (oz)	-	2
Mortality; first-lay to slaughter (per cent)	-	15

Note: An economic analysis of typical laying and broiler units is given in Appendix II.

9.6 WILD GAME

Game was evidently of some importance as a source of meat for the population in the past. Of the larger mammals; feral water buffaloes (Bubalus bubalis), banteng or femadan (Bos (bibos) bateng), the sambar (Cervus unicolor), the barking deer (Muntiacus muntjak), mouse deer (Tragulus spp.) the wild pig (Sus barbatas barbatus) and various types of primates, were hunted. Today the wild pig and to a lesser extent the sambar, barking deer and mouse deer still provide a useful source of meat for rural people.

9.7 FORAGE, BY-PRODUCT FEEDS AND THE LIVESTOCK FEED INDUSTRY

9.7.1 Forage

There are very limited areas of planted pasture or forage within the Study Area and with few exceptions local farmers have no knowledge of the husbandry of forage.

The major indigenous and exotic grasses and legumes at present available for use in Sarawak are:-

Indigenous grasses	Indigenous legumes
Axonopus compressus (broad-leaved carpet)	Desmodium trifolium
Axonopus affinis (fine-leaved carpet)	Desmodium heterophyllum
Cynodon spp.	Indigofera spp.
Eragrostis spp.	Mimosa pudica (sensitive plant)
Imperata cylindrica (lalang)	Mimosa invisa
Ischaemum digitatum	Vigna hoseii
Ischaemum magnum	
Ischaemum rugosum	
Paspalum confugatum (sour)	
Zoysia matrella	

Exotic grasses	Exotic legumes
Brachiaria brizantha	Calopogonium muconoides (calopo)
Brachiaria decumbens	Centrosema brasillinum (Q8216)
*Brachiaria mutica (para)	*Centrosema pubescens (centro)
Brachiaria ruziziensis	Desmodium intortum
Digitaria decumbens(pangola)	Desmodium uncinatum
*Ischaemum aristatum (Batiki blue)	Glycine wightii
Melinis minutiflora (molasses)	Leucaena leucocephala
*Panicum maximum (Guinea)	Lontononis bainesii
Pennisetum purpureum (ele-plant, Napier)	Phaseolus atropurpureus (siratro)
Tripsacum laxum (Guatemala)	Stylosanthes guyanensis (stylo)
	Stylosanthes humilis
	Vigna marina

* Introduced species

Mixtures of the carpet grasses and sour grass together with indigenous legumes are generally found wherever land has been cleared for rough grazings. This is particularly true in the highland areas and immediately outside the Study Area in Long Semado and Bario where pastures composed mainly of these grasses are to be found. Sour grass grows everywhere under tree crops and where land is cleared for oil palms it appears to be the pioneer grass species. It is also found mixed with _Zoysia matrella_ under coconut plantations along the coast. _Ischaemum spp._ are found almost everywhere in the lowlands and to a lesser extent in the highlands. _Ischaemum magnum_ or _rumput Malay_ is said to be palatable when young and regenerates rapidly from a burn. _Imperata cylindrica_ is widely spread as it is throughout the humid tropical region of South-east Asia, but no very large pure stands were seen within the Study Area. The palatable indigenous legumes are small and not very agressive. _Mimosa spp._ are likely weeds of planted pasture.

Some exotic grasses and legumes have been introduced, either accidently or for specific purposes, and those indicated by an asterisk in the lists above have acclimatised and spread naturally. Numerous new introductions have now been made at Semongok and only those that appear to be of some importance are listed above.

Experimental studies on some of the indigenous and exotic species have been made at Semongok and elsewhere and the results to date may be summarised as follows:-

- Napier is more productive than guatemala grass. When planted at 24 by 30 inches intervals and well fertilised it has yielded 90 ton per acre per annum of wet forage.
- _Brachiaria ruziziensis_ grows well in plots at Kabuloh. _Brachiaria decumbens_ responds well to nitrogenous fertilisers (450 pounds per acre per annum) but without adequate fertilisation it cannot compete with indigenous grasses under grazing conditions. Using indigenous cattle, average daily liveweight gain on heavily fertilised pangola pastures at Semongok has been 0.7 pound with a stocking rate of 1.5 livestock units (l.s.u.'s) per acre.
- Para grass has not thrived particularly well at Semongok, but where it has been introduced at Long Lama within the Study Area and at Long Semado outside the Study Area it is thriving and spreading naturally.
- Sour grass and _Ischaemum aristatum_ respond to high levels of nitrogenous fertilisation but are less efficient at utilising fertiliser nitrogen than the exotic grasses.
- At Semongok a sour grass, _Ischaemum spp._ and centro mixture looks promising. Of the _Ischaemum_ species _I. digitatum_ might be one of the most promising.

- Guinea grass mixes well with centro and acclimatises readily. Of new introductions the variety Gatton is promising.
- Stylo, centro and a new introduction Centrosema brasillinum (Q8216) show promise as legumes. The most suitable variety of stylo used to date is Q8558 from Queensland. Leucaena leucocephala is growing well at Kabuloh.

The Department of Agriculture has recently initiated a subsidy scheme for forage production. In order to qualify for a farmer must possess three to five head of cattle. A total of subsidy a $250 is advanced to such a farmer. This includes $150 for barbed wire and fencing materials, $50 for fertiliser in the first and $50 for fertiliser in the second year.

9.7.2 By-Product Feeds

Present major sources of by-product feeds are coconuts and padi.

Coconuts: Coconut or copra meal, a by-product of oil production from copra, contains approximately 21 per cent crude protein and is a useful protein concentrate feed. In 1971, 12 617 tons of copra were produced in Sarawak, yielding 4 755 tons of coconut meal. Very little if any was produced within the Study Area. In the same year the State's livestock feed industry used 6 644 tons so that coconut meal had to be imported.

Padi: Rice bran, a milling by-product of padi, is an excellent feed when fed in limited quantities for pigs and poultry and can also be used in fattening rations for cattle. It is estimated that 80 per cent of the padi produced in the Study Area is milled and that 20 per cent is pounded. The rice bran obtained by pounding includes the husk and consequently has a much lower feeding value than rice bran obtained by milling. It is estimated that in the State and in the Study Area, respectively, there were approximately 7 900 and 1 700 tons of the pounded produce, 18 000 and 3 800 tons of husk and 15 500 and 3 300 tons of better quality rice bran available in 1971. Some of this product is at present discarded and much of it is fed very wastefully.

9.7.3 The Livestock Feed Industry

Commercial livestock feeds come from two sources, imports and local manufacture from mainly imported ingredients. There are two livestock feed manufacturers in the State, both located in Kuching, with an estimated total capacity of 6 000 tons of feed per month. They are: Kion Hoong Animal Feed Factory owned by Zuellig and Co., and Tong Kwang Co. Ltd. owned by Malaysian Feed Mills. It is estimated that at present the industry is operating at approximately 60 per cent of rated capacity. Approximately two-thirds of total production is pig feed and there is no pelleting of feeds.

Imports of mixed livestock feeds are on a quota, and at present the annual quota is no more than 75 per cent of total imports in 1968. It is estimated that at present imports amount to approximately 14 000 tons per annum, that is one-quarter of total consumption.

There are some livestock feed dealers within the Study Area, including the Pig Breeders Association which imports supplies from West Malaysia. The price of livestock feeds appears to be high by world standards but there is competition between the feed mills in Kuching and between locally produced and imported mixed feeds. Apparent distribution margins less than 10 per cent but data are not available on actual distribution margins. The ration ingredients such as maize, sorghum, wheat pollards, rice bran, groundnut cake, coconut meal, soya bean meal, fishmeal and grassmeal are almost all imported and so pricing within the industry is very dependent on fluctuations in the external prices of straight feeds.

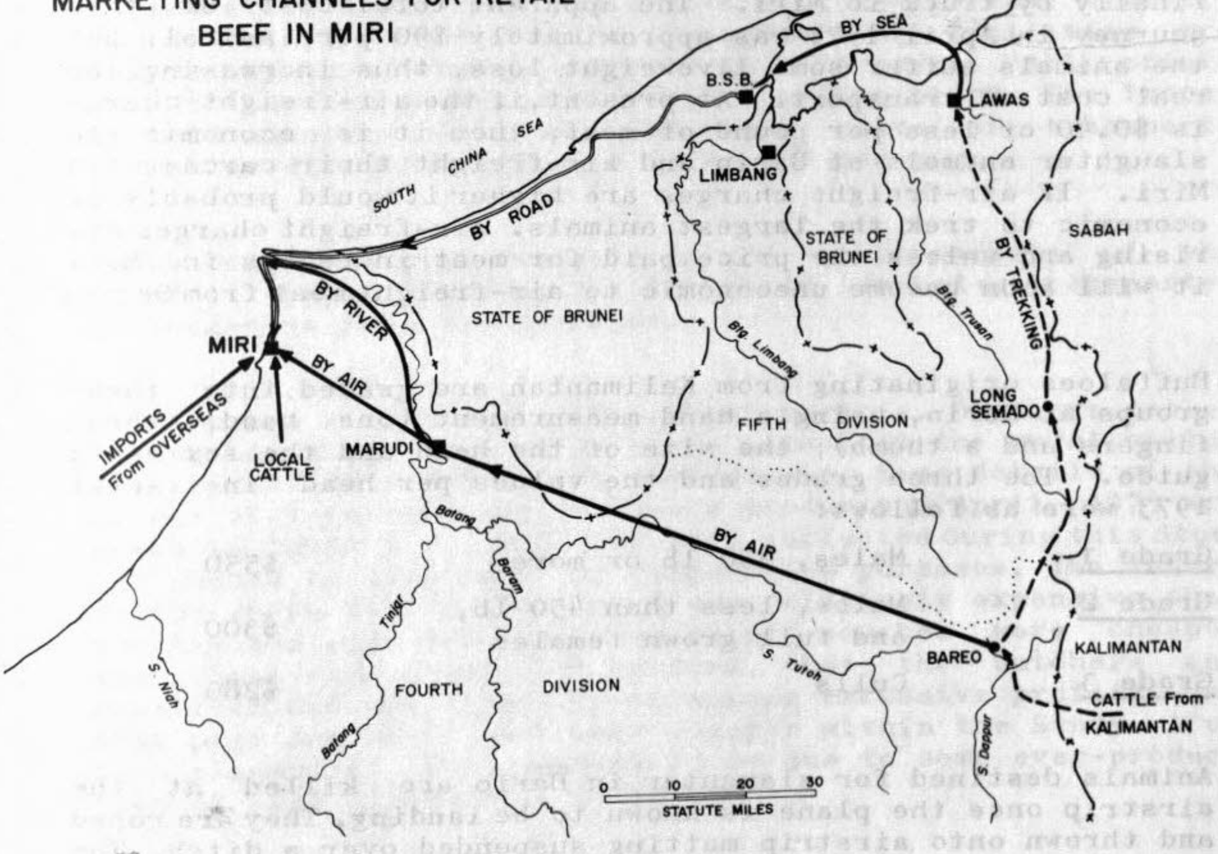
9.8 MARKETING AND PROCESSING

There are no organised livestock markets and there is minimal organisation in the marketing of livestock products. Even the air-freighting of beef from Bario to Marudi or Miri is sporadic and unreliable. Processing, apart from slaughter, is almost non-existent. Slaughtering is undertaken at the most elementary level.

Miri is the major centre of meat and other animal products consumption within the Study Area. Buffaloes and cattle for slaughter for this market are at present derived from two sources. Some are purchased from nearby farming areas by dealers and butchers who make the necessary arrangements for transport and slaughter. Others are imported, mainly from the Lawas District. These animals may have originated in Kalimantan or in Bario, Bakalalan, Long Semado or Lawas Districts. In addition buffalo and cattle beef is from Bario and marketed in Marudi and Miri. The various channels by which beef is provided for retail sale in Miri are shown in Figure 9.1.

FIGURE 9.1

MARKETING CHANNELS FOR RETAIL BEEF IN MIRI



The number of buffaloes and cattle slaughtered in Sarawak that originate from Kalimantan each year is unknown. This trade across the international boundary is conducted by barter and Kalimantan livestock are exchanged for such goods as rice, milling machinery, sugar, utensils and clothes. One of the major trading centres is Bario and some idea of the extent of this trade can be obtained from the local estimate that approximately 250 cattle and buffaloes were slaughtered in Bario in 1972 and that the majority of these animals originated from Kalimantan. This estimate is approximately two-thirds of the estimated number slaughtered in the whole Fourth Division including the Study Area. It is not known how many additional animals were purchased from Kalimantan and trekked to Lawas. A decision as to whether buffaloes and cattle should be trekked to the coast for slaughter or whether they should be slaughtered up country and their meat despatched to the coast by air, depends upon the relative cost of the two operations. Buffaloes and cattle that are trekked travel eight days from Bario to Lawas, then by boat to Brunei and finally by truck to Miri. The apparent total cost of this journey in April 1973 was approximately $90 per animal, but the animals suffer some liveweight loss, thus increasing the real cost of transport. At present, if the air-freight charge is $0.40 or less per pound of meat, then it is economic to slaughter animals at Bario and air-freight their carcass to Miri. If air-freight charges are higher it would probably be economic to trek the largest animals. Air-freight charges are rising and unless the price paid for meat increases in Miri it will soon become uneconomic to air-freight meat from Bario.

Buffaloes originating from Kalimantan are graded into three groups at Bario, using a hand measurement (one hand, three fingers and a thumb), the size of the head and the sex as a guide. The three grades and the values per head in April 1973 were as follows:

Grade 1	Males, 450 lb or more	$550
Grade 2	Males, less than 450 lb, and full grown females	$300
Grade 3	Culls	$280

Animals destined for slaughter in Bario are killed at the airstrip once the plane is known to be landing. They are roped and thrown onto airstrip matting suspended over a ditch. The slaughter technique is very crude and wasteful; the head, feet, hide and much of the offals being thrown away. The meat is packed hot either into stainless steel boxes measuring 40 by 18 by 15 inches or into plastic bags. Two air charter firms are employed by the Bario people. One plane can freight 1 200 pounds and the other 1 400 pounds of meat at a time. There are three firms handling air-freighted meat in Miri. Payment is not necessarily made in cash but sometimes in goods used for barter purposes.

In Miri there are several meat importers. Two of these are also butchers. The number of animals slaughtered in Miri is less than one buffalo or bovine animal per day. The slaughter fee is $5 per animal but slaughter facilities are minimal.

There is a Pig Breeders' Association in Miri which slaughters pigs, retails pork and owns four stalls in the local retail market. In addition there are 13 other pork butchers, all paying a fee to the local authority of $100 per annum. Pigs are purchased on the farm by the butchers, usually for cash. The animals are then packed in long, cylindrical rattan baskets and transported to the municipal slaughterhouse. The basket costs $15. The butcher pays a slaughter fee of $2 per pig and may slaughter himself or employ labour. Miscellaneous charges concerned with slaughter are estimated to be $3 per pig. Slaughter begins at 0300 hours and usually 30 pigs are killed every day. Pork and offals are transported directly to the retail market stalls. Slaughterhouse facilities are reasonably good, though there is no cold store. All offals are utilised including a major part of the blood. The latter is sold mainly to Chinese. The total costs of transport, slaughter etc. are estimated to be $20 per pig.

A few longhouse pigs are sold in the retail markets of the coastal towns. They are air-freighted, walked or transported by long-boat from the interior.

Poultry are sold live in the retail markets. Broilers, culled laying birds and free range birds raised in the rural villages are all retailed in the same manner. Some details of the prices of livestock and livestock products in April, 1973 are given in Table 9.7. The data were collected during this Study and should be used only for comparative purposes. The information shows that poultry meat was relatively expensive, that poultry and pigs from non-commercial sources were cheaper than those from commercial sources, that the butchers and retailers did not appear to be making excessive profits and that pigs and hence pork were cheaper within the Study Area than elsewhere. This appears to be due to some over-production of pigs in the Miri District.

Goat meat is not listed in Table 9.7 because only a very small quantity is commercially available.

9.9 RESEARCH, EXTENSION AND TRAINING

Although there is an agricultural research station at Semongok and an established animal breeding station at Tarat, (both in the First Division), only limited research has been conducted into forage and livestock production. Thus there are few local guidelines at present for the development of a livestock industry.

The veterinary and animal husbandry extension service in the State is small. In the Study Area for example there are only six officers concerned with livestock work. Four posted to Miri, one at Bintulu and one at Marudi. The senior officer at Miri is also in charge of livestock extension in the Fifth Division, where four other extension officers are stationed. There is no professional veterinarian in either the Fourth or Fifth Divisions.

Although animal husbandry is included in the agricultural training courses held at Kabuloh Agricultural Station the overall training facilities in livestock and pasture husbandry are negligible.

TABLE 9.7 PRICES OF LIVESTOCK AND LIVESTOCK PRODUCTS, APRIL 1973 (DOLLARS)

Farm gate		Retail	
Type of animal and location	**Price per lb liveweight**	**Location**	**Price per lb carcass meat**
<u>Buffaloes and cattle</u>			
Bario	1.15 (buffaloes)		
Lawas	1.16 (buffaloes)		
Bintulu	1.67 (cattle	Bintulu	3.00 (all cuts)
Miri	1.69 (buffaloes)	Miri	3.01 (all cuts)
			4.89 (steak)
			1.88 (rib bones)
			0.90 (other bones)
<u>Pigs</u>			
Miri	1.04 (commercial)	Miri	3.01 (lean)
Kuching	1.20 (commercial)		2.11 (ham)
Brunei	1.26 (commercial)		1.20 (leg and belly)
Sabah	1.28 (commercial)		0.90 (hand)
			0.68 (fat)
Baram river	0.83 (village)	Brunei	3.38 (lean)
<u>Poultry: meat</u>			<u>Price per lb liveweight</u>
Kalimantan (adjacent to Bario)	0.90 (village)		
Bario	1.28 (village)	Lawas	1.65 (village)
Miri	1.28 (commercial cockerels)	Miri	1.43 (commercial cockerels)
	1.50 (commercial pullets)		1.65 (commercial pullets)
	0.94 (commercial culled hens)		
<u>Poultry: eggs</u>	<u>Price for each</u>		
Miri	0.12 (small)		
	0.13 (large)		

CHAPTER 10

A POSSIBLE DEVELOPMENT STRATEGY

10.1 INTRODUCTION

A development strategy must be based on likely future demand for animal products and the economic availability of resources that can be used for development purposes. Estimates of future demand in 1990 for beef, pork and poultry meat within the Study Area have already been given in Table 9.3. Possible overall demands for beef within Sarawak and possibilities for exporting beef are discussed in Chapter 11. Details on pork and poultry production projections are discussed in Appendix II.

Estimated meat consumption rates in these Appendices, expressed as pounds per capita per annum are:-

	1970	1990
beef	1.4	1.9 - 9.0
pork	13.0	21.4
poultry	6.5	11.7 - 15.7

The wide spread in the estimate for beef consumption in 1990 can be accounted for by the number of variables that may be considered. Per capita beef consumption is so low at the present time that it is reasonable to assume that it will increase to at least the present Peninsular Malaysia level. Furthermore, increased availability could lower the price of beef and further increase demand. Similarly with poultry.

It appears that the productivity of the livestock sector will have to be increased three, four or five times to meet expected demand. However, different sectors of the livestock industry will require very different conditions for development. As stated previously the climatic environment favours pig and poultry production. Furthermore, productivity can always be very rapidly increased in these sectors. Pigs are very prolific and day-old chicks can be imported in large numbers. Also the commercial sectors of these industries are usually organised by farmers who will react rapidly to any increase in demand. The major problems of the pig and poultry sectors are to obtain regular and economically priced supplies of feed and improved efficiency within the present managerial structure. At present the pig and poultry industries within the Study Area are entering a period of retrenchment as the small export markets that they created in the past disappear, but it can be assumed that both industries will ultimately increase production as demand grows with increasing population and prosperity.

For ruminant livestock, however, the situation is different. There is no commercial industry but only a medley of small, fragmented and very inefficient units. An industry will have to be deliberately created. The first objective in achieving this must be the establishment of breeding herds. The major problem is to determine what type of ruminant livestock industry should be given priority in development plans.

Although milk and milk products consumption is increasing in Sarawak and will continue to increase, dairy husbandry is so much more complex than beef cattle and buffalo husbandry that it would be unrealistic to attempt to develop a dairy industry before a beef industry has become reasonably well established. Whether a developing beef industry should be based on buffaloes, beef cattle or both species has been considered. The conclusion reached is that although a buffalo beef industry should be encouraged, particularly as the species is well adapted to the climatic environment and buffaloes could act as pioneers in the development of pastures, it is most essential to develop a beef cattle industry on a national scale. It is argued that although a beef cattle industry might be initially more difficult to establish it will be more suited to world market demands and therefore have a far greater growth potential. Any demand for work animals in agriculture could be met easily from the enlarged buffalo herds and from the beef cattle.

Because the climatic environment is not particularly favourable for the husbandry of goats and for sheep no major action should be taken to develop these industries apart from additional extension assistance, particularly with regard to the control of internal parasites and improvements in existing management.

10.2 BUFFALOES

The advantages of the buffalo are that it is well adapted to the climatic environment, that it thrives better than cattle under poor managerial conditions and in particular utilises low nutritional value forage more efficiently. Also buffalo beef is acceptable to local consumers. It would, therefore, appear to be a useful pioneer animal whose husbandry should be generally encouraged. It could be particularly appropriate in the areas to be developed for swamp rice production.

Major difficulties in the implementation of such a policy at the present time are that the small total, and possibly declining, population of buffaloes does not afford much scope for expansion and that except among the Kelabit and Murut peoples there is no tradition of buffalo husbandry in Sarawak.

If the buffalo industry is to be expanded it will be necessary for the Government to first stimulate the production of breeding buffaloes and then encourage their husbandry among the local people, possibly at first in the riverine villages and alluvial flats. It is suggested that this aim could be achieved by the Government purchasing young breeding buffaloes at a price somewhat above that which would be paid for buffaloes destined for slaughter and then subsidising their sale to such villagers.

It is therefore recommended that Government through the Department of Agriculture;

(a) subsidise the distribution of breeding buffaloes;

(b) create organisations in each Division empowered to purchase, sell and exchange livestock;

(c) train field extension workers in buffalo husbandry.

10.3 CATTLE

If an economic cattle industry is to be developed it will, as stated previously, have to be deliberately created. The first emphasis should be on the development of at least one large-scale beef cattle breeding unit and it is recommended that this objective should be considered and studied as a specific project. There are quite a number of localities within the Study Area that on account of topography, depth of soil and availability of water, etc. would be suitable for the development of pastures for beef production. For a number of reasons, however, the first choice of locality for a future beef project should be a site at Sungai Karabungan. Detailed project proposals are outlined and discussed in Chapter 11. There are, however, certain other necessary developments that would have to be conducted concurrently. These are:-

(a) The organisation of cattle and forage husbandry economic feasibility trials, as so little is at present known as to the basic technical requirements of an economic beef industry.

(b) The training of animal husbandry personnel at all levels.

(c) An expansion and reorganisation of the present extension service in order to enable the Government to provide animal husbandry, veterinary and forage husbandry specialist advise to livestock farmers.

(d) The organisation of a new marketing authority that would be empowered to purchase, sell and exchange livestock and if necessary engage in the growing-out, fattening, transport and slaughter of livestock and the processing of animal products.

(e) The investigation into methods for initiating the integration of cattle husbandry and crop production and the increased utilisation of crop by-product feeds by cattle.

10.4 PIGS

It has been stated previously that the commercial pig industry is capable of developing at a rate that will satisfy all increased demands for pork, without Government financial assistance. The industry does, however, need some restructuring in order to increase the efficiency of its operations and the Government could assist this process by appropriate action, aid and advice.

It is recommended that:-

(a) Legislative and administrative control of the animal feedingstuff industry be strengthened in order to ensure the maintenance of adequate nutritional standards.

(b) Efforts be made
- to encourage the evolution of specialised, privately owned breeding units, producing both purebred and crossbred boars and gilts;
- to end the wasteful keeping of boars by the smaller pig farmers;
- to encourage the Pig Breeders Association to replace the Government as a provider of breeding stock.

It is suggested that these aims might best be achieved through a closer association between the Government and the Pig Breeders Association (PBA). If the PBA were encouraged to organise an AI service for which the Government provided specialist assistance and, initially, high performance boars, then the boar purchase subsidy could be withheld from farmers who only possess a few sows.

(c) Investigational programmes should concentrate on
- methods of incorporating cheap carbohydrate feeds such as sago and tapioca flours into pig rations;
- the provision of a cheap, high protein, concentrate feed that could be used by the longhouse pig industry.

The present random attempts at upgrading the longhouse pig industry are undoubtedly mistaken. Within strictly defined environmental limits the present industry is both economic and moderately efficient in providing adequate supplies of pork for the villagers. The indigenous domestic pig will never be as productive as exotic pigs even if it is well managed and fed on commercial feeds. Also the upgraded crossbred animals will never be as efficient at scavenging or at utilising local foods as the indigenous pig. Many cases were noted in the villages where crossbred pigs were not thriving as well as the indigenous pigs.

Under special circumstances, that is where there is a specific local market or where there are feed surpluses, upgrading might be successful if managerial methods were also upgraded and the commercial feed industry could supply a special high protein ration tailored to the requirements of indigenous pigs fed large quantities of locally produced feeds.

It is therefore recommended that the extension service should concentrate on demonstrating to longhouse pig farmers simple managerial improvements that will help reduce piglet mortality and the high incidence of internal parasitism, simple methods of selecting breeding stock and the use of high protein rations to supplement local feeds and ensure more adequate liveweight growth.

10.5 POULTRY

The commercial poultry industry, like the pig industry, is capable of developing at a rate compatible with likely increased demand without Government assistance in order to improve the efficiency of its operations.

In Miri for example, the decline of the export market for day-old chicks to Brunei has caused the specialist hatching sector to become somewhat disorganised. It needs restructuring so that it can supply the needs of the local broiler and laying hen sectors, thus reducing the importation of day-old chicks. In order to do this it must import the specific lines of poultry required by the broiler and laying sectors and be able to sex the chicks that are hatched.

The whole industry also requires cheap and properly formulated commercial rations if it is to function at maximum efficiency.

It is recommended that:-

(a) the Government extension service should sponsor the formation of a Commercial Poultry Industry Association and that in co-operation with this association it should formulate plans for the restructuring of the industry. It

TABLE 10.1 COMPOSITION OF THE DRY MATTER OF SOME BY-PRODUCTS FEEDS

	Coconut meal	Sago flour	Tapioca chips	Rubber seed cake meal	Linseed cake meal	Illipe nut cake
Total dry matter	93.0	86.0	94.4	91.4	91.1	100.0
Total digestible nutrients	77.1		75.0	63.4	75.5	
Crude protein	21.2	0.7	2.8	28.8	35.2	13.6
Fat	6.7	0.2	0.5	9.2	4.6	
Crude fibre	11.2	0.2	5.0	10.0	8.9	9.1
Mineral matter	6.5	0.4	2.0	5.5	5.7	7.1
Nitrogen free extractive	47.4	84.5	84.1	37.6	36.7	70.2

Source: Morrison, F.B. (1957)

as high as 10 to 12 per cent and the crude fibre content varies from 33 to 43 per cent. Burt has also stated that this is a high oil and fibre and low crude protein feed with a digestibility lower than that of cereal straws. Thus it does not appear to be a very promising by-product feed. Nevertheless sugar cane bagasse which is a somewhat similar product is being used on an increasingly large scale. Investigations are being conducted in Peninsular Malaysia to see if dried fruit fibre can be used in any way as a feed. Little is known about the feeding value of materials in the effluent from the mills but in Peninsular Malaysia investigations into its possible use as a feed are being undertaken. If these are successful it could prove important to the livestock industry in Sarawak because the future area of oil palm plantations in the Study Area alone could be about 155 000 acres. It is recommended that any possible nutritional value of the effluent should be investigated.

Padi: The total quantity of padi that will be milled is expected to slowly increase not only because there will be more padi available but also because a higher percentage of padi will be milled rather than pounded. Thus there is expected to be more rice bran available for feed. However, perhaps even more important in improving the supply position will be an improvement in the efficiency of rice bran feeding, particularly to pigs, by the provision and marketing of a cheap protein concentrate feed for village pig feeding.

Tapioca: This is essentially a carbohydrate feed with a low crude protein and crude fibre content. The roots can be chipped and sun-dried to form a storable feed with a moisture content of approximately seven per cent. The present acreage of tapioca in the Study Area is unknown but it is planted in widely scattered holdings and cannot be considered seriously as a raw material source for a dried chip industry. Nevertheless, with organised agricultural development being planned the possibilities of tapioca should not be overlooked.

Sago: Like tapioca, refined sago flour is essentially a carbohydrate feed with a low crude protein and crude fibre content. There are, however five types of feed that can be obtained from the sago palm; split logs from which the bark has been stripped can be fed to water buffaloes, cattle and goats; logs that have been kept in water for up to 14 days can be rasped to form a coarse sawdust, the yield being 60 per cent of the original log; starch can be expressed from the woody part of the pith to form a crude wet sago, (lemantak), the yield being 40 per cent of the original log; lemantak can then be refined to produce a sago flour, (tepong), the yield being 21 per cent of the original log; finally the sago flour can be refined for human consumption. The split logs and by-products at each stage of processing can be fed to ruminant livestock and the sago flour to non-ruminants.

The yields of these products per acre are not high but the sago palm requires little management and can be grown in permanent swamps where few other crops thrive. For this reason the palm could become a valuable source of carbohydrate feed in Sarawak but in the Study Area the potential is very limited.

Dried forage: On account of favourable environmental conditions for forage growth and the ready availability of low-cost natural gas for heating purposes, the possibilities for the development of a grass drying industry should be investigated in the Study Area. Some guidance could be obtained from the experience of the Guthrie Corporation at Labu in Negri Sembilan, Peninsular Malaysia, where a pilot grass drying and pelleting plant using high temperature dehydration is at present operating. Dried legume and high quality grass leaf is utilised in pig and poultry rations and could also be used in a fattening ration for beef cattle. There would also be an export potential for this product.

Fishery by-product: Both the fresh water and sea fishery potentials are promising and the possibility exists in the future for converting trash fish into protein feed. However, for the present and immediate future the quantities available are too small and irregular to warrant a processing plant. Nevertheless as fish meal would be a valuable addition to the by-product feed resources, particularly for inclusion in pig and poultry rations the situation should be constantly reviewed.

Abattoir by-products: It is only economic to produce abattoir by-product feeds such as blood meal, meat meal and meat and bone meal when slaughtering is centralised and conducted on a sufficiently large scale. Possibilities for the production of abattoir livestock feed by-product within the Study Area are discussed in Chapter 18.

Minor by-product feeds: Rubber seeds contain rather less than 30 per cent of a semi-drying oil and these seeds could be collected by small-holders and transported to a central oil extraction plant. The residue is a useful protein concentrate feed, possessing a somewhat similar feeding value to linseed cake meal. Rubber seed cake meal is said to be dry and powdery and not very palatable when fed alone and like linseed it does contain some cyanogenetic glucosides. These do not cause trouble in adult ruminant livestock or in adult pigs but the meal should not be used in the compounding of rations for young calves, pigs or poultry.

There are many species of illipe nut trees (Dipterocarpaceae) growing wild in the forests. The trees bear irregularly, often with fruit intervals of five to six years. The wild nuts are collected and exported but if they were crushed within the State the oil could be exported and the cake, which is a low quality protein concentrate feed, retained as a livestock feed.

Pulse crops: The haulm from pulse crops is a useful feed for ruminant livestock. In the Study Area this is not expected to be an important source of by-product feed.

Potential by-product feeds are so important for the future economic development of the livestock industry that it is recommended that the Department of Agriculture should establish a special committee to investigate the possibilities throughout Sarawak and to recommend how investigations into the feeding value of potential by-product feeds should be organised and financed.

10.7.3 The Livestock Feed Industry

A projection of the quantity of livestock feed that will be required by the pig and poultry industries within the Study Area by 1990 is given in Table 10.2. These data suggest that demand will expand to at least half of the present demand of livestock feeds in the entire State. In addition would be the demand for livestock feeds that might be generated by the development of cattle fattening enterprises.

TABLE 10.2 ESTIMATED QUANTITIES OF LIVESTOCK FEED REQUIRED BY THE PIG AND POULTRY INDUSTRIES IN 1970 AND 1990

	Livestock feed requirements (tons per annum)	
	1970	1990
Sarawak	56 000	150 300
Study Area	6 400	30 300
Study Area as percentage of Sarawak	11	20

Considering that in the future by-product feeds will become increasingly available as development proceeds in the Study Area, that transport costs to bring feedstuffs from Kuching will be high and that the straight feeds still needing to be imported will be landed in the Study Area at the same price as in Kuching, it is recommended that in a few years time a feasibility study should be undertaken of the establishment of a livestock feed mill in the Study Area. The possibility would exist as soon as the demand for feedstuffs in the Study Area reaches 12 000 tons per annum when a mill could be established with a capacity of eight tons per hour or 16 800 tons per annum for 300 day, eight hour shift year. But because a large number of different mixes would have to be produced it is probable that the mill would only be to work on a double shift. The first possiblity would be preferable in order to make allowances for breakdowns in the plant. Pelleting could also be undertaken with the capacity of the pelleting plant being rated at about half that of the whole mill.

The feasibility study for establishing the feed mill in the Study Area should also include the economic feasibility of a major feed complex that could include a palm kernel extraction plant, possibly an illipe nut cracking plant, a rubber seed oil extraction plant and a cocoa pod and forage drying plant that would not only produce by-product feeds for inclusion in local feed mixes but also products for export such as palm kernel oil, illipe nut oil, rubber seed oil and high quality dried forage.

10.8 MARKETING AND PROCESSING

In order to encourage the water buffalo industry and to establish a new beef cattle industry it will be essential for Government to create a marketing organisation. There are two major possibilities:-

(a) to empower the National Livestock authority that is authorised to develop the beef cattle industry to also undertake marketing and processing;

(b) to establish a new and independent State marketing authority.

The merits and demerits of these possibilities are discussed in Chapter 12 because the marketing system should form an integral part of any development plan for the beef industry. However, private enterprise should be allowed to retain its interest in the marketing of pigs and poultry and their products. Also the local authorities should continue to provide slaughter facilities for pigs but additional legislation may become necessary, as the industries grow, to protect the legitimate interests of farmers and consumers. These aspects should be reviewed from time to time.

10.9 RESEARCH, EXTENSION AND TRAINING

Although some limited investigational work has been conducted on livestock and forage production problems at Semongok, there is generally a dearth of information on these topics and this acts as a serious constraint on development.

The State Government is fully aware of this and the Department of Agriculture has plans for establishing a Livestock Production and Animal Husbandry Training Centre at Sungai Karabungan. It is recommended that the initial investigational work at the Station should be restricted to two major topics:-

- economic feasibility trials concerned with the problems of beef animals and forage husbandry;
- the development of low cost feeds for pigs and poultry.

Some details of the type of economic feasibility trials required by the beef cattle industry are given in Chapter 18, while the reasons for developing low cost feeds for pigs and poultry have already been discussed in previous sections.

Estimated requirements for research and extension staff up to 1990 are given in Supporting Report 2 Part III.

In Sarawak veterinarians and their subordinate staff form a Veterinary and Animal Husbandry Division within the Department of Agriculture. It is recommended that this should continue because the arrangement will best serve the interests of livestock development in Sarawak, particularly for the future integration of livestock and crop husbandry. The control of disease is only one aspect of livestock production and fortunately within Sarawak it is likely to be less important than breeding, feeding and management. Although the Head of the Division could be a veterinarian the majority of his senior officers should be animal husbandrymen. All aspects of forage production should be administered by the Division.

Training of graduate and diplomate staff in animal husbandry will have to be conducted outside the Study Area but considerable training of junior extension staff and small farmers in livestock and forage husbandry will have to take place in the Study Area. It is recommended that this training be centred in Kabuloh with considerable assistance from the staff of the new Livestock Production and Animal Husbandry Training Centre.

For farmers with large holdings, interested in developing beef breeding herds and selling breeding stock or rearing and fattening their home-bred animals, the most suitable means of acquiring the necessary knowledge and practical experience would be through a period of training on the commercial beef ranch which it is proposed should be established at Sungai Karabungan.

In Sarawak veterinarians and their subordinate staff [illegible] Veterinary and Animal Husbandry Division within the Department of Agriculture. It is recommended that this should continue [illegible] the arrangement will best serve the interests of livestock development in Sarawak, particularly for the future [illegible] of livestock and crop husbandry. The control of diseases is only one aspect of livestock production and fortunately within Sarawak it is likely to be less important than breeding, feeding and management. Although the head of the Division could be a veterinarian the majority of his senior officers should be animal husbandrymen. All aspects of forage production should be controlled by the Division.

Training of graduates and diplomates in Animal Husbandry will have to be conducted outside the Study Area but in-service training of junior extension staff and small farmers in livestock and forage production will have to take place in the Study Area. It is recommended that this training be centred at [illegible] with considerable assistance from the staff of the [illegible] Livestock Production and Animal Husbandry Training Centre.

For farmers with large holdings, interested in developing beef breeding herds and taking breeding stock or rearing and fattening their home-bred animals, the most suitable means of acquiring the necessary knowledge and practical experience would be through a period of training on the commercial beef ranch which it is proposed should be established at [illegible] [illegible]

PROPOSED SUNGAI KARABUNGAN BEEF PROJECT

SUMMARY OF RECOMMENDATIONS

1. The overall objective of the proposed beef project is the establishment of a base for the development of a commercial beef industry in Sarawak and this report covers the requirements for primary development, the possibilities and requirements for secondary development and the requirements of an economic feasibility investigational programme.
2. A commercial beef production unit, approximately 5 000 acres in extent, should be established on unencumbered land at Sungai Karabungan adjacent to the Sarawak Land Development Board's (SLDB) oil palm plantation.
3. The National Livestock Industry Board (NLIB) should be the authority charged with responsibility for initiating the project as part of a long-term programme for developing a cattle industry in Sarawak.
4. The NLIB should sub-contract clearing of the land for the project to the SLDB.
5. The Department of Agriculture in Sarawak should conduct economic feasibility investigations, on the Livestock Production and Animal Husbandry Training Centre which the Department of Agriculture proposes to establish adjacent to the commercial ranch.
6. A strategy of creating a fully stratified beef industry should be accepted as the ultimate goal for Sarawak.
7. The proposed project should last 20 years and be phased. Phase 1 would last five years and Phase 2 the remaining 15 years.

   DURING PHASE 1:-

   - The commercial unit at Sungai Karabungan would be developed to include elite and commercial breeding herds, and growing-out fattening operations.
   - The Department of Agriculture would organise feasibility trials to ascertain amongst other problems the most economic pasture and animal husbandry methods to be employed on the commercial unit; whether the adjacent SLDB oil palm estate could be used for the growing-out of young cattle using the cover crops planted between the oil palms; and whether cattle could be economically fattened in feedlots.
   - The NLIB would initiate the organisation of new slaughter and marketing facilities.

   DURING PHASE 2:-

   - Associated growing-out and fattening operations would be developed on estates, private farms and smallholdings.

- Development of the Sungai Karabungan unit would continue with increasing emphasis being placed on its utilisation as a base for the production of breeding cattle and in conjunction with the Livestock Production and Animal Husbandry Training Centre act as a centre for the dissemination of information and services to small-holders and to other associated producers.

8. The rate of all development of the project should be based on the schedule shown in Figure 13.1.

9. During the first year of operations two different clearing methods should be assessed; partial destumping and clean clearing. Some clean clearing will always be necessary; particularly along the proposed fence lines and where forage grasses are to be planted. The most suitable method, however, by which the major part of the area can be most economically cleared and planted can only be determined by practice.

10. Whatever method of clearing is used, a belt of forest should be left unfelled on either side of streams and on steep slopes. This will act as an anti-erosion measure and will help to solve the problem of providing shade for the cattle during the first years of development.

11. It is concluded from the available evidence that some of all of the following grasses and legumes could be utilised either in pastures or as fodder.
    - Brachiaria mutica (para) and Lersia hexandra (rice grass) on low and wet soils.
    - Digitaria decumbens (pangola), Brachiaria brizantha, Brachiaria decumbens and Cynodon plectostachyum (African (Naivasha) star grass) on well drained, medium to deep soils.
    - Panicum maximum (guinea) and the indigenous grasses Paspalum conjugatum (sour) and Ischaemam spp. on the drier elevated and shallower soils.
    - Pennisetum purpureum (Napier or elephant) as a fodder grass on the deeper, well drained soils.
    - Centrosema pubescens (centro) and Stylosanthes guyanensis (stylo) on all reasonably well drained soils.

12. The most suitable and economic methods of pasture establishment can only be ascertained by practice and feasibility trials. Species ecologically adapted to the soil type and topography must be utilised and no effort made to establish only one pasture species in topographically variable paddocks. At least during the first phase, some fodder grass should be grown as an insurance against inadequate pasture supplies during the infrequent drought periods. There will be major differences in the fertiliser requirement of different species and the degree of weed infestation during establishment will greatly affect costs. Managerial methods must be utilised to ensure the rapid cover of cleared land by pasture species.

13. The breed for the commercial unit should be the Brahman. Two-year old, pregnancy tested, in-calf, low grade (1/2 to 5/8) crossbred heifers should be imported from Australia. Purebred, high genetic merit Brahman bulls should be imported either from Australia or the United States. In addition, at least 50 purebred, pregnancy tested, in-calf Brahman heifers should be imported from Australia to form the nucleus of an elite breeding herd that would provide the commercial unit with second and subsequent generation breeding bulls.

14. Technical assumptions have been made with regard to the performance of the cattle during the next 20 years. They are conservative and it is quite possible that overall performance will be better than assumed.

15. The commercial unit will require a somewhat larger managerial component than would be normal in established ranching areas. Expatriate management will be required during the initial period. Management during the first five years should consist of an expatriate manager, a local understudy manager and the part-time services of a veterinarian and a pasture agronomist. Once the expatriate manager is replaced the managerial component should consist of a manager and an assistant manager, together with the part-time assistance of two technical officers.

16. The recruitment of suitable stockmen will be difficult and expatriates will be required temporarily. Local recruits should be sought from among the Kelabits and/or Muruts and be trained for about one year by expatriate stockmen. The recruitment of other labour should present no difficulties.

17. It would probably be economically advantageous for the NLIB to contract with an Australian consultancy group for a package deal that could include the selection, purchase and transport of cattle, the provision of expatriate staff and overseas training of Sarawak staff.

18. Details are given of fixed and other equipment requirements and estimated development and operational assumptions and costs.

19. The Miri quarantine station should be completed rapidly so that it can be used for quarantining cattle imported for the Sungai Karabungan project.

20. During the first year 400 acres of natural pastures plus stylo and centro and 400 acres of guinea plus stylo and centro should be established on partially destumped and cleared land; 100 acres of pangola, 50 acres of Napier for fodder and 40 acres of Brachiaria decumbens, and/or para if low lying land is available, should be established on clean cleared and cultivated land. The decision as to the areas to be established in subsequent years should await practical experience during the first year and the early results of the economic feasibility trial programme.

21. 1 000, 3 000 and 5 000 acres of pasture should be established by the end of the first, second and third years, respectively.

22. Details are given of the estimated growth of the cattle population, the numbers that will be available for sale, and how the estimated availability of grazings will match up with the estimated grazing requirements for three periods; year one to year six, year seven to year 10, and year 11 to year 20.

23. Short and long term economic feasibility investigational programmes should be initiated on the Livestock Production and Animal Husbandry Training Centre with priority given to the short term programme. The investigations that should be included in these programmes have been listed.

24. Secondary development should be encouraged. This should include the encouragement of beef production outside the ranch area, the training of extension workers and farmers, the organisation of a new marketing and processing system and new agro-industries.

25. Capital development costs are estimated at \$6.8 mn and operating expenses before income covers annual expenditure accounts for a further \$2.2 mn. The commercial rate of return on the project is 8.9 per cent.

CHAPTER 11

BACKGROUND AND JUSTIFICATION OF THE PROJECT

11.1 INTRODUCTION

The agricultural economy of Sarawak is heavily dependant on subsistence based agriculture and a limited number of cash crops mainly rubber, coconuts and pepper. Heavy reliance on a few crops for which prices have tended to fluctuate widely or decline, and which are subject to competition from other producers on the markets where they are sold, has prompted the Sarawak Government to explore possibilities for diversification. Large scale oil palm plantings in the Fourth Division are the first projects in this programme and other activities which are receiving attention are cocoa, coffee, spices, various fruits and vegetables. The favourable production environment, the availability of suitable land combined with local research experience has recently led to attention also being focussed on the possibilities for large scale beef operations.

Livestock production is of limited importance in Sarawak at present. Domestic production of pigs and poultry adequately supplies the demand for these products. There has been no apparent change in the population of cattle and buffaloes over the past decade, but significant quantities of beef have been imported either as live animals for slaughter or as frozen meat. There would thus appear to be an established local market for beef which combined with the favourable production potential mentioned above justifies further investigation and development.

On a world-wide basis F.A.O. (1961) has indicated that there will be increasing pressure on meat supplies and that demand is likely to exceed supplies. This situation will undoubtedly lead to hardening beef prices and would enable a local beef industry to enter export markets.

11.2 THE MARKET POTENTIAL FOR BEEF

11.2.1 Internal Market

Sarawak is currently importing about $1.3 mn worth of chilled and frozen beef and live cattle and buffaloes each year largely to supply the needs of urban complexes. Total consumption for the country as a whole cannot be ascertained with accuracy since the data available on animals slaughtered for domestic consumption are limited. Few cattle and buffaloes slaughtered outside the main slaughter houses are recorded, but the numbers are considered to be relatively insignificant. All races in Sarawak are potential beef consumers and so global estimates are assumed.

The actual slaughter weight of domestically killed animals is not known but observation and experience suggest that cattle are slaughtered at 300 pounds deadweight and buffaloes at 400 pounds deadweight. Uning these assumptions and the slaughter house data available, Table 11.1 shows the estimate of total beef consumed in Sarawak between 1967 and 1970.

TABLE 11.1 TOTAL BEEF CONSUMPTION AND CONSUMPTION PER CAPITA 1967-1970 IN SARAWAK

Year	Imported chilled or frozen beef	Domestic Slaughter Cattle	Domestic Slaughter Buffaloes	Total	Per capita consumption pounds
	Total quantity consumed - thousand pounds				
1967	393.1	333.9	559.2	1 286.2	1.42
1968	335.7	409.2	426.4	1 171.3	1.27
1969	338.9	334.5	488.0	1 211.4	1.28
1970	540.3	357.9	424.4	1 322.6	1.36

Thus the average consumption over the period 1967-1970 was around 1.33 pounds of beef per head. In 1970 and 1971 the average retail price for better quality lean, boneless beef was $3.60 per kati or $2.70 per pound. Lower quality meat and bones sold for $1.80 per kati or $1.35 per pound.

In Peninsular Malaysia, where beef is generally graded into six grades, the average retail price is lower - around $2.10 per kati or $1.60 per pound. Per capita consumption there is around four pounds per year at the same per capita income level as in Sarawak. There seems to be no reason to suppose that given Peninsular Malaysia prices for beef, consumption should not rise to West Malaysian levels. These appear to be three times higher than the Sarawak level.

In making projections of the demand for beef, the following assumptions are made:-

(a) The population will grow at an average 2.5 per cent per year;

(b) That income per capita will grow at 3 per cent per year;

(c) That price changes will occur and that these will tend to be downwards. Prices elasticity could be in the region of 3.0;

(d) That the income elasticity of demand for beef will be between 0.5 and 1.0.

Various estimates for income elasticity of demand for meat and beef have been made. FAO estimates (1967) used for agricultural commodity projections to 1975 and 1985 were 1.07 for all meats and 1.2 for beef. In the Indicative World Plan for Agriculture (FAO, 1961), the estimate for all meats was lowered to 0.9. Purvis, (1965) estimating in Malaya for 1957/58 data suggested a value of 1.26 for all meats. Thus a value in the range 1.0-1.4 could be appropriate under normal circumstances. However, it is felt that if the high price of meat is maintained in Sarawak, a lower value of say 0.5 should be used for income elasticity of demand.

Assuming an income elasticity of demand of 0.5 at the current retail market price, per capita consumption is projected to be 1.93 pounds per annum by 1995. The countrywide consumption of beef would then be 3.5 mn pounds compared to the current 1.6 mn pounds. In terms of cattle slaughtered the former figure would be equivalent to 7 000 carcasses. The projected consumption of beef and the number of animals required to produce this amount of meat are shown in Table 11.2.

TABLE 11.2 PROJECTED BEEF CONSUMPTION IN SARAWAK 1975-1995 AT CURRENT PRICE LEVELS

Year	Beef consumption		Equivalent No. carcasses at 400 pounds each	Total animals required*
	Per capita pounds	Total thousand pounds		
1975	1.43	1 567	3 917	19 625
1980	1.54	1 910	4 775	23 750
1985	1.66	2 329	5 822	29 000
1990	1.79	2 843	7 107	35 500
1995	1.93	3 466	8 665	43 250

Note * Total number of animals required in a herd to produce the number of slaughter animals shown.

The possible effect of an increase in beef supplies would be decrease in retail prices which, if brought to the levels prevailing in Peninsular Malaysia of $1.60 per pound, would increase consumption to an estimated 4.3 pounds per capita. Projections based on these consumptions are shown in Table 11.3. By 1995 per capita consumption might be 9.0 pounds and the total quantity of meat demanded would be 16.1 mn pounds, equivalent to 40 000 carcasses per annum.

TABLE 11.3 PROJECTED BEEF CONSUMPTION IN SARAWAK 1975-1995 AT LOWER PRICE LEVELS

Year	Beef consumption: Per capita pounds	Beef consumption: Total thousand pounds	Equivalent No. carcasses at 400 pounds each	Total animals required*
1975	5.0	5 480	13 700	63 125
1980	5.8	7 192	17 940	89 875
1985	6.7	9 400	23 500	117 500
1990	7.8	12 386	37 212	150 500
1995	9.0	16 164	40 412	208 250

Note * Total number of animals required in a herd to produce the number of slaughter animals shown.

11.2.2 External Market

The main markets to which Sarawak beef might be exported are Singapore, Hong Kong, Japan and Brunei. All are already supplied live animals and/or meat by large scale, well established organisations in Australia, New Zealand, China, Thailand and Indonesia. To compete with these traditional suppliers will require efficient production methods and high veterinary standards.

Few statistics of beef imports into the above countries are available in Sarawak. However, the Singapore market is currently estimated to require 12 000 live animals and 7 mn pounds of frozen beef annually and by 1990 demand will treble even at a conservative rate of growth. Medium quality curry meat accounts for a large proportion of the market but nevertheless there is an increasing demand for better quality carcasses. Sarawak is well positioned to supply this market. Hong Kong is a large importer of live animals, and Japanese imports of chilled and frozen beef increased from 13.5 thousand metric tons in 1968 to 23.2 thousand metric tons in 1970. These markets provide prospects for future development.

Since the export of chilled or frozen meat would require costly slaughter house and refrigeration plant, which would not be worth establishing for less than 25 000 head per annum, initial developments should be based on live animal exports.

Whichever course is pursued continued freedom from diseases, particularly foot and mouth, is a prerequisite for export trade. Considerable care should, therefore, be taken over quarantine facilities and regulations during the development phase of a beef industry when breeding stock is being imported. Similarly the importation of fresh or chilled meat should be subject to veterinary regulations.

11.3 OBJECTIVES OF THE PROPOSED PROJECT

The overall objective would be the establishment of a substantial base for the future development of a commercial beef industry in Sarawak.

Within this overall objective the primary objectives would be:-

(a) The establishment and subsequent development of a 5 000 acre commercial beef cattle breeding and production unit.

(b) The identification of production problems generated during the development of this unit.

Secondary objectives would be:-

(a) To establish the base and the production parameters for the future organisation of a stratified beef industry in Sarawak, incorporating breeding, growing-out and fattening sectors.

(b) In conjunction with the Livestock Production and Animal Husbandry Training Centre to train local staff and labour, at all levels, in large scale beef production methods and provide facilities for the further training of Department of Agriculture livestock extension staff.

(c) To provide highly productive breeding stock for the future expansion of the beef industry.

(d) The development of an efficient marketing system for live animals and beef.

(e) The development of agro-industries, such as an abattoir and a hides preservation unit, based on the beef industry.

CHAPTER 12

DESCRIPTION OF THE PROJECT

12.1 CHOICE OF THE PROJECT

There are a number of possible sites within the Study Area that could be suitable for an initial scheme but a site at Sungai Karabungan (Figure 12.1), adjacent to the SLDB's oil palm plantation has been chosen for the following reasons:-

(a) About 18 000 acres of unencumbered, logged, State Land is available in a single block. This area could provide sufficient land for the initial scheme and for future expansion, either in large or small-holdings.

(b) On account of the generally shallow soils the area is not suitable for the development of oil palm based development.

(c) Access to the proposed site is reasonably good from the main Miri-Bintulu road, and part of the cost of access road upkeep would be provided by adjacent SLDB oil plantation. Access could also be provided quite easily to the Sibuti river system.

(d) Several small streams in the area together with the undulating topography and the adequate total rainfall make it possible to provide water supplies for cattle quite cheaply by the construction of a number of small dams.

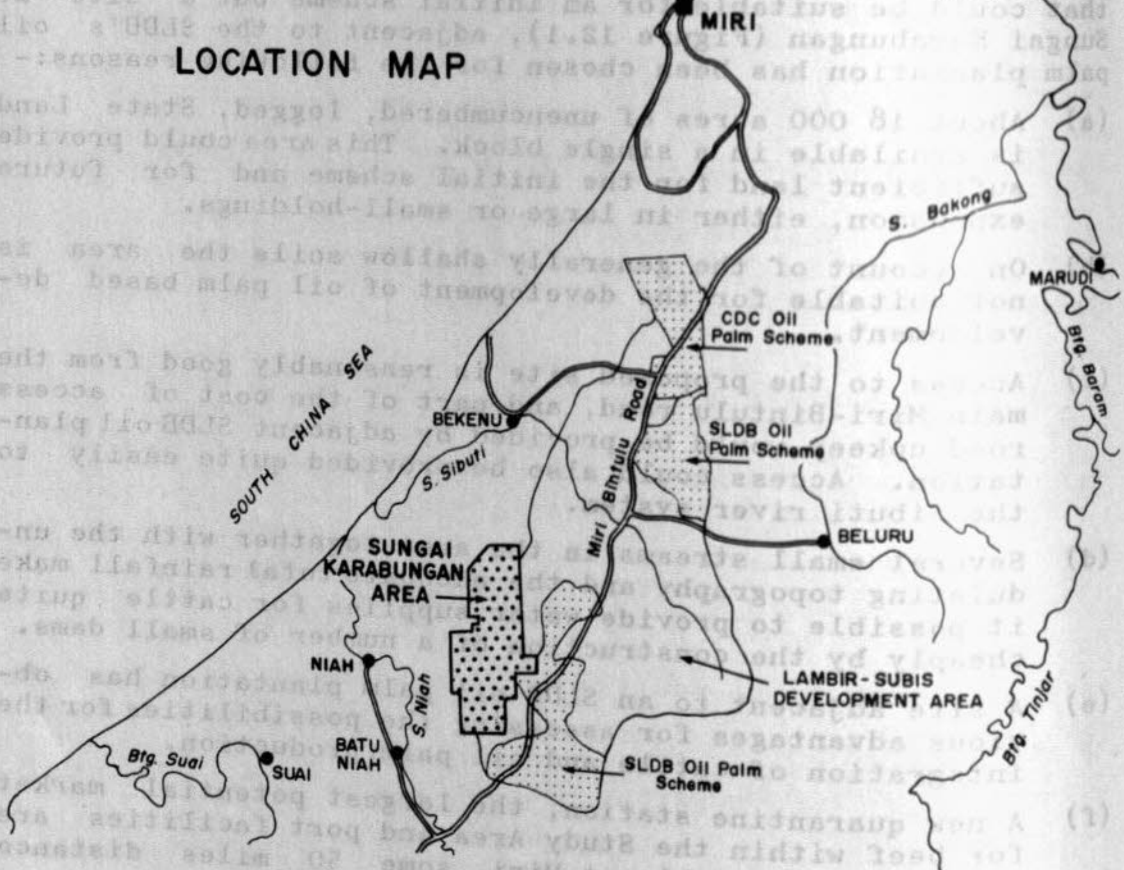
(e) A site adjacent to an SLDB oil palm plantation has obvious advantages for assessing the possibilities for the integration of cattle and oil palm production.

(f) A new quarantine station, the largest potential market for beef within the Study Area and port facilities are or will be available at Miri, some 50 miles distance from the proposed site.

The Sungai Karabungan area of 19 964 acres was covered by semi-detailed soil surveys as described in Supporting Report 1 Part II. Most of the area surveyed is unoccupied, logged State Land but is still currently under licence. Salvage logging should be carried out prior to land clearing operations, and this is planned for in Supporting Report 3 Part I.

On the basis of the land use potential classification an area of 5 700 gross acres in extent was selected for the project as shown on Figure 12.2. The area chosen consists mainly of soils which are derived from calcareous parent materials and having a clay or silty clay texture, there is a relatively small area of soils derived from non-calcareous materials in the north western section of the project. On the whole soil depths are shallow, between 25 and 75 cm in the northern half but deeper in the southern section. The topography of the area is generally gently undulating with average slopes of

FIGURE 12.1

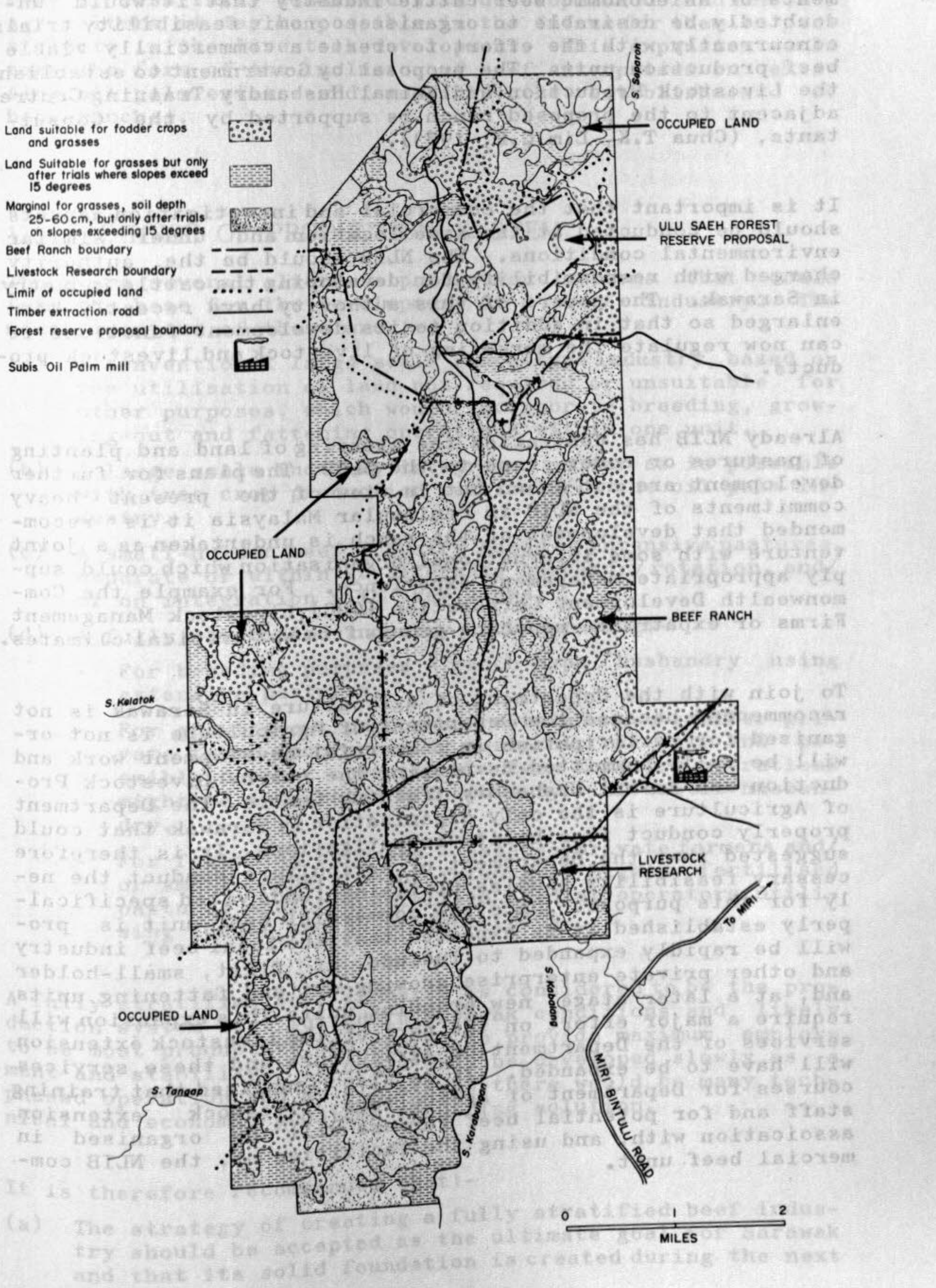


under 10 degrees. The north western section tends to be somewhat more broken and a small area enclosed within the project boundary should remain as a forest enclave.

The effects of grazing animals on the generally heavy-textured soils is an aspect which will require careful observation and management because it is not known to what extent poaching or compaction might occur.

FIGURE 12.2

SUNGAI KARABUNGAN LIVESTOCK DEVELOPMENT AREA



12.2 CHOICE OF ORGANISATIONAL STRUCTURE

So little is known as to some of the basic technical requirements of an economic beef cattle industry that it would undoubtedly be desirable to organise economic feasibility trials concurrently with the effort to create a commercially viable beef production unit. The proposal by Government to establish the Livestock Production and Animal Husbandry Training Centre adjacent to the proposed ranch is supported by the Consultants, (Chua T.K, Lim C.P, 1973).

It is important that the commercial and investigation aspects should be conducted at the same location and under similar environmental conditions. The NLIB should be the authority charged with responsibility for developing the cattle industry in Sarawak. The powers of this authority have recently been enlarged so that in addition to its development functions it can now regulate the marketing of livestock and livestock products.

Already NLIB has contracted the clearing of land and planting of pastures or cover crops to the SLDB. The plans for further development are not known but in view of the present heavy commitments of the NLIB in Peninsular Malaysia it is recommended that development of the ranch is undertaken as a joint venture with some international organisation which could supply appropriate management experience. For example the Commonwealth Development Corporation (CDC), Livestock Management Firms or expatriate ranching groups from wet tropical climates.

To join with the Department of Agriculture in Sarawak is not recommended because the Department of Agriculture is not organised for participation in commercial development work and will be fully committed developing the nearby Livestock Production and Animal Husbandry Training Centre. The Department of Agriculture is the only organisation in Sarawak that could properly conduct feasibility investigations. It is therefore suggested that the Department of Agriculture conduct the necessary feasibility studies utilising funds voted specifically for this purpose. Once the commercial beef unit is properly established it is expected that the local beef industry will be rapidly expanded to include, at first, small-holder and other private enterprise growing-out and fattening units and, at a later stage, new breeding units. This expansion will require a major effort on the part of the livestock extension services of the Department of Agriculture and these services will have to be expanded. It is also visualised that training courses for Department of Agriculture livestock extension staff and for potential beef farmers will be organised in assoication with, and using the facilities of, the NLIB commercial beef unit.

Although the existing managerial resources of the SLDB are more or less fully committed with development of land for crop agriculture it may be possible in the future for them to participate in the livestock development. This expansion would take the form of the inclusion of beef enterprises on existing oil palm estates and, possibly, the establishment of beef ranches.

12.3 CHOICE OF PRODUCTION SYSTEM

There are several alternate production systems that could form the base for the development of a beef industry. The most important of these are :-

(a) A conventional large scale ranch-type industry, based on the utilisation of land not required or unsuitable for other purposes, which would incorporate breeding, growing-out and fattening operations within one unit.

(b) A large scale industry integrated as far as is possible with tree crop production particularly the oil palm industry.

(c) A small-holder beef industry based on intensive pastures, separate or within an alternate husbandry rotation, and/or on integration with tree crops.

(d) A fully stratified industry incorporating:-

- For breeding purposes - ranch-type husbandry using extensive pastures.
- For growing-out purposes - estate and/or smaller private farms incorporating pastoral, oil palm and possibly coconut operations. Even forestry operations might be integrated with this type of cattle husbandry.
- For fattening purposes - estates, private farmers and/or small-holders using intensive, highly fertilised pastures and/or specialised feedlot operators utilising fodder and by-product feeds.

A fully stratified beef industry is considered to be the production system best suited in Sarawak conditions and likely to be most productive and geared to provide maximum employment and stability. It could only be developed slowly as a phased operation and at all stages there would be many technical and economic problems requiring solution.

It is therefore recommended that:-

(a) The strategy of creating a fully stratified beef industry should be accepted as the ultimate goal for Sarawak and that its solid foundation is created during the next twenty years.

(b) Phase 1 of this strategy, which should last five years, would include:-

- The establishment of a 5 000 acre cattle ranch at Sungai Karabungan, adjacent to the SLDB oil palm plantation. This should be considered as the major base for the development of the State's future cattle population; one important special task being the gradual establishment of an elite herd of breeding cattle. In addition, during this phase, the ranch would have to undertake the growing-out and fattening of most of its slaughter stock.
- The simultaneous organisation of feasibility trials to ascertain;
  - the most viable and economic pasture and animal husbandry methods to be employed on the ranch or on associated enterprises;
  - whether the adjacent SLDB oil palm estate could be used for the growing-out of cattle grazed on special pastures planted between the oil palms; and
  - whether cattle could be fattened in feedlots using fodder and local by-product feeds.
- The organisation of new slaughter and marketing facilities; the existing ones would be completely inadequate.

(c) During Phase 2, which would last 15 years:-

- Associated growing-out and fattening operations would be slowly developed on estates, private farms and small-holdings using managerial methods based on the information and techniques acquired during the Phase 1 feasibility trials.
- Development of the Sungai Karabungan ranch would continue with increasing emphasis being placed on its utilisation as a base for the production of breeding cattle and in conjunction with the Department of Agriculture station as a centre for the dissemination of information and services to small-holders and other associated producers.
- Establishment of other such ranches in other parts of the Study Area and Sarawak using breeding stock from the Sungai Karabungan ranch.

CHAPTER 13

PRIMARY DEVELOPMENT

The existing cattle industry is so small and so fragmented that the development of one 5 000 acre unit will determine the future of the State's cattle industry for at least the next two decades. Under these circumstances it is essential that the correct basic decisions should be taken as to the scheduling of initial operations, the choice of pasture(s), the choice of breed and the methods of management.

13.1 PROPOSED SCHEDULE OF OPERATIONS

Realistic scheduling is an essential prerequisite of development planning and in this project scheduling is required for the field operations, the purchase and management of the cattle, the recruitment and training of management and labour and the provision at the appropriate time of the fixed equipment.

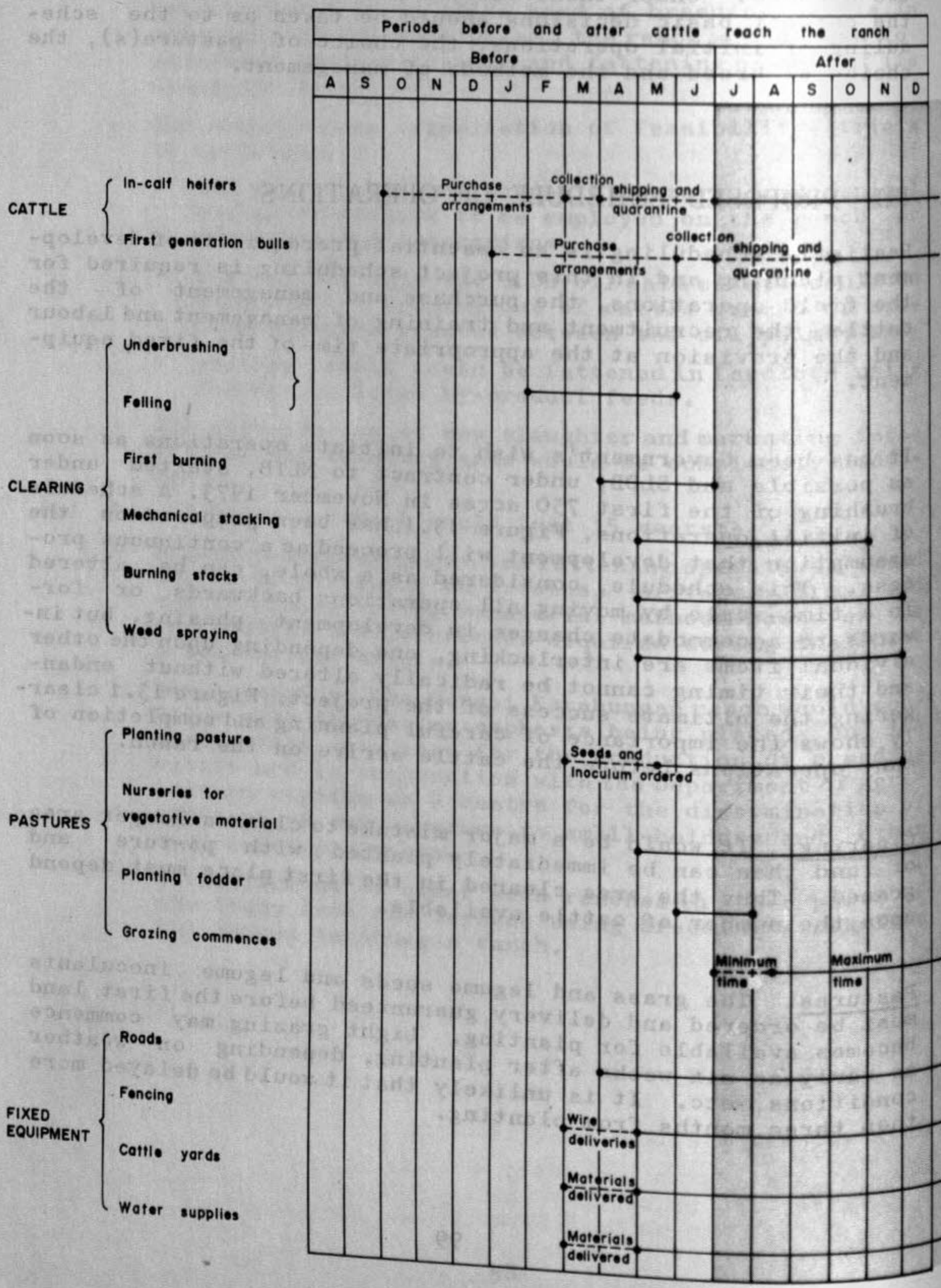
It has been Government's wish to initiate operations as soon as possible and SLDB, under contract to NLIB, started under brushing of the first 750 acres in November 1973. A schedule of initial operations, Figure 13.1, has been prepared on the assumption that development will proceed as a continuous process. This schedule, considered as a whole, can be altered in a time scale by moving all operations backwards or forwards to accommodate changes in development phasing, but individual items are interlocking, one depending upon the other and their timing cannot be radically altered without endangering the ultimate success of the project. Figure 13.1 clearly shows the importance of careful planning and completion of many operations before the cattle arrive on the ranch.

<u>Clearing</u>: It would be a major mistake to clear a larger area of land than can be immediately planted with pasture and grazed. Thus the area cleared in the first place must depend upon the number of cattle available.

<u>Pastures</u>: The grass and legume seeds and legume inoculants must be ordered and delivery guaranteed before the first land becomes available for planting. Light grazing may commence as early as six weeks after planting, depending on weather conditions, etc. It is unlikely that it would be delayed more than three months from planting.

FIGURE 13.1

SCHEDULE INDICATING TIMING FOR INTEGRATION OF PASTURE DEVELOPMENT AND CATTLE PURCHASING OPERATIONS



Cattle: Breeding cattle for the proposed ranch must be imported. Not only are the local stock not beef-type animals but the size of the national herd is such that even under the most favourable circumstances there could only be 200 to 300 surplus breeding heifers available annually. The arrangements for importing cattle will have to be made far in advance. These arrangements should include inspection and purchase, collection within the exporting country, transport to Sarawak, quarantine within Sarawak and transport to the ranch. The first shipment of cattle could be quarantined on the ranch, but it would be better to have the quarantine station in Miri ready for this. Subsequent shipments would have to be quarantined either in Kuching or Miri. Whether the cattle go direct to Miri or Kuching will require careful consideration. At Miri the off loading of the cattle from a large ship will have to be into lighters. This could be hazardous to in-calf animals especially if the weather is rough as it may well be during the October to January monsoon season. It would appear better for the animals to go first to Kuching where they can be quietly unloaded directly to shore. Subsequently they could be transported to Miri in smaller ships or barges that can sail into the harbour.

Management and labour: The problems of recruiting and training managers and labour are discussed in a later Section but it is recommended that expatriate management skills should be employed in the first instance because of the severe shortage of qualified and experienced local people in the whole of Malaysia. An expatriate manager should be recruited at an early stage in the operations, preferably from the country of origin of the cattle, so that he can help select the cattle before his arrival in Sarawak.

Fixed equipment: Roads must be developed during land clearing and fencing wire delivered before the first pastures are planted. Belian, a local forest tree (*Eusideroxylon zwageri*) which produces rot-resistant timber, can be used for posts and obtained from the forests before they are felled and burned. The first cattle yard must also be completed before grazing. It is essential that managers and labour should live on the ranch and therefore plans for housing must be prepared and the building contracts let, well before the main labour force is expected to arrive.

13.2 CHOICE OF CLEARING METHODS

There are likely to be major differences in cost between different methods of clearing and establishment of pastures. Two methods should be considered:-

(a) partial destumping where grass and/or legume seeds would have to be planted or oversown by hand;

(b) clean clearing where seeds could be drilled and/or vegetative material planted by hand or machine.

The first method would be similar to that employed for oil palm planting and would include underbrushing, felling, uprooting the smaller stumps, stacking, burning, weed spraying and planting or sowing seeds in the ashes. The second method would include underbrushing, felling or bulldozing the trees, complete derooting, stacking, burning, cultivating and sowing the seeds or planting vegetative material in the prepared land. Table 13.1 shows the approximate calculated costs of the two methods but only practice will finally establish their advantages or disadvantages.

Whatever method of clearing is used a belt of forest 50 feet wide should be left unfelled on either side of creeks and streams and steep slopes should also remain uncleared. The SLDB calculate that on their present estates 19 per cent of the land is unusable for oil palm planting after clearing. On the proposed ranch site most of this type of land should not be cleared in the first instance.

The problem of providing natural shade for cattle will be partially solved if some forest remains unfelled and fences are located so that cattle have access to the unfelled areas. Large rain forest trees are unsuitable as shade trees but small trees could be left standing for shade purposes along projected fence lines or in isolated clumps. Probably these would eventually have to be replaced by suitable planted shade trees.

13.3 CHOICE OF PASTURE SPECIES

Although some experimental studies have been made by the Department of Agriculture, at Semongok and Tarat in the First Division, as to the most suitable grass and legume species to use in the country, there are at present virtually no commercially established and managed pastures. Thus any proposals as to the most suitable species to use on the commercial ranch must depend primarily on experience gained in somewhat similar environments outside Sarawak. It should be emphasised, however, that very limited differences between environments can markedly influence the growth of both grass and legume species so that overseas experience is no real substitute for local feasibility trials.

Within the proposed ranch area the choice of adaptable species will depend upon the slope and drainage of the land, the depth of soil and inherent soil fertility. Sufficient information is available to suggest that some or all of the species discussed below might be utilised. Generally a grass/legume mixture would be preferred and should be tried wherever there is a chance of success. The only two legume species that appear to be worth consideration are Centrosema pubescens (centro) and Stylosanthes guyanensis (stylo). The most productive strain of the latter appears to be Q8558. Seeds of both legumes are readily available and seeding rates are suggested. However, all the seeding and fertiliser rates quoted are tentative and subject to revision after experience and investigation.

TABLE 13.1 DIFFERENCES IN THE ESTIMATED COST PER ACRE OF TWO DIFFERENT METHODS OF ESTABLISHING GUINEA GRASS PASTURE

Operations	Method 1 Partial destumping	Method 2 Clean clearing
	$ per acre	$ per acre
Initial clearing (1)	275	350
Cultivation and seeding (2)	-	150
Spraying weeds, behind clearing (1)	3	-
Seeding in ashes (1)	8	-
Seeds: guinea, stylo, centro and inoculant (2)	23	23
Initial fertiliser application 140 pounds per acre of 40 per cent superphosphate (2)	27	27
Total costs	$336	$550

Notes: 1) SLDB Estimate
2) Asian New Zealand Development Consultants Ltd. Estimate (1971)

Grass species for the low and wet soils:

Brachiaria mutica (para) - this grass is not particularly recommended by the authorities at Semongok but it was seen to be growing well in damp localities in other parts of the State. Some para seed is available from Australia and the seeding rate is 2 pounds per acre. It is, however, usually propagated vegetatively. Leersia hexandra (rice grass) - This is found in local swamps and is known, from overseas experience, to be a useful grass for beef cattle. No commercial supplies of seed are available. The grass will have to be propagated vegetatively or by collecting seed locally. It seeds prolifically in the Study Area.

Both grasses could be planted vegetatively from cuttings and disced in, or from slips planted 30 inches apart and 24 inches within the row. Centro will mix with either grass and should be seeded at a rate of no less than seven pounds per acre. Phosphate fertilisers should be used at establishment and nitrogenous fertilisers later with discretion.

Grass species for better drained, medium and deep soils:

Digitaria decumbens (pangola) - According to the Semongok authorities this grass is only competitive with the indigenous grasses when it is very heavily fertilised. It has to be propagated vegetatively. Cuttings should be spread and disced in. At Semongok 400 pounds per acre per annum of a complete fertiliser are used. An initial application of 200 pounds per acre of an 18:11:5 compound fertiliser could be used, followed by alternate applications of complete fertiliser and nitrogenous fertiliser.

Brachiaria brizantha (signal) - This grass appears quite promising under trial at Semongok and in Brunei. Planting and fertiliser applications should be the same as for pangola grass.

Brachiaria decumbens - This is a promising grass at Semongok. It is normally planted vegetatively but seed is available overseas. To obtain a good germination the seed coat must be removed by acid treatment before planting. The treatment is to soak the seed in commercial quality sulphuric acid for 10 to 15 minutes, then thoroughly wash the seed and sow immediately. Fertiliser application should be the same as for pangola grass.

Cynodon plectostachyum (African(Naivasha)star grass) - This grass has done well in Peninsular Malaysia under somewhat similar environmental conditions. It has to be propagated vegetatively and should be managed in the same way as pangola.

Grass species for the well drained elevated soils:

Panicum maximum (guinea) - This grass is known to perform well in slightly drier climates but some evidence suggests that some strains of guinea might be suitable. It can be propagated from seed or vegetatively. The seeding rate should be four pounds per acre. If it is sown without legumes managerial treatment should be approximately the same as that for pangola. When planted with legumes the seeding rate for a stylo-centro mixture should be two pounds of stylo plus five pounds of centro per acre. The legume seeds should be inoculated and planted approximately 0.5 inches deep in hand-made drill lines 36 inches apart. Single 18 per cent superphosphate should be applied in a band alongside or preferably beneath the seed at the rate of 336 pounds per acre. The equivalent of triple-superphosphate could also be used. After establishment phosphatic fertiliser should be used annually and Christmas Island rock phosphate could be used at this stage. The seeds should not be mixed with the fertiliser because of the danger of destroying the legume inoculant. Nitrogenous and/or complete fertilisers should be applied with discretion when the grass appears to need it, taking care not to cause major damage to the legume component of the pasture.

Indigenous grasses: Paspalum confugatum (sour grass) is a common grass which pioneers cleared areas. It is palatable when young but it is not a heavy producer. Ischaemum spp. appear to be secondary invaders of cleared areas. They are palatable when young. A stylo-centro legume mixture should be planted in the indigenous grasses in the same way as it is planted in guinea. Indigenous grass-legume pastures should also be managed in the same way as guinea-legume pastures.

Fodder grasses:

Pennisetum purpureum (elephant or Napier) - This is considered by the authorities at Semongok to be the most productive fodder grass in the local environment. It must be planted on cultivated land. Establishment could be by planting stem cuttings approximately 18 inches long containing two nodes at 18 by 18 inches spacing, or by laying long mature stalks in furrows 24 inches apart and then covering them with soil. A legume such as centro should be drilled between the rows at the rate of 5 pounds per acre. When elephant grass is planted without a legume it should be heavily fertilised. Initially at least 224 pounds per acre of an 18:11:5 compound fertiliser should be used. When it is planted with a legume a fertiliser mixture much higher in phosphatic fertiliser rates should be used.

Tentative estimated carrying capacities of the above pastures during the first years after establishment are as follows:-

- indigenous grasses plus legumes	0.5+ l.s.u.'s per acre
- guinea grass plus legumes	0.75 l.s.u.'s per acre
- planted pastures	1.00 l.s.u.'s per acre

13.4 METHODS OF PASTURE ESTABLISHMENT

The basic requirement is that establishment should be at minimum cost. No effort should be made to attempt the establishment of one species in paddocks where the topography is markedly varied. In general, para or rice grass should be planted in the lower swampy areas of paddocks and guinea should be planted, or indigenous grasses be allowed to establish themselves, on the higher well drained areas. It would also be a mistake to depend entirely on one grass or grazing. Different grasses demonstrate somewhat different growth cycles so that the use of several grass species would provide a more even production throughout the year. Some fodder, preferably Napier, should also be grown, especially in the early experimental years, as an insurance policy against failure to establish a particular pasture and against the infrequent drought periods.

There could be major differences in fertiliser requirements according to the type of pasture established. Experimental work at Semongok has established that a planted pasture such as pangola requires up to 400 pounds per acre per annum of a complete fertiliser if it is to compete successfully with the indigenous grasses. It is believed, though there is no experimental proof, that guinea, para and rice grass pastures would also require fairly large fertiliser applications. On the other hand it is thought that the indigenous grass pastures with introduced legumes will only require a large initial application of phosphatic fertiliser, followed by smaller applications of phosphatic fertilisers at specific intervals and perhaps some small application of nitrogenous fertilisers from time to time. Differences in the calculated cost of fertilising some of these different pastures, together with assumed carrying capacities and yield of liveweight gain per acre, are shown in Table 13.2. It is suggested that the cheapest method of application of fertilisers to unstumped pastures would be by air. It will be essential to conduct feasibility trials on fertiliser requirements for different types of pasture.

Another factor that could greatly influence costs is the degree of weed infestation during establishment. Sowing or planting of seeds should therefore take place immediately after the burn, and seeding rates should be sufficient to ensure rapid cover of bare land.

13.5 CHOICE OF BREED

Experimental work and commercial practice in Malaysia offers no guide at present as to the most suitable breed(s) to import, but an assessment of the situation suggests that there are five possible importation policies. The correct policy could be one or a combination of two or more. The alternative policies are as follows:-

(a) The importation of purebred bulls and breeding females. This is a practical policy based on experience elsewhere. It would be very expensive to import many for example purebred Brahman cattle but there are other breeds that might be considered, such as the Indonesian Ongole, the Madagascar Zebu and the Bali.

(b) The importation of two or more pure breeds of cattle and their utilisation in a crossbreeding programme. This

TABLE 13.2 DIFFERENCES IN THE CALCULATED COST PER ACRE OF FERTILISING PASTURES, ASSUMED CARRYING CAPACITIES, YIELD OF LIVEWEIGHT PER ACRE AND TOTAL RETURN PER ACRE OVER THE FIRST FIVE YEARS

	Indigenous grass plus legumes	Guinea grass plus legumes	Planted pangola grass
	Dollars per acre		
First year			
Pounds per acre			
140 of 40 per cent superphosphate	27	27	-
400 of complete 18:11:5 compound (Semongok)	-	-	64
120 of complete 18:11:5 compound	-	19	-
Second year			
Pounds per acre			
45 of Christmas Island Rock Phosphate	4	4	-
400 of complete 18:11:5 compound	-	-	64
120 of complete 18:11:5 compound	-	19	-
Third to fifth year as year two	12	69	192
Total for 5 years	43	138	320
Cost per year	8.6	27.6	64
Assumed carrying capacity/l.s.u.'s/ acre	0.5	0.75	1.0
Assumed l.w.g. lb/day	0.5	0.75	1.0
Assumed l.w.g. lb/year	182.5	273.8	365
Assumed l.w.g. lb/acre/year	91.3	205.4	365
Assumed return dollar per acre per year	45.7	102.7	183.5

could be less expensive than the previous programme if cattle from one breed could be purchased very cheaply and upgraded using bulls or semen from the other more expensive breed. One example would be the importation and upgrading of Madgascar Zebu heifers using Brahman bulls. It is well established that crossbreds are generally the most productive of all beef cattle in the humid tropics but crossbreeding is a system that is difficult to sustain. Another alternative possible for the Study Area is that it should be ultimately possible to maintain *Bos taurus* beef-type breeds at higher altitudes at Bario and use them to produce bulls and/or semen for crossbreeding with *Bos indicus* females at the lower altitudes where the future beef industry will be mainly established.

(c) The importation of animals of an established *Bos taurus* x *Bos indicus* breed, such as the Santa Gertrudis, the Beefmaster, the Brangus and the Charbray from the United States, the Droughtmaster from Australia and the Bonsmara from South Africa. Given high standards of feeding and management there is no doubt that animals of some of these breeds would thrive in Sarawak, but such standards cannot be guaranteed during the first phase of the project. In addition cattle of these breeds would be expensive to purchase.

(d) The importation of crossbred (1/2 to 5/8 *Bos indicus*) heifers and the use of purebred Brahman bulls to upgrade them. The advantages of this policy are that crossbred heifers of this type can be purchased relatively cheaply in Australia and when they are upgraded, using purebred Brahman bulls, the first generation of calves bred and born in Sarawak should exhibit some degree of hybrid vigor.

It is recommended that the breed for the commercial unit should be the Brahman and that the initial importation and breeding policy should be as follows:-

(a) Importation of approximately two-year old, pregnancy tested in-calf, low grade (1/2 to 5/8 zebu), crossbred zebu heifers from Australia. Although in-calf heifers will be more expensive to purchase than younger non-pregnant heifers, they are likely to be more economic in the long term (Table 13.3), also the commercial herd can be expanded more rapidly and imports of bulls will not be required immediately. In addition, if the offspring of the in-calf heifers are generally unrelated this should provide a broad genetic base for breeding operations within the commercial herd.

(b) An importation of at least 50 purebred pregnancy tested; in-calf Brahman heifers from Australia. The heifers and their offspring should be unrelated to any bulls that may be purchased and, if possible, to bulls that served the imported in-calf crossbred heifers. These heifers would form the nucleus of an elite breeding herd and a selection would be made from their first crop of bull calves for the second and subsequent generation ranch bulls.

TABLE 13.3 DIFFERENCES IN THE LIVESTOCK INVENTORY AND THE TOTAL ESTIMATED VALUE AFTER FIVE YEARS BETWEEN IMPORTING 1 000 IN-CALF HEIFERS AND 1 000 14-18 MONTH OLD HEIFERS

	Importing 1 000 in-calf heifers	Importing 1 000 14-18 month old heifers
Livestock inventory (Year 5)		
Heifers and cows	1 265	800
Female calves	411	260
Male calves	411	260
Female yearlings	329	264
Male yearlings	329	264
Female 2 year olds	222	278
Male 2 year olds	222	278
Male 3 year olds	251	-
Sold between first and fifth year		
Cull cows	300	200
Steers	427	-
Estimated value dollars	1 208 350	690 300

Assumptions: - All imported in-calf heifers in calf.
- Calving percentage in Sarawak 65.
- Mortality percentage in Sarawak 10 until weaning and 5 thereafter.
- 10 per cent culling of breeding cows.
- Value estimated at $0.50 per pound liveweight.

(c) The importation of a sufficient number of purebred, high genetic merit Brahman bulls for use as the first generation of ranch bulls. It is recommended that these bulls be imported from the United States because of the greater choice and higher genetic merit available there than in Australia. The advantages of the overall importation policy are that:-
- it would be the least expensive import policy
- low grade crossbred zebu heifers are much more easily obtainable in Australia than higher grade zebu heifers; and
- the first generations of calves bred in Sarawak would exhibit some degree of hybrid vigour.

13.6 TECHNICAL ASSUMPTIONS AS TO THE LIKELY PERFORMANCE OF THE CATTLE

Details of the assumptions that have been made as to the likely performance of the imported and Sarawak bred cattle are given in Table 13.4. These assumptions are deliberately conservative because the performance of cattle in the Sarawak environment has not been well established.

TABLE 13.4 TECHNICAL ASSUMPTIONS AS TO THE PERFORMANCE OF THE CATTLE

	Years of project		
	1 - 5	6 -10	11-20
Calving per cent	1 st year* - 90 years 2-5 - 65-75	76-80	80
Mortality per cent: pre-weaning	5	3	3
: post-weaning	2	1	1
: breeding cows	2	2	2
Culling per cent (heifers and cows)**	1 st year Nil years 2-5 - 10-11	12-15	15
Average age at first calving of heifers (months)	30	30	30
Age of bulls at first service (months)		24-36	
Ratio of breeding females to bulls	15:1	20:1	20:1
Average age of steers at slaughter (months)	30	24	24
Average weight of steers at slaughter (pounds)	700	800	900
Average killing-out per cent of steers	54	55	56
Average weight of culled cows (pounds)	800	850	900
Average killing-out per cent of culled cows	50	50	50
Average weight of culled heifers (pounds)	700	725	750

Notes: * Only in-calf heifers imported during the first year.

** All non-breeding heifers to be culled. All cows that do not breed but have produced a calf in the previous year to be given a second chance.

13.7 MANAGEMENT AND LABOUR

A high standard of management will be a crucial factor in assuring the success of this project. Initially expatriate management will be required to provide the high standard because there are no local cattle men with the necessary experience of large scale beef cattle farming. Thus the questions to be faced are:-

- what type of managerial structure is needed by an enterprise of this type?
- for what period will expatriate management be required?
- by what method should the expatriate management be recruited?

In a country where the cattle industry is well established, an enterprise of this type would require only one manager assisted by experienced stockmen and a well staffed and experienced extension and investigational organisations for technical advice and services. The situation will be quite different within the proposed project. Here the expatriate manager will be required to teach an understudy, who will replace him after a certain period. Also the manager will need special technical assistance until such time as the State extension and investigation services have been expanded and have gained essential experience. It is recommended that the manager is provided with at least the part-time services of a pasture and forage agronomist and of a veterinarian. These technical personnel could also assist in the economic feasibility trial programme on the nearby Government station.

It is obviously difficult to estimate the length of time that expatriate management will be required. It will depend on the problems encountered, how quickly they are solved, and on the calibre of the understudy manager and other staff. For planning purposes a period of five years has been taken.

For calculation purposes it is suggested that an initial period of three years with the option to continue on an annual basis might satisfy the requirements of the project and the personal needs of the manager recruited. After approximately three years a second trainee manager is assumed to be recruited. He would become the assistant manager as soon as the expatriate manager was replaced by a local manager.

There are two major methods by which an expatriate manager could be recruited. Either directly by the authority operating the project or as part of an overall contract by which a consultancy firm provided expatriate management, overseas training of the local understudy manager and other services, such as the purchase of cattle.

Other managerial functions apart from the technical ones are finance and accounts. If the authority operating the project is the SLDB then the management of finance and accounts would present no problems as suitable administrative arrangements already exist.

The recruitment of suitable livestock labour will present many problems. Only the Kelabits and the Muruts among the indigenous Sarawak people have any long experience of cattle husbandry and they have no practical experience of a large scale operation. Therefore it is recommended that two or three expatriate stockmen are recruited for a short period. Their major duty would be to instruct locally recruited labour in the practical aspects of large scale cattle husbandry. They could be recruited for one year with an option for a further period, if this was thought to be required. The recruitment of other labour such as a clerk/accountant drivers and a mechanic should present no difficulties.

It is further recommended that the NLIB should contract with an Australian consultancy group to select, purchase and transport the cattle to be imported from Australia, provide the expatriate management and stockmen and arrange for overseas training of local managers.

13.8 FIXED AND OTHER EQUIPMENT

Roads

A good all weather road, leading from the main Miri-Bintulu road to the administrative centre of the ranch, will be required together with lower standard internal roads leading to all paddocks. A bulldozed road constructed immediately inside the perimeter fence is recommended because it would provide easy access for inspection and maintenance of the perimeter fence and act as a firebreak. All internal roads could be maintained by use of a grader blade attachment on a wheeled tractor.

Fences and paddock size

Fence lines should be demarcated at the time of forest clearing. All stumps should be cleared from along the fence lines and the route smoothed out by use of a bulldozer in order to eliminate small humps and hollows, thus facilitating fence construction and reducing its cost. In order to ensure complete control of the grazings and the cattle the maximum size of paddocks should be 100 acres. At least 30 smaller paddocks of 20-acres will also be required. There are several fencing methods that could be employed; three are considered suitable for the project:-

(i) - ordinary belian posts with barbed wire and droppers;

(ii) - belian posts with smooth high-tensile wire and droppers;

(iii) - live posts with barbed wire and droppers. Possible live post species that could be used are; Dellinia spp. and particularly D. suffructicosa (local name simpok ayer), Oncosperma filamentosa (local name nibong), Pithecolobium spp. Pterocarpus indicus (local name yemane) and Gliricidia sepium.

The choice between (i) and (ii) will depend on the relative cost and availability of the wire. It is recommended that the perimeter fence should be constructed by either of these methods and that the cheaper live post method is attempted for sub-division fencing. A fencing master-plan must be prepared, the perimeter fence erected first and the sub-division fences then gradually erected as they are required in accordance with the master plan.

Cattle working yards

Two working yards will ultimately be required, able to accommodate up to 300 head of cattle at any one time. They should incorporate a spray race or dip, crush and head bail, weighing scales, drafting gates, a veterinary gate for pregnancy diagnosis and a loading and unloading ramp. Detailed construction plans for different types of working yards are readily available in many livestock text books and could be provided if necessary by the Consultants. Construction of the yards should be phased, one being required immediately the first cattle are introduced onto the ranch.

Shade

Some form of shade for the cattle is desirable. If the forest is cleared according to the suggested procedure shade will be immediately available in the majority of paddocks.

Water

Water must be made available both for domestic use and for the cattle. Water for cattle must be available in every paddock and it can be assumed that consumption will be on average 10 gallons per head per day. In the Karabungan area water for the cattle can be provided easily from small dams constructed on several semi-permanent streams. At present there are numerous permanent dams formed by the blocking of the drainage lines during forest logging operations. It is recommended that water should be piped from the dams to conveniently situated troughs because the surrounds of the dams are likely to become very soft and at times it could be difficult for the cattle to reach the water. Domestic water can also be supplied from dams.

Machinery

Even if the major part of the ranch is not clean cleared, some areas will have to be cultivated for the production of forage. Also in the other parts once the stumps have rotted pasture renovation and improvement can be partially achieved by cultivation. Thus machinery will be required for cultivation purposes, for forage harvesting and for pasture renovation. Equipment will also be required for the transport of men, material and cattle. Landrovers and light motorcycles have been proposed for use by the staff for internal transport. Horses too could be used but because there are so few in Sarawak this possibility has been disregarded for planning purposes. Additional equipment required are: an electrical generating set, the equipment for a workshop and for spray races, weighing machines in the cattle working yards and tractors. Details of these are given in the cost estimates.

Building and houses

Details are given under estimated development costs (14.10).

13.9 ESTABLISHMENT AND MAINTENANCE OF PASTURES

13.9.1 Pasture Establishment

Much of the terrain in the proposed ranch area is quite steeply undulating and complete destumping to provide areas suitable for mechanical cultivation will only be possible on a limited scale. Thus most pastures will have to be established by other methods. These could include:-

(a) sowing grass and/or legume seeds in the ashes after the first burn;

(b) sowing seed or planting cuttings in manually drawn traces as at present practised by the SLDB in the sowing of cover crops for oil palm plantations;

(c) overseeding legumes from vehicles or by air on natural or hand seeded pastures;

(d) feeding hard shelled legume seeds to stock who would then spread them over the grazings through their faeces;

(e) sod-seeding grasses in areas of established legumes.

13.9.2 Pasture Maintenance

There are two aspects of pasture maintenance; annual and periodic renovation. Properly managed pastures could last indefinitely but the correct techniques have yet to be worked out in Sarawak. Some suggestions and principles are discussed below.

The length of life of a pasture depends upon proper grazing management. This helps to ensure that desirable species are encouraged and that a proper balance is retained between the grass and legume components of the pasture. Proper grazing management depends upon:-

(a) Size of paddock - in the wet tropics paddock size should be small as pasture growth is rapid and uncontrollable in large paddocks, but some balance has to be held between desirable and economic practice. The absolute maximum paddock size should be 100 acres.

(b) Carrying capacity - this is more often under- than over-estimated on large holdings in the wet tropics.

CHAPTER 14

ESTIMATED DEVELOPMENT COSTS AND ASSUMPTIONS

Estimated costs have been calculated from data provided by the SLDB, the Department of Agriculture, local commercial firms and from assumptions based on experience elsewhere. They refer to the April-May period of 1973.

14.1 LAND CLEARING

Land clearing costs are related to the type of forest to be cleared, the method of clearing employed and the extent to which destumping is practised. The estimates provided are based on experience gained by the SLDB. This organisation fells manually and stacks mechanically. Complete destumping operations if required over a large area will necessitate purchase of more powerful machinery than is at present used by the SLDB.

Estimates of the cost of various types of clearing operations are as follows:-

(a) All clearing operations but no destumping; $190 per acre.

(b) All clearing operations with partial destumping; $255 per acre. In this operation the larger stumps would be left in the ground. It is expected that most of these stumps will rot within three to five years. Belian stumps will not rot but can be burned.

(c) All clearing operations with complete destumping; $360 per acre.

(d) Spot spraying weeds after partial destumping and before seeding or planting of the pasture species; $3 per acre.

14.2 PASTURE ESTABLISHMENT

Estimates of the cost of various types of pasture establishment, seeds and inoculants are as follows:-

(a) Cultivation and seeding after complete destumping; $160 per acre.

(b) Seeding in the ashes after a burn on cleared and partially destumped land; $71 per acre.

(c) Planting vegetative cuttings in cleared land; $180 per acre.

(d) Cover crop (legume) establishment in oil palm plantations and maintenance until the third year; $36 per acre.

(e) The current cost of purchase of grass and legume seeds is given in Table 14.1.

(f) Legume inoculants would have to be purchased from Australia. They can be imported from Tropical Inoculants, 1, Kneale St. Holland Park, Brisbane, Queensland 4121. Inoculant CB 1103 is needed for centro at the rate of 3 oz per 30 lb of seed. The inoculant for stylo is CB1552, used at the rate of 3 oz for every 15 lb of seed. Inoculants are sold in 3, 6 or 9 oz packets costing A$ 0.68, A$ 0.95 and A$ 1.48, respectively. They have a normal life of five to six months if they are stored in a refrigerator.

(g) Cost of initial application of 140 lbs triple superphosphate per acre $27.

TABLE 14.1 INFORMATION ON GRASS AND LEGUME SEED COSTS

Supplier		Variety	Price
			A$ per lb.
Wright Stephenson	Brachiaria decumbens		3.60
Arthus Yates			no quote
Wright Stephenson	Panicum maximum	Common	2.60
Arthur Yates		Common	1.79
		Colonaio	1.91
		Hamil	1.91
Wright Stephenson	Centrosema pubescens		0.90
			M$ per lb.
Diethelm			0.76
			A$ per lb.
Wright Stephenson	Stylosanthes guyanensis	Q8558	1.95
			M$ per lb.
Diethelm		Endeavour ?	8.50
			A$ per lb.
J. H. Williams		Q8558	1.95
Arthur Yates		Q8558	1.91
		Schofield	1.63
		Oxley	5.40

Notes: The addresses of the suppliers quoted are:-

* Wright Stephenson and Co. (Australia) Pty Ltd., 46, Reginald St., Rocklea, Brisbane, 4106, Australia.
* Diethelm and Co. Ltd., Seed Department, P. O. Box 191, Singapore.
* J. H. Williams and Sons, P. O. Box 102, Aurwillumbah, New South Wales 2484, Australia.
* Arthur Yates and Co. Pty Ltd., P. O. Box 72, Revesby, New South Wales 2212, Australia.

The Australian prices are f.o.b. Sydney or Brisbane, whilst Diethelm's prices are c.i.f. Miri. Sea freight charges for seeds from Australia are A$ 54 per long ton with a minimum charge of A$ 20, whilst air freight charges from Sydney are A$ 1.10 per lb for quantities under 100 lb and A$ 0.83 per lb for quantities over 100 lb of seed. In addition, within Australia there will be quarantine charges including a phytosanitary certificate costing A$ 3.50 for each consignment.

14.3 PURCHASE OF CATTLE AND/OR SEMEN

14.3.1 Zebu and/or Crossbred Heifers

Widespread enquiries suggest that the only possible sources of relatively cheap, disease-free Zebu or crossbred heifers would be Madagascar or Australia. No information is at present available as to the cost of purchase and transport of heifers from Madagascar but that country has recently stopped sales of cattle to Mauritius and is aiming to develop its own potential for export to Eastern Europe. It is unlikely that cattle could be purchased from Madagascar for Sarawak. Currently prices in Australia are approximately as follows:-

12 to 14 month old, 1/2 to 5/8 crossbred heifers; A$115 to A$ 160.

2 year old pregnancy tested, in-calf, high grade Brahman heifers; A$ 200 to A$ 300.

14.3.2 Zebu and/or High Grade Zebu Bulls

Purebred Zebu or high grade Zebu bulls are available from both Australia and the United States. It is likely that better quality bulls could be obtained for any specific price in the United States but transport costs would be higher. Current prices in Australia are approximately as follows:-

2 to 3 year old high grade Brahman bulls ready for service; A$ 500 to A$700.

2 to 3 year old purebred Brahman bulls of high genetic merit ready for service; A$ 3 000 to A$ 5 000.

Current prices in Florida, U.S.A. are approximately as follows:-

15 to 20 month old, purebred bulls; US$ 1 500

18 to 30 month old, purebred, top genetic merit bulls; US$3 500.

14.3.3 Costs of Collection, Preshipment, Transport, etc.

Costs for cattle purchased in Australia would be:-

- Veterinary expenses; health tests, dipping, ear-tags, etc; A$8.50 per head.
- Pregnancy testing; A$0.50 per head.
- Freight (farm to port); A$5.00 per head.
- Agistment for quarantine (14 days); A$1.00 per head.
- Fodder for voyage and 2 days prior to shipping; A$4.00 per head.
- Insurance, ramp fees, etc. A$3.00 per head.

The most suitable cattle boat available is the <u>MV Ida Clausen</u> that has a capacity to carry 320 yearling heifers or 290 2-year old bulls or in-calf heifers. The cost would be A$ 50 000 per voyage and bookings would have to be confirmed four to five months in advance. Air freighting the cattle would be a possible alternative but no costs are available.

Costs for cattle purchased in Florida would be:-

- Quarantine, insurance and air transport by DC-8; approximately US$ 600 per head.

A DC-8 cannot land at Miri. It would have to land at Kuching and the animals subsequently transported to Miri. An alternative could be for the cattle to be flown to Bandar Seri Begawan in Brunei from where the cattle could be transported by road to Miri but it is not known if Brunei would permit this because of quarantine regulations.

The estimates for Australian costs have been provided by, Gunn Rural Management Pty. Ltd., Box 449 G.P.O, Brisbance, Queensland 4001, who have experience of purchasing cattle for the authorities in Sabah. They would charge a flat five percent of the total f.o.b. cost of the shipment or direct costs plus professional time at appropriate rates.

The Florida estimates have been provided by G.T. Stack, Suite 306, 308 Tampa St., Tampa, Florida, who have recently exported cattle to Kuala Lumpur and Kota Kinabalu. There would be no additional charge over and above those quoted.

From the data provided by these two firms it is calculated that the average landed cost of high genetic quality Brahman bulls would be A$ 3 400 to A$ 5 500 from Australia and US$4 100 from Florida.

14.3.4 Importation of Deep Frozen Semen

Liquid nitrogen could be made available in Sarawak. It is imported in bulk into Brunei by Shell from ICI Malaysia Senderian Berhad, P. O. Box 284, Kuala Lumpur. The importation and utilisation of deep frozen, Brahman semen is therefore a practical possibility and an alternative to the importation of high grade, quality Brahman bulls.

If deep frozen semen is imported it should be obtained from the United States. The approximate cost would be US$ 2.00 to US$ 6.00 per dose. It would be necessary to purchase some specialised equipment and to train at least two local staff in insemination techniques.

The essential equipment requirements would be:-

(a) one or more large liquid nitrogen containers (a 600-straw capacity container would cost approximately US$ 600).

(b) smaller containers for transport purposes.

(c) a supply of rubber gloves.

(d) insemination guns,

(e) throw-away plastic sheaths,

(f) ear-tags; and

(g) an assumed supply of liquid nitrogen. The estimated initial cost of equipment would be US$ 2 500.

Training in the techniques of artificial insemination is available at many centres. The most suitable would be at the Dairy Training and Research Institute, Los Banos, Philippines or at a centre in Australia.

Estimates of the cost of semen have been obtained from:-

Agripure International Ltd. P. O. Box 342, Seymour Conn. 06483, U.S.A.

Curtiss Breeding Service, Gary Ill., U.S.A.

14.4 ROADS

An allweather road leading from the main road to the administrative centre of the ranch would cost approximately $20 000 per mile. For part of the distance the road has been already built by SLDB. The remainder is estimated to cost $20 000. Internal roads are estimated to cost $14 per acre, or a total of $72 000.

14.5 PADDOCK SIZES AND FENCES

For calculation purposes it is assumed that all fences are constructed using four strands of barbed wire and five, six foot six inch belian posts per chain, and droppers of bush timber; posts are set 31 inches, into the ground and the wires fixed at 11, 22, 33 and 44 inches above ground level, respectively; corner and gate posts are strainer assemblies and the gates 15 feet wide, constructed of number 8 gauge wire and light timber. Such fencing is estimated to cost $2 000 per mile.

Assuming the ranch is ultimately subdivided into approximately 44 100-acre paddocks and 30 paddocks of 20 acre each as shown in Figure 14.1 then the total length of fencing required will be approximately 80 miles and the approximate total cost \$160 000 or \$32 per acre. This fencing need only be erected gradually as the land is cleared and subdivisions are required. The costs could be reduced by utilising hardwoods other than belian as posts for the wire fences, live fences where these are practical and ranch employed labour for erection purposes. Cost of wire and staples too could be reduced by the importation of bulk supplies

14.6 CATTLE WORKING YARDS

These yards should be constructed mainly of locally cut timber. The estimated cost is \$25 000 each.

14.7 SHADE

If artificial shades have to be built, they should be no less than 10 to 12 feet high and constructed from bush materials at a cost of no more than \$1 000 each. The number of artificial shades required will not be known until clearing is completed. Shade tree species will ultimately have to be planted in some paddocks but this can be carried out gradually, using available labour that has already been costed. Suitable shade trees would be Albizzia chinensis, Pithecolobium saman (the rain tree), Pterocarpus indicus (sena), Acacia auriculiformis, Erythrina spp. and Parkia javanica. Coconuts could also be planted along the fence lines for future shade purposes. They will provide shade and nuts but will require protective fencing while they are young to prevent the cattle from damaging them.

14.8 WATER

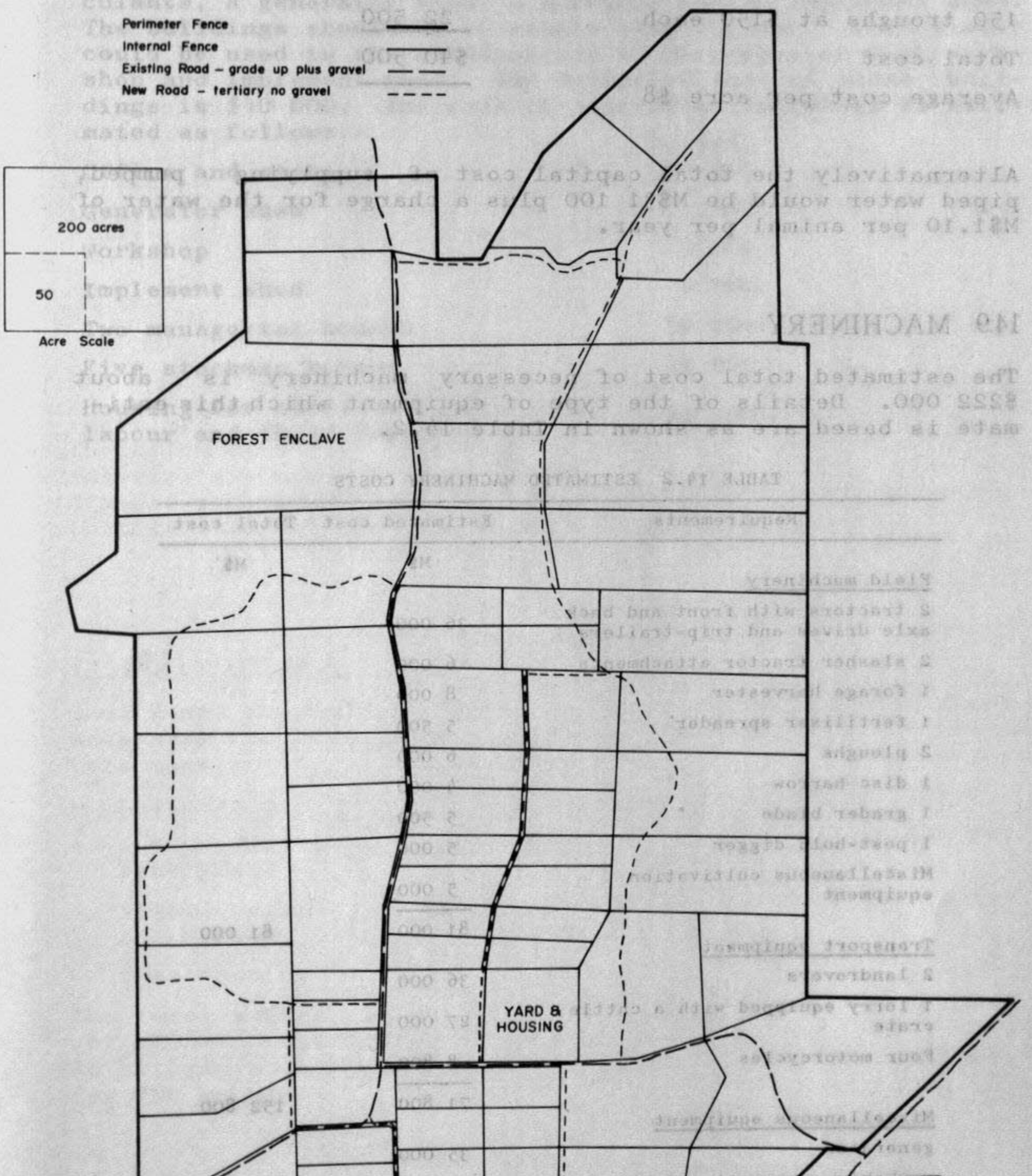
The cost of water for domestic purposes is accounted for in the estimated cost of housing and buildings.

It is assumed that small dams can be constructed in most paddocks. These should be fenced off and the water piped to cattle troughs. Pre-cast concrete troughs measuring 12 feet by 32 inches by 18 inches are estimated to cost approximately \$150 each.

For calculation purposes it is assumed that there will be 74 paddocks and that each dam will supply two 100 acre or four 20 acre paddocks, thus 30 dams are required together with 150 troughs. It is also assumed that the small dams together with their piped outlets can be constructed at a cost of \$600 each,

SUNGAI KARABUNGAN BEEF RANCH SCHEMATIC FENCE & ROAD LAYOUT

FIGURE 14.1



thus the total capital cost of supplying water from dams will be:-

30 dams at $600 each	$18 000
150 troughs at $150 each	22 500
Total cost	$40 500
Average cost per acre $8	

Alternatively the total capital cost of supplying pumped, piped water would be M$31 100 plus a charge for the water of M$1.10 per animal per year.

14.9 MACHINERY

The estimated total cost of necessary machinery is about $222 000. Details of the type of equipment which this estimate is based are as shown in Table 14.2.

TABLE 14.2 ESTIMATED MACHINERY COSTS

Requirements	Estimated cost	Total cost
	M$	M$
Field machinery		
2 tractors with front and back axle drives and trip-trailers	36 000	
2 slasher tractor attachments	6 000	
1 forage harvester	8 000	
1 fertiliser spreader	5 500	
2 ploughs	6 000	
1 disc harrow	4 000	
1 grader blade	5 500	
1 post-hole digger	5 000	
Miscellaneous cultivation equipment	5 000	
	81 000	81 000
Transport equipment		
2 landrovers	36 000	
1 lorry equipped with a cattle crate	27 000	
Four motorcycles	8 800	
	71 800	152 800
Miscellaneous equipment		
generator	35 000	
workship equipment and miscellaneous workship and ranch tools	15 000	
	50 000	202 800
Equipment for cattle working yards		
2 spray races	4 000	
2 weighing machines	12 000	
Miscellaneous equipment and spares	3 000	
	19 000	221 800

14.10 BUILDINGS

Essential buildings required at the ranch administrative centre include an office and store with one cool room for the storage of seeds and a refrigerator for the storage of inoculants, a generator shed, a workshop and an implement shed. The buildings should be of simple construction; bush timber could be used in the construction of the generator shed, workshop and implement shed. The estimated cost of these buildings is $40 000. The cost of individual buildings is estimated as follows:-

	Dollars
Office and store	30 000
Generator shed	1 000
Workshop	5 000
Implement shed	4 000
Two managerial houses	70 000
Five stockmen houses	75 000
Housing for clerical staff, labour and their families	42 500

14.10 BUILDINGS

Essential buildings required at the ranch administrative centre include an office and store with one cool room for the storage of seeds and a refrigerator for the storage of inoculants, a generator shed, a workshop and an implement shed. The buildings should be of simple construction: bush timber could be used in the construction of the generator shed, workshop and implement shed. The estimated cost of these buildings is $40 000. The cost of individual buildings is estimated as follows:-

	Dollars
Office and store	30 000
Generator shed	1 000
Workshop	5 000
Implement shed	4 000
Two managerial houses	70 000
Five stockmen houses	75 000
Housing for clerical staff, labour and their families	42 500

CHAPTER 15

ESTIMATED OPERATIONAL AND MAINTENANCE COSTS

15.1 PASTURE MAINTENANCE

Estimated average annual cost of weeding $6 per acre.

Because the techniques of pasture maintenance have yet to be completely established allowance is made for the annual renovation of 10 per cent of the total area of pasture. This is estimated to cost $87.50 per acre. Annual fertiliser costs are estimated at $21 per acre. Distribution costs of this fertiliser are estimated at $5 per acre.

15.2 VETERINARY EXPENSES

There are few major cattle diseases known to exist in Sarawak. The existing strict quarantine regulations to prevent disease entering are assumed to continue. Consequently the cost of disease prevention should be relatively low. It is estimated that it would be approximately $6 per head per annum.

15.3 MANAGEMENT

Gunn Rural Management consider that the salary and conditions necessary for recruiting an expatriate manager from Australia (the most suitable country) would be:-

- basic salary - A$12 000 to A$14 000 per annum tax free;
- a two-year management contract with leave and sick pay benefits;
- allowance for full travel and excess baggage allowance for the manager and his family;
- free housing.

The local managers, the pasture agronomist and the local veterinarian would have to be paid at prevailing local rates. An allowance should be made for a training period overseas for the managers.

15.4 LABOUR

Gunn Rural Management estimate that the cost of recruiting expatriate stockmen would be:-

- basic salary - A$6 000 to A$7 500 per annum tax free;
- a contract for a 12-month period with leave and sick pay benefits;

- other allowances as for the expatriate manager.

The estimated labour requirements for the operation of the ranch are one man per 500 acres or a total of 10 men once the ranch is fully operational. With, in addition, drivers, a mechanic and clerical staff, employees will number:

	Dollars
6 stockmen at $9 400 each	56 400
4 general labourers at $1 500 each	6 000
2 " " at $1 900 each	3 800
3 drivers at $3 500 each	10 500
1 mechanic at $4 400	4 400
1 accountant at $9 400	9 400
1 secretary/clerk at $4 400	4 400

15.5 MAINTENANCE OF FIXED ASSETS AND MACHINERY

The annual maintenance costs of fixed assets and machinery are estimated on the following basis:-

	Per cent
Metalled roads	10
Dirt roads	15
Fencing	7.5
Cattle working yards	5
Water installations	5
Farm machinery	10
Buildings	3

CHAPTER 16

DEVELOPMENT PHASING AND PROCEDURE

The rate at which the project can be developed depends upon both economic and technical considerations. The proposed managerial structure would justify a total breeding herd of at least 3 000 cows and heifers and it is obviously desirable to attain this target as quickly as possible. Important considerations will be whether the breeding herd and their followers can be maintained on 5 000 acres, whether the pastures can be established sufficiently quickly and whether surplus stock can be readily sold. The assessment of the market potential presented in Chapter 11 shows that the Sarawak market will be able to absorb all of the slaughter animals produced. The questions concerning the balance between the number of animals and the available grazing are discussed below.

Importations of in-calf heifers from Australia by sea could be at the rate of approximately 290 per voyage. The first batch of imported cattle could be quarantined on the ranch but subsequent importations would have to be quarantined in a quarantine station. The total time elapsing between the commencement of the voyage and release of the breeding animals from the quarantine station would be 90 days. The quarantine station at Kuching could easily accommodate 290 in-calf heifers, as there is accommodation available for 400 cattle at any one time. Nevertheless, it would be less expensive to quarantine the cattle at Miri because after quarantine at Kuching the cattle would have to be shipped by coastal steamer to Miri.

The situation at Miri (late 1973) is that a site of 21 acres adjacent to the Sungai Pujut has been acquired for a quarantine station. This site is well fenced and four acres of fodder grass have been planted, but there are no buildings, apart from an important shed and store, and access is poor. It is important that this quarantine station is completed so that it can be used by imported cattle destined for Sungai Karabungan. Arrangements could be made for extra fodder to be grown on the nearby farms and Youth Settlement Scheme. A total of about 50 acres of fodder would be required.

The problem as to whether 3 000 breeding cows and heifers and their followers can be maintained on 5 000 acres of pasture depends upon the carrying capacity of the pastures. This in turn depends on what forage species are utilised and how the forage species are managed. Some information has already been provided in previous Sections (13.3) and in Tables 13.1 and 13.2 on estimated carrying capacities and on the costs of clearing and pasture establishment. If it is assumed that the pastures will have a 10-year life, then using the data in

TABLE 16.1 A TENTATIVE FORAGE PLANTING PROGRAMME

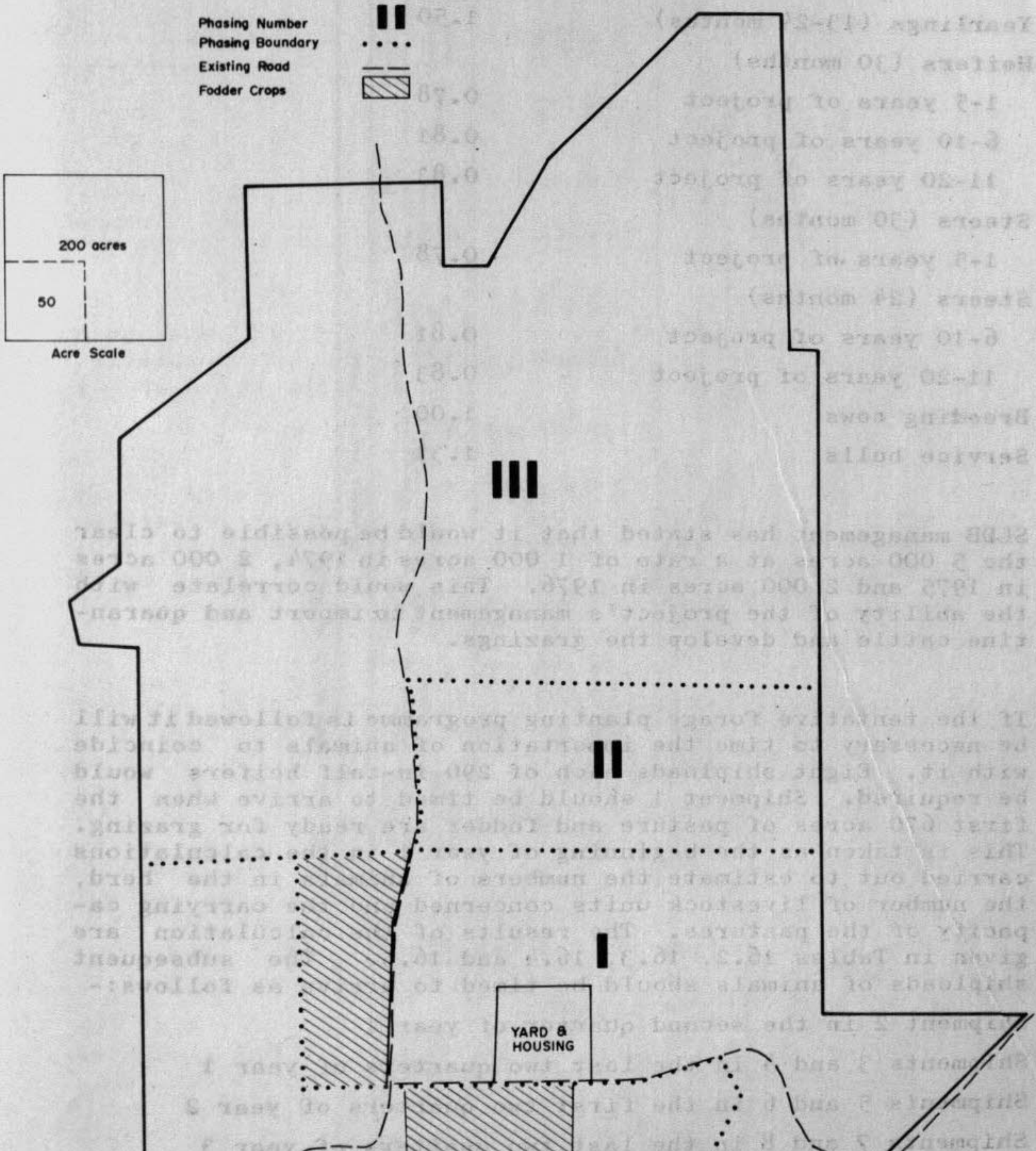
Timing	Area to be cleared and planted (acres)	Species to be used	Estimated carrying capacity (l.s.u.'s per acre)
Before cattle arrive	1 000	400 acres cleared as for oil palm planting 200 acres stylo plus centro with natural grasses 200 acres stylo plus centro with guinea 400 acres partially destumped 200 acres stylo plus centro with natural grasses 200 acres stylo plus centro with guinea 200 acres clean cleared 100 acres clean cleared 50 acres Napier for fodder 10 acres for cattle yards, building, etc. 40 acres to be planted with Brachiaria decumbens and/or para if a low lying area is available	Overall 0.75
First year after cattle arrive	2 000	To await the results of the first year's planting experience	Overall 0.75
Second year after cattle arrive	2 000	To await the results of the first two years planting experience and the economic feasibility trials	Overall 0.75

in Tables 13.1 and 13.2 it can be estimated that the cost per pound of liveweight gain on indigenous grasses plus legumes, guinea grass plus legumes and pangola grass would be $0.40, $0.27 and $0.33, respectively. This data suggests that guinea-legume pastures would be the most economic and that pangola pastures would be more economic than natural grasses plus legumes. These estimates are, however, only a rough guide, and it is recommended that until such time as practical experience and the economic feasibility trial programme has provided definite information on required husbandry and productivity of the forage species available for utilisation, the planting programme suggested in Table 16.1 should be followed. A schematic illustration of the possible scheme phasing is shown in Figure 16.1.

For purposes of estimating what number of cattle can be grazed on these pastures it is assumed that the overall carrying capacity will be 0.75 livestock units (l.s.u.'s) per acre until 1977 and that it will slowly rise with improvement in the management of the operation to 1.00 l.s.u.'s by 1980. This assumption is not over optimistic and should be easily achieved. As the project develops further progress should be made in livestock carrying capacity and it is assumed that after 20 years it could be as high as 1.5 l.s.u.'s per acre. The l.s.u. used in this paper is equivalent to one adult breeding cow weighing 900 pounds. The various classes of cattle to be used in this project, with performance assumptions as detailed in Table 13.4 are assigned the following l.s.u. values.

FIGURE 16.1

SUNGAI KARABUNGAN BEEF SCHEME PHASING



Class of Cattle	l.s.u.
Calves (0-12 months)	0.15
Yearlings (13-24 months)	1.50
Heifers (30 months)	
1-5 years of project	0.78
6-10 years of project	0.81
11-20 years of project	0.83
Steers (30 months)	
1-5 years of project	0.78
Steers (24 months)	
6-10 years of project	0.81
11-20 years of project	0.83
Breeding cows	1.00
Service bulls	1.33

SLDB management has stated that it would be possible to clear the 5 000 acres at a rate of 1 000 acres in 1974, 2 000 acres in 1975 and 2 000 acres in 1976. This would correlate with the ability of the project's management to import and quarantine cattle and develop the grazings.

If the tentative forage planting programme is followed it will be necessary to time the importation of animals to coincide with it. Eight shiploads each of 290 in-calf heifers would be required. Shipment 1 should be timed to arrive when the first 670 acres of pasture and fodder are ready for grazing. This is taken as the beginning of year 1 in the calculations carried out to estimate the numbers of animals in the herd, the number of livestock units concerned and the carrying capacity of the pastures. The results of the calculation are given in Tables 16.2, 16.3, 16.4 and 16.5. The subsequent shiploads of animals should be timed to arrive as follows:-

Shipment 2 in the second quarter of year 1

Shipments 3 and 4 in the last two quarters of year 1

Shipments 5 and 6 in the first two quarters of year 2

Shipments 7 and 8 in the last two quarters of year 3

Breeding bulls would also have to be imported at the following rates; 39 early in year 1, 39 at the end of year 1 and a further 39 in year 2. No further importations of bulls should be required as locally reared bulls would become available by year 3.

Given the parameters outlined previously and the assumptions for productivity given, (Table 13.4) it is shown in Table 16.2 how estimated cattle numbers would build up during the first six years of the project. Table 16.3 shows how during the

TABLE 16.2 HERD BUILD-UP YEARS 1-6

Year	Opening Inventory: Breeding cows	Breeding bulls*	Calves 0-12 months F	Calves 0-12 months M	Stock 12-24 months		Changes during Year: Purchases or addition: Breeding cows	Purchases or addition: Breeding bulls	New calves born F	New calves born M	Cows dying	Bulls dying	New calves dying F	New calves dying M	Last year's calves dying F	Last year's calves dying M	Last but one year's calves dying F	Last but one year's calves dying M	Sales: Steers	Sales: Culls cows	Sales: Culls bulls
1	580	39	-	-			580	39	522	522	18	1	18	18	-	-	-	-	-	-	-
2	1142	77	504	504			580	38	631	633	34	2	26	26	13	13	-	-	-	56	-
3	1632	113	605	607	491	491	580	43	917	918	43	2	32	32	13	14	5	5	200	162	14
4	2250	140	885	885	835	836	-	66	1018	1018	58	4	37	37	26	26	3	4	592	185	20
5	2665	182	981	981	1033	1034	-	61	1225	1224	65	5	45	45	26	27	8	9	541	287	26
6	2914	212	1124	1122	1379	1377	-	2	1466	1467	78	4	33	31	22	21	4	4	1375	350	30
7	3430	180	1433	1436	1588+	1158	-														

* Provision has been made for breeding bulls by reducing the number of steers sold.

+ of which 430 are between 2 years & 2½ years old and are assumed, in Table 16.4, to be sold in-calf for creating new breeding herds.

Note: Imported heifers assumed to arrive at farm without casulties, but only 90 per cent assumed to give birth to living calves. Other production parameters given in Table 13.4.

TABLE 16.3 ESTIMATED CATTLE NUMBERS, ACREAGE OF PASTURE AVAILABLE AND CARRYING CAPACITY

Start of Year	Opening Industry					Number of acres available for grazing	Around Stocking rate	
	Breeding cows	Breeding bulls	Calves 0-12 months	Yearlings 12-24 months	Total l.s.u.		l.s.u. per acre	Total carrying capacity l.s.u.
1	580	39	-	-	504	670	.75	500
2	1142	77	1008	-	1395	3000	.75	2250
3	1632	113	1212	982	2210	5000	.75	3750
4	2250	140	1770	1671	3673	5000	.75	3750
5	2665	182	1962	2067	4332	5000	.9	4500
6	2914	212	2246	2756	5149	5000	1.0	5000

first six years the estimated number of l.s.u. in the herd would match up with the grazing expected to be available. In Appendix III tables are given which show the build-up of animals from the various shipments.

Within six years the total number of breeding females would approach 3 000 and sale of breeding heifers could commence. During years 1, 2, and 3 there would be some excess of grazing, but this would be desirable as the project would be in the initial stages and an additional allowance of grazings has to be made for the small elite herd.

Sales of culled cows will begin in the second year and of steers in the third year (Table 16.2). Sales of breeding bulls could begin from the commercial herd in year four if some of the young bulls from the most productive cows were not castrated. The data in Table 16.2 simply signify under the heading 'steers' the total number of males available. Sales of breeding bulls from the elite herd could certainly commence on a small scale in year five. If the Government will accept the practice of selling bull beef then no bull need be castrated.

The estimated herd composition between the seventh and the tenth year are given in Table 16.4. About 1 800 slaughter cattle and 1 000 in-calf heifers will be available for sale annually from year eight. The estimated herd composition would represent approximately 5 930 l.s.u.'s and if by the tenth year the pasture carrying capacity was raised to 1.2 l.s.u.'s per acre, and this should be possible, then 6 000 l.s.u.'s could be carried on the project.

On the assumption that the carrying capacity of pastures rises to 1.5 l.s.u.'s per acre between the tenth and the twentieth year a breeding herd of almost 3 700 females could be managed on the 5 000 acres. By the twentieth year the annual out turn of the project would be about 3 920 animals based on 4 230 breeding cows. The approximate composition and out turn of the herd over this period is given in Table 16.5.

TABLE 16.4 HERD BUILD-UP YEARS 7-10 IF PASTURE CARRYING CAPACITY REACHES 1.2 L.S.U. PER ACRE

Year	Opening Inventory						Transfers, Births, Deaths, Sales during year														Closing Inventory					
	Breeding Herd		Calves 0-12 months		Stock 12-24 months		Transfers to breeding herd		Calves born		Deaths						Sales				Breeding Herd		Calves 0-12 m		Stock 12-24 m	
											New Calves		Last Year's Calves		Breeding Herd		Breed-ing	Steers	Culls							
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
6																					3430	180	1433	1436	1158*	1158
7	3430	180	1433	1436	1158	1158	579	20	1543	1544	46	14	14	14	80	4	579	1106	412	28	3517	168	1497	1497	1419*	1422
8	3517	168	1497	1497	1419	1422	422	30	1536	1536	46	46	15	15	79	4	1000	1364	457	24	3403	170	1490	1490	1482	1482
9	3403	170	1490	1490	1482	1482	482	25	1534	1535	46	46	15	15	78	4	1000	1429	476	24	3331	167	1488	1489	1475	1475
10 and following	3331	167	1488	1489	1475	1475	475	23	1522	1523	46	46	15	15	76	4	1000	1424	500	24	3230	162	1476	1477	1473	1474

Note: * 430 heifers 2-2½ years old are assumed sold to form other breeding herds.

TABLE 16.5 ESTIMATED AVERAGE COMPOSITION AND OUT TURN OF THE HERD FROM THE TENTH TO THE TWENTIETH YEARS OF PASTURE CARRYING CAPACITY INCREASES TO 1.5 L.S.U. PER ACRE

Category	Years 11 to 19	Year 20 and onwards
Breeding Stock and followers:		
Breeding cows	3 680	4 230
Breeding bulls	145	169
Calves (0-12 months)		
females	1 710	2 023
males	1 710	2 023
Yearlings (13-23 months)		
females	1 620	2 003
males	1 620	2 003
Estimated sales of stock per year:		
Steers (at 24 month)	1 595	1 973
Heifers for breeding or slaughter	900	1 072
Culled breeding cows	645	846
Culled breeding bulls	22	25

Note: Breeding bulls could also be sold if the best of the young steers were not castrated.

CHAPTER 17

FINANCIAL AND ECONOMIC ANALYSES

17.1 FINANCIAL ANALYSIS

The scheme is evaluated at market prices on the basis of the costs and returns outlined in the preceeding chapters of the report, and in Appendix IV, over a 25 year period. Capital development costs of the 5 000 acre ranch are estimated to amount to \$6.8 mn and operating costs to \$2.2 mn before a positive cash flow situation is reached, thus the net cash outflow of the project from 1974 to 1979 is expected to be \$8.1 mn.

The summary cash flow of the scheme is given in Table 17.1 from which the commercial rate of return is calculated as 8.6 per cent and the present value of the net cash flow at 10 per cent is -\$1 503 mn.

If interest is charged at 7 per cent and the annual cash surplus is assumed to repay initial development costs the payback period of the scheme would be 20 years. Thereafter there would be a surplus of about \$1.1 mn per annum.

In the above calculations a terminal herd valuation of \$4.7 mn has been included in the income stream of the project, but no residual value has been attributed to the land occupied by the ranch. The above returns are therefore slightly on the conservative side.

17.2 SOCIAL ECONOMIC EVALUATION

For the social economic evaluation of the scheme adjustments are made to the cost of labour and materials expended on the project and the income to account for the following:-

a) The shadow wage of unskilled labour is assessed at \$3 per man day.

b) Taxes on materials, vehicles and equipment used on the scheme.

c) The value of breeding heifers sold off the ranch is related to a value equivalent to their future production potential. This is assessed on the basis of seven calves worth \$540 each produced over eight years, the cull value of the cow at \$450, capital costs of \$1 360, and annual costs of \$100. If these costs and returns are discounted a net present value of \$1 100 per breeding heifer is arrived at.

TABLE 17.1 SUMMARY CASH FLOW OF THE BEEF BRANCH SCHEME AT MARKET PRICES

Year	Costs: Development	Costs: Operating	Costs: Management	Total costs	Total income	Net cash flow
				Thousand dollars		
1974	682.0	15.0	113.8	810.8	-	- 810.8
1975	3 284.2	77.5	217.6	3 579.3	-	-3 579.3
1976	2 038.5	181.1	177.3	2 396.9	22.4	-2 374.5
1977	798.6	284.3	165.5	1 248.4	155.8	-1 092.6
1978	-	293.2	173.8	467.0	332.6	- 134.4
1979	-	337.5	173.8	511.3	355.0	- 156.3
1980	-	342.4	189.9	532.3	1 066.8	+ 534.5
1981	-	347.0	169.4	516.4	1 067.4	+ 551.0
1982		349.5	272.8	622.3	1 460.9	+ 838.6
1983		348.9	173.8	522.7	1 500.2	+ 977.5
1984		348.2	169.4	517.6	1 508.0	+ 990.4
1985		353.8	228.9	582.7	1 701.6	+1 118.9
1986			205.3	559.1	1 701.6	+1 142.5
1987			173.8	527.6		+1 174.0
1988			169.4	523.2		+1 178.4
1989			169.4	523.2		+1 178.4
1990			272.8	626.6		+1 075.0
1991			173.8	527.6		+1 174.0
1992			189.9	543.7		+1 157.9
1993			169.4	523.2		+1 178.4
1994			173.8	527.6		+1 174.0
1995			173.8	527.6		+1 174.0
1996			228.9	582.7		+1 118.9
1997			180.4	534.2		+1 167.4
1998			272.8	626.6		+1 075.0
1999			169.4	523.2	6 389.6 (1)	+5 866.4
TOTAL	6 803.3	8 231.6	4 949.9	19 983.8	37 681.1	17 697.3
N.P.V. at 10 per cent	6 468.5	2 981.9	2 012.7	11 474.1	9 961.7	-1 503.3

Note: (1) Includes terminal herd valuation of dollars

The net cash flows for the scheme are shown in Table 17.2 from which the following economic returns are calculated:-

Internal rate of return 12.3 per cent.

Return to land $41 per acre.

Return to labour $11 per man day.

There are also benefits to this project which cannot easily be expressed in specific financial or economic terms and which will not be felt until the scheme has run for some years.

Firstly the project will provide a secure internal supply of beef for Sarawak which could have the effect of stabilizing meat prices and possibly even lowering them. Better supplies at more reasonable prices will bring beef within the means of a much larger number of consumers with consequent nutritional benefits. There would also be the saving in foreign exchange through reduced imports.

The scheme will also result in technological improvements and progress in production know-how in parts of Sarawak where development problems exist at the moment. The establishment

TABLE 17.2 SUMMARY CASH FLOW OF THE BEEF RANCH SCHEME AT SOCIAL PRICES

Year	Total costs	Total income	Net cash flow
	Thousand dollars		
1974	731.4	-	- 731.4
1975	3 474.1	-	-3 474.1
1976	2 279.1	22.4	-2 256.7
1977	1 208.9	155.8	-1 053.1
1978	425.8	332.6	- 93.2
1979	464.6	355.0	- 109.6
1980	486.0	1 281.8	+ 795.8
1981	470.9	1 356.9	+ 886.0
1982	549.7	1 960.9	+1 411.2
1983	475.5	2 000.2	+1 524.7
1984	472.0	2 008.0	+1 536.0
1985	534.3	2 152.1	+1 617.8
1986	510.4	2 152.1	+1 641.7
1987	408.4		+1 671.7
1988	477.6		+1 674.5
1989	477.6		+1 674.5
1990	554.1		+1 598.0
1991	480.4		+1 671.7
1992	497.2		+1 654.9
1993	477.6		+1 674.5
1994	480.4		+1 671.7
1995	480.4		+1 671.7
1996	534.3		+1 617.8
1997	488.1		+1 664.0
1998	554.1		+1 598.0
1999	479.7	6 840.1	+6 360.4
TOTAL	18 544.6	46 443.1	27 898.5
N.P.V. at 10 per cent	10 793.1	12 413.4	+1 591.8

of a nucleus rational herd from which beef production can be expanded in the future could be of considerable importance to national development.

In addition to providing livestock for future development programmes the project will be a training ground for livestock workers particularly at the stockmen level. A new class of worker and a new approach to livestock husbandry could thus be developed with far reaching consequences.

Beef cattle, whether developed on large ranches or on small holdings, would make a valuable contribution to the diversification of the agricultural economy. Pasture production can itself take several forms ranging from purely breeding orientated operations to growing and finishing of slaughter stock.

TABLE 17.3 SUMMARY CASH FLOW OF A BEEF RANCH ESTABLISHED UNDER AN EXPANSION PROGRAMME AT MARKET PRICES

Year	Costs: Development	Costs: Operating	Costs: Management	Total costs	Total income	Net cash flow
	Thousand dollars					
0	682.0	15.0	70.0	767.0	-	- 767.0
1	1 755.8	77.5	135.8	1 969.1	-	- 1 969.1
2	1 298.1	181.1	147.8	1 627.0	22.4	- 1 604.6
3	392.6	284.3	158.6	835.5	155.8	- 679.7
4	-	293.2	173.8	467.0	332.6	- 134.4
5		337.5	173.8	511.3	355.0	- 156.3
6		342.4	189.9	532.3	1 056.0	+ 523.7
7		347.0	169.4	516.4	1 032.6	+ 516.2
8		349.5	272.8	622.3	1 400.9	+ 778.6
9		348.9	173.8	522.7	1 440.2	+ 917.5
10		348.2	169.4	517.6	1 448.0	+ 930.4
11		353.8	228.9	582.7	1 647.6	+ 1 064.9
12		353.8	205.3	559.1	1 647.6	+ 1 088.5
13			173.8	527.6		+ 1 120.0
14			169.4	523.2		+ 1 124.4
15			169.4	523.2		+ 1 124.4
16			272.8	626.6		+ 1 021.0
17			173.8	527.6		+ 1 120.0
18			189.9	543.7		+ 1 103.9
19			169.4	523.2		+ 1 124.4
20			173.8	527.6		+ 1 120.0
21			173.8	527.6		+ 1 120.0
22			228.9	582.7		+ 1 064.9
23			180.4	534.2		+ 1 113.4
24			272.8	626.6		+ 1 021.0
25			169.4	523.2	6 335.6	+ 5 812.4
TOTAL	4 128.5	8 231.6	4 786.9	17 147.0	36 645.5	+19 498.5
N.P.V. at 10 per cent	3 931.7	2 983.5	1 863.6	8 779.3	9 676.9	+ 906.6

Furthermore grassland can easily be converted to an alternative crop at minimum cost.

17.3 EXPANSION OF BEEF PRODUCTION

It is too early to make firm projections of how beef production may be expanded in Sarawak because much will depend on the outcome of this first scheme. However it is obvious that future schemes will not have the burden of high initial costs attributed to the following:-

(a) Importing breeding stock with associated high procurement costs.

(b) Employing expatriate management staff during the establishment period until local staff gain sufficient experience and management expertise.

In order to gauge the effect of relieving future projects of the burden of these costs an alternative economic analysis was carried out in which it was assumed that breeding stock would be purchased from the established herd and locally trained management staff would be employed from the start of

TABLE 17.4 SUMMARY CASH FLOW OF BEEF RANCH ESTABLISHED UNDER AN EXPANSION PROGRAMME AT SOCIAL PRICES

Year	Total costs	Total income	Net cash flow
	Thousand dollars		
0	677.6	-	- 677.6
1	1 863.9	-	- 1 863.9
2	1 509.2	22.4	- 1 486.8
3	796.0	155.8	- 640.2
4	425.8	332.6	- 93.2
5	464.6	355.0	- 109.6
6	486.0	1 056.0	+ 570.0
7	470.9	1 032.6	+ 561.7
8	549.7	1 400.9	+ 851.2
9	475.5	1 440.2	+ 964.7
10	472.0	1 448.0	+ 976.0
11	534.3	1 647.6	+ 1 113.3
12	510.4	1 647.6	+ 1 137.2
13	480.4		+ 1 167.2
14	477.6		+ 1 170.0
15	477.6		+ 1 170.0
16	554.1		+ 1 093.5
17	480.4		+ 1 167.2
18	497.2		+ 1 150.4
19	477.6		+ 1 170.0
20	480.4		+ 1 167.2
21	480.4		+ 1 167.2
22	534.3		+ 1 113.3
23	488.1		+ 1 159.5
24	554.1		+ 1 093.5
25	479.7	6 335.6	+ 5 855.9
TOTAL	15 707.8	36 645.5	+20 937.7
N.P.V. at 10 per cent	8 098.3	9 676.9	+ 1 587.6

the scheme while all animals would be sold as slaughter stock.

The summary cash flow of the alternative is given in Tables 17.3 and 17.4 from which the following economic returns are derived:-

(a) The capital development costs of the scheme would be \$4.1 mn and operating costs before a positive cash flow position is reached would amount to \$2.0 mn; the net outflow of funds would be \$5.3 mn.

(b) The commercial rate of return to the project is 11.9 per cent and the payback period 17 years.

(c) At social prices the internal rate of return is 13.2 per cent while the return to land is \$36 per acre and to labour \$10 per man day.

The above results are regarded as satisfactory for commercial investment and are indicative of the possibilities of joint venture or independent private investor schemes at a later date.

17.4 FOREIGN EXCHANGE COSTS OF THE PROJECT

Imported items involving foreign exchange costs are the following:-

land clearing equipment;

pasture establishment and maintenance for seeds, fertilisers and herbicides;

imported stock;

fencing construction materials;

road construction equipment;

vehicles and equipment;

veterinary expenses;

water supply fixtures.

The total foreign exchange component of the development capital costs are estimated at $5.2 mn. Operational costs are estimated to involve varying amounts of foreign exchange over the life of the project averaging about $207 000 per annum.

CHAPTER 18

PROPOSED FEASIBILITY INVESTIGATION PROGRAMME

Discussed below are the types and priorities of investigations that should be undertaken at the Government Livestock Production and Animal Husbandry Training Centre in connection with an economic feasibility investigational programme. Two separate programmes are required. A relatively short-term programme should be concerned with the husbandry of pasture and fodder species; the husbandry of cattle with particular reference to grazing management and disease control; the possibilities for integration of cattle and tree crop management with particular reference to the management of cattle in oil palm plantations; and the utilisation of fodder, crop by-products and other feeds for fattening cattle under Sarawak conditions.

The long-term investigations should be concerned with a search for the most productive forage plants for use in the Study Area environment; the most productive method of exploiting Sarawak soils for the production of cattle feeds; and a search for the most suitable cattle type to utilise in the Sarawak environment.

The short-term programme should at least incorporate the following investigations:-

- The most economic method of clearing the forest and establishing pasture and/or forage crops.
- The most economic seeding or vegetative planting rates for the forage species that will be used in the commercial unit, that is guinea, pangola, Brachiaria decumbens, Brachiaria brizantha, cynodon plectostachyum, para, rice grass, Napier, centro and stylo.
- The most economic methods of seeding and/or vegetative planting of the above species.
- The most economic fertilisers and fertiliser rates to use when establishing and maintaining the above species.
- The most economic grazing intervals and intensities of grazing to use with the above species.
- Whether the growing of fodder as opposed to pasture species is economic and/or a necessary insurance policy in the Study Area.
- A survey of cattle diseases and parasites likely to cause difficulties within the Study Area and what economic methods should be taken to control them.
- Whether cattle can utilise the forage grown between oil palms from the third to the eighth year from establishment of the palms, and whether it would be economic to include grasses with the legumes used as cover crops.

- What crop by-product feeds can be used in the economic fattening of cattle, with particular reference to the by-products of oil palm processing.
- Whether lot fattening is as economic as fattening on pasture under the Study Area environmental conditions.

The long term programme might incorporate some of the following investigations:-

- The introduction and testing of forage plants that have not yet been introduced but that might be productive in the Sarawak environment.
- The investigation and comparison of different agricultural systems designed to produce animal feed and incorporate ruminant livestock. These should include pasture grasses and legumes under legume browze trees planted at specific intervals; pasture grasses and legumes under oil palms, coconuts and varied types of fruit and nut trees; pure stands of heavily fertilised and highly productive forage grasses mechanically harvested for drying; and forage and/or pasture alternated with crops in a specific rotation.
- The importation of Bali cattle and investigation of their utility both as purebreds and for crossbreeding using artificial insemination (AI) techniques and deep frozen semen from a Bos taurus dual-purpose breed, preferably the Red Poll. Unlike Bos indicus cows such as the Brahman, Bali cows appear to possess long heat periods and the use of of AI for crossbreeding purposes is likely to be successful in this breed. The rationale for these proposals is that the Bali is likely to be completely acclimatised to the local environment and that this breed possesses several very advantageous characteristics. These are:-
  - that their calving percentage under peasant managerial conditions is 80 per cent or 20 per cent better than that of zebu cattle of the Brahman type in Indonesia;
  - they possess a higher killing-out per cent than zebu cattle;
  - there is very little fat in their carcass and their meat commands a premium in the Chinese market;
  - they are very resistant to internal and external parasites;
  - and they are easily trained for work, are docile and appear to be more efficient converters of feed into meat than are zebu cattle.

The great disadvantage of these cattle is that they possess a very poor milk supply and as a consequence their calves grow slowly, though they eventually attain mature weights of 1 000 pounds or more. It is possible that this disadvantage might be overcome by crossbreeding them with a dual-purpose type of beef animal, such as the Red Poll.

- The establishment of a Bos taurus beef breed such as the

Red Poll at medium altitude in Kelabit country. Semen and bulls from this herd would then be used for crossbreeding with the Bali and for other feasibility trials such as crossbreeding with the Brahman. There is known to be considerable merit in the second type of crossbreeding as one of the most productive beef breeds in the tropics - the Jamaican Red - is a more or less stabilised crossbreed between the Brahman and the Red Poll. The possibilities for establishing a Bos taurus beef-type breed in Kelabit country should be explored, particularly as it is known that the Kelabits were a cattle rearing people in the past.

18.1 POSSIBLE SECONDARY DEVELOPMENT

Secondary development proposals should include:-

- The encouragement of beef production on small-holdings, medium size private farms, estates and additional ranches.
- The training of extension workers, small-holders, private farmers and estate managers in beef production techniques.
- The organisation of a new marketing and processing system for beef animals and meat.
- The development of new agro-industries.

18.1.1 Small-Holder, Estate and Satellite Ranch Beef Production

Breeding bulls and surplus in-calf heifers will become available in small numbers in the sixth year from the commencement of the project and by the tenth year approximately 500 surplus in-calf heifers will become available each year. It would be extremely wasteful to slaughter these surplus breeding animals. The aim should be that the new marketing organisation created should lease or agist weaners to small-holders, private farmers and estates for growing-out and fattening operations.

Possible methods of encouraging beef production outside the Sungai Karabungan project are:-

Cattle on Oil Palm Estates

Oil palms are planted at roughly 60 to the acre and on the estates the establishment system is that legume cover crops (stylo and centro) are grown between the palms as erosion and weed control measures. It appears possible that if palatible legumes were planted (stylo and centro) cattle could graze the cover crops from the third to at least the eighth year after planting. The life of a plantation is 25 to 30 years. Thus at any one time approximately 20 per cent of the total estate land is under cover crops that could be made available for cattle grazing. It is estimated that during the period from the third to the eighth year the carrying capacity is approximately one-half to one-third of the carrying capacity that might be expected on similar open land.

If the recommended trials to investigate the possibility of managing beef on the cover crops are successful, then changes could be envisaged in present husbandry practices that would increase the number of l.s.u.'s that the land could carry. The changes could include the introduction of grass species into the cover crops and heavier applications of fertiliser.

There could ultimately be at least 100 000 acres of oil palm in the Study Area. If 20 per cent of this area was used for cattle grazing at any one time then 20 000 acres would be available for grazing. At a carrying capacity as low as 0.3 l.s.u.'s per acre this area could carry about 7 000 l.s.u.'s per annum.

This capacity could be utilised either by agisting growing cattle to graze in oil palm plantations or, on large estates, breeding herds could be established.

Cattle on Medium Size Private Holdings

It is considered unlikely that private individuals with medium sized farms or estates will establish breeding ranches. It is far more likely that these farmers would undertake agisting and/or fattening enterprises provided there was a guaranteed market for the beef animals.

Cattle on Small-holdings

The breeding of cattle on small-holdings, as envisaged in the present PAWAH schemes is unlikely to be economic because the number of animals for sale is always so low. However, the small-holder could play an important role in a fully stratified beef industry as a 'grower' and/or finisher. The system envisaged is that small-holders would graze and/or finish a few beef cattle in a scheme whereby they would receive limited subsidies for the establishment of pasture and fencing, (as in the PAWAH schemes), free training in the management of pastures and cattle and be provided with young cattle by the proposed marketing authority on an agistment basis. The authority would provide the cattle at no cost, the small-holder would graze them and/or finish them and the authority would then market the cattle. Financial gains produced by an increase in liveweight while the cattle were on the small-holding would be split fairly between the authority and the small-holder in a proportion to be determined on the basis of the experimental results.

Expansion of the beef industry in this way should be started only after the techniques and economic feasibility have been established by the proposed trials on the Livestock Production and Animal Husbandry Training Centre. When it is started it should be a closely controlled operation. Not only should the small-holders be specially selected and trained but the whole undertaking should be concentrated into defined areas so that intensive advice and assistance can be given by the staff of the Agricultural Development Unit (see Supporting Report 2 Part III).

18.1.2 The Training of Extension Workers, Small-Holders, Private Farmers and Estate Managers in Beef Production Techniques

Training courses should be organised by the Department of Agriculture at the Government Livestock Production and Animal Husbandry Training Centre and practical training could be organised in co-operation with the NLIB on the commercial ranch.

18.1.3 The Organisation of a New Beef Animal and Meat Marketing Organisation

The present marketing organisation and the municipal slaughterhouses within the Study Area will be unable to cope with the number of animals that will become available for sale and for slaughter from the project. Furthermore, the marketing and processing requirements should be so organised that they assist in the development of the beef industry.

Fortunately the NLIB now possesses the legal powers to regulate the marketing of livestock and to license wholesalers, retailers, processors, importers and exporters.

It is recommended that the NLIB should be given the responsibility to create, by 1978 a marketing organisation that would:-

(a) Organise either directly or through licensed buyers the farm gate purchase of all beef cattle produced as a result of the activities at Karabungan. In addition any other cattle and buffaloes offered by producers should be accepted. Initially there will be only a few animals for sale and purchase will probably have to be on the basis of a controlled fixed price per pound liveweight. But later, as the number of animals increases and the industry develops, the introduction of regular auction markets should be considered.

(b) Own and operate, either directly, or by licensed contractors, new slaughterhouse facilities at appropriate places in the Study Area. The facilities at Miri and Bintulu should receive priority and should be planned so that capacity can be expanded as the supply of slaughter cattle and buffaloes increases. Once an adequate supply of good quality local meat is assured the cancelling of existing meat import privileges should be considered.

It is expected that the local Study Area demand for meat will be satisfied by about 1978 if the Karangan project is started in 1974 and export of meat to Kuching and other parts of Sarawak could commence. It is considered that there should be one central slaughterhouse, planned so that capacity can be increased as production expands. Whether this centre should be sited within the main area of production (involving transport of meat in refrigerated containers) or in the main area of consumption, (entailing transport of live animals), is an economic decision that must be made later, taking into account the state of development of part and road facilities and the costs of transport.

Eventually the new facilities should include a packing plant to produce pre-packed refrigerated meat for the supermarket trade and the handling of all slaughter by-products.

(c) License wholesalers and retailers of meat and establish and control hygienic handling standards.

(d) Organise the agistment of cattle to small-holders and other producers so as to encourage the stratification and further development of the industry. It is envisaged that yearling steers could be purchased from the commercial ranch and agisted, under contract, with the selected small-holders. When the animals are ready for slaughter or for moving to fattening lots the appropriate arrangements for payment and transport would be made by the marketing organisation.

18.1.4 The Development of Other New Agro-Industries

These would include the tanning of hides, possibly the drying of fodder grass for feed, the production of crop by-product feeds and the possible establishment of fattening lots based on the feeding of by-product feeds.

APPENDIX I

capacity can be expanded as the supply of slaughter cattle and buffaloes increases. Once an adequate supply of good quality local meat is assured the cancellation of [illegible] meat import privileges should be considered.

It is estimated that the total Study Area demand for [illegible] will be satisfied by about 1976 if the Karangan project is [illegible] 1974 and export of meat to Kuching and other parts of Sarawak could commence. It is considered that there should be one central slaughterhouse, planned so that capacity can be increased as production expands. Whether this centre should be sited within the main area of production (involving transport of meat in refrigerated containers) or in the main area of consumption (involving transport of live animals), is an economic decision that must be made later, taking into account the state of development of port and road facilities and the costs of transport.

Eventually the new facilities should include a packing plant to produce pre-packed refrigerated meat for the supermarket trade and the handling of all slaughter by-products.

(e) License wholesalers and retailers of meat and establish and enforce hygienic marketing standards.

(f) Encourage the [illegible] of cattle to small-holders and [illegible] stratification [illegible]. It is envisaged [illegible] would be purchased from the [illegible] under contract, with the [illegible] when the animals are ready for slaughter [illegible] into the appropriate [illegible] would be made by the [illegible].

10.4.5 The Development of Other New Agro-Industries

These would include the tanning of hides, possibly the drying of [illegible] grass for feed, the production of crop by-product feeds and the possible establishment of fattening lots based on the feeding of by-product feeds.

APPENDIX I

ECONOMICS OF AQUACULTURE SCHEMES

I.1 INTRODUCTION

Although the possibilities for large scale aquaculture schemes appear to be relatively limited, and require further investigation, there will be scope for small scale operations to be undertaken in the Study Area as settlement and improvement schemes are developed. In rural villages, on estates and SLDB schemes there will be a demand for fresh fish and in the larger urban centres there are established markets. The possibility of integrating fish and livestock production schemes appears to deserve further investigation and trial in view of the current upward trend of livestock feed prices in the region.

The prospective farmer has a choice of several schemes available to him and the one which suits his particular situation best in terms of size, cost and output should be chosen. The input requirements and costs of various schemes have been outlined in Chapter 4 and the purpose of this Section is to produce comprehensive financial and economic analyses which demonstrate their economic performance and which enable comparisons to be made with other agricultural enterprises.

I.2 INPUTS AND COST ASSUMPTIONS

The production input requirements and thier costs are outlined in Section 4.3 and are based on current technical knowledge and practice in Sarawak. Costs of some items are likely to vary according to the location of the scheme and the general level of commodity prices in the region.

I.2.1 Pond Construction

The major development cost in aqua-culture schemes is required for the construction of the pond and providing a secure water supply. Two possible cost levels are distinguished:-

1. On easy sites requiring relatively little earth works the cost may be $1 500 for a half acre pond.
2. On more difficult sites earth works may be extensive and costs may be as high as $3 000 for a half acre pond.

Machine costs and materials are likely to account for 70 to 75 per cent of this expenditure. Smaller or larger ponds are costed on a pro-rata basis.

A subsidy of $200 per pond of 0.5 acre or more is allowed with pro-rata allowance for smaller ponds.

Maintenance and repair costs of ponds are estimated on the following basis:

i) Annual repairs and maintenance at three per cent of initial construction costs;

ii) Every five years major cleaning out and repairs at 10 per cent of the initial construction cost.

I.2.2 Lime and Fertilisers

Application of lime and triple superphosphate are costed in the various schemes at the following rates and prices:-

	Quantity used per 0.5 acre pond	Cost per lb
	pounds	cents
Lime - initial dressing and 5 yearly intervals	1 200	15
- annual dressing	222	
Phosphate - annual dressing	150	20

I.2.3 Nets and Equipment

The main items which this should cover are nets, buckets, transportation baskets, holding tanks, changkols, spades, rope and small tools. The initial cost of these items for a 0.5 acre pond is estimated at $203 and thereafter annual replacements are costed at $40 per annum.

No special buildings would be required for schemes of less than one acre. A small shed for storage of equipment and materials is included for one acre schemes at an initial construction cost of $200 and maintenance costs at $6 per annum. This could be built as an extension to the farmer's house.

I.2.4 Supplementary Feeds

Rice bran is readily available from local mills at a price of $10 per pikul and is fed at various rates according to the requirements of the fish being produced.

I.2.5 Stock

The Inland Fishery Division is the main source of fingerlings and fry all except the carp species are supplied free of charge. The costs of carp fry are:-

Silver carp	70 cents each
Grass carp	70 " "
Big-head carp	80 " "

Juvenile prawns although supplied free at present are costed at $1.00 per 100 for this exercise due to the relative difficulty of raising this species.

I.2.6 Labour

All the schemes dealt with are expected to be operated by the farmer himself or members of his family. The going wage rate for this type of labour is $5.00 per day while the shadow wage (opportunity cost) is estimated at $3.00 per day for social economic evaluation.

I.3 YIELDS AND RETURNS

Two factors are primarilly involved in determining the earning - potential of aqua culture schemes:

1. Growth (size) and survival rates of fish in the pond,
2. Prices received or the value of the fish produced and consumed by the household.

I.3.1 Yields and Survival Rates

The managerial skill of the farmer will largely determine the growth and survival rates and for the present exercise current standards achieved or considered feasible for Sarawak are used. Individual schemes could do better or worse than these standards. The survival rates used for calculation purposes are the following:-

Type	Proportion of initial stock harvested per cent
Local fish	90
Carp	80 to 90
Prawns	50
Turtles	80

I.3.2 Prices

The price received from the sale of fish off the farm will be determined by the demand for fish in the market and the prices of alternative meats. The availability of sea fish is particularly prone to interference due to adverse weather conditions and there are festival periods, particular during Chinese New Year, when the demand for carp species is particularly strong. Organising the production cycle to ensure that harvesting periods occur during these periods would be most advantageous.

Fresh fish are usually sold to middle men who arrange transport to market and storage. The farmer may expect to receive 50 to 60 per cent of the market value of the fish and appropriate farm gate values are allowed in calculating the returns to each scheme for this exercise.

I.4 RESULTS OF THE ECONOMIC ANALYSES

Five schemes were chosen for economic analysis from the ten described in Section 4.3

For each scheme a complete cash flow analysis was computed over a 20 year period and two pond construction cost situations were examined as mentioned in I.2.1 to assess the sensitivity of the scheme to this item.

The results of these analyses are summarised in Tables I.4.1, I.4.2, I.4.3, I.4.4, and I.4.5.

For comparison with alternative forms of agricultural development the achievements of each scheme in terms of the following criteria were calculated:-

1. Commercial rate of return
2. Internal rate of return at social prices
3. Return to labour at social prices
4. Return to land at social prices
5. Employment generated at maturity.

The performance of the five schemes selected for analysis are shown in Table I.4.6. The sensitivity of the schemes to the cost of pond construction was examined in terms of the commercial rate of return and the internal rate of return criteria and of these analyses the results are summarised in Table I.4.7.

TABLE I.4.1 ECONOMIC ANALYSIS OF ONE TENTH ACRE LOCAL FISH SCHEMES

Year	Net Revenue	Costs		Farmers labour	Net Cash flows		
		Capital	Operating		Excluding labour	Including labour at $3	Including labour at $5
	$	$	$	mandays	$	$	$
1	-	298	13	12	- 311	- 347	- 371
2	276	-	73	12	+ 203	+ 167	+ 143
3	276	-	73	12	+ 203	+ 167	+ 143
4	276	-	73	12	+ 203	+ 167	+ 143
5	276	-	96	12	+ 180	+ 144	+ 120
6	-	-	73	12	- 73	- 109	- 133
7	276	-	73	12	+ 203	+ 167	+ 143
8	276	-	73	12	+ 203	+ 167	+ 143
9	276	-	73	12	+ 203	+ 167	+ 143
10	276	-	96	12	+ 180	+ 144	+ 120
11	-	-	73		- 73	- 109	- 133
12	276	-	73		+ 203	+ 167	+ 143
13	276	-	73		+ 203	+ 167	+ 143
14	276	-	73		+ 203	+ 167	+ 143
15	276	-	96		+ 180	+ 144	+ 120
16	-	-	73		- 73	- 109	- 133
17	276	-	73		+ 203	+ 167	+ 143
18	276	-	73		+ 203	+ 167	+ 143
19	276	-	73		+ 203	+ 167	+ 143
20	276	-	73		+ 203	+ 167	+ 143
TOTAL	4 416	298	1 469	240	+2 649	+1 929	+1 449
N.P.V. at 10 per cent	1 965	298	655	102	+1 012	+ 674	+ 450
Internal Rate of Return (per cent)					› 50	41.6	30.9
HIGH COST: POND CONSTRUCTION COSTS							
TOTAL (20 years)	4 416	638	1 702	240	+2 076	+1 356	+ 876
N.P.V. at 10 per cent	1 965	638	758	102	+ 568	+ 230	+ 6
Internal Rate of Return (per cent)					23.3	15.3	10.2

TABLE I.4.2 ECONOMIC ANALYSIS OF 0.5 ACRE GIANT PRAWN WITH LOCAL FISH SCHEMES

Year	Net Revenue	Costs		Farmers labour	Net Cash flows		
		Capital	Operating		Excluding labour	Including labour at $3	Including labour at $5
	$	$	$	mandays	$	$	$
1	-	1 680	200	55	- 1 880	- 2 045	- 2 155
2	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
3	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
4	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
5	1 512	-	355	55	+ 1 157	+ 922	+ 882
6	-	-	360	28	- 360	- 444	- 500
7	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
8	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
9	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
10	1 512	-	355	55	+ 1 157	+ 922	+ 882
11	-	-	360	28	- 360	- 444	- 500
12	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
13	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
14	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
15	1 512	-	355	55	+ 1 157	+ 992	+ 882
16	-	-	360	28	+ 360	+ 444	- 500
17	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
18	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
19	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
20	1 512	-	360	28	+ 1 152	+ 1 068	+ 1 012
TOTAL	24 192	1 680	7 025	668	+15 487	+13 483	+12 147
N.P.V. at 10 per cent	10 762	1 680	3 203	326	+ 5 879	+ 4 901	+ 4 241
Internal Rate of Return (per cent)					50	45.7	39.1
HIGH COST: POND CONSTRUCTION COSTS							
TOTAL (20 years)	24 192	3 180	8 195	668	+12 817	+10 813	+ 9 477
N.P.V. at 10 per cent	10 762	3 180	3 724	326	+ 3 858	+ 2 880	+ 2 227
Internal Rate of Return (per cent)					27.1	22.5	19.5

TABLE I.4.3 ECONOMIC ANALYSIS OF 0.5 ACRE CHINESE CARP SCHEME

Year	Net Revenue	Costs		Farmers labour	Net Cash flows		
		Capital	Operating		Including labour	Including labour at $3	Including labour at $5
	$	$	$	mandays	$	$	$
1	-	1 680	235	55	- 1 915	- 2 080	- 2 190
2	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
3	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
4	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
5	1 540	-	355	55	+ 1 185	+ 1 020	+ 910
6	-	-	395	28	- 395	- 479	- 535
7	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
8	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
9	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
10	1 540	-	355	55	+ 1 185	+ 1 020	+ 910
11	-	-	395	28	- 395	- 479	- 535
12	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
13	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
14	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
15	1 540	-	355	55	+ 1 185	+ 1 020	+ 910
16	-	-	395	28	- 395	- 479	- 535
17	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
18	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
19	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
20	1 540	-	395	28	+ 1 145	+ 1 061	+ 1 005
TOTAL	24 640	1 680	7 620	668	15 340	13 336	12 000
N.P.V. at 10 per cent	10 961	1 680	3 483	326	+ 5 799	+ 4 820	+ 4 168
Internal Rate of Return (per cent)					› 50	44.5	38.3
HIGH COST: POND CONSTRUCTION COSTS							
TOTAL (20 years)	24 640	3 180	8 790	668	12 670	10 666	9 330
N.P.V. at 10 per cent	10 961	3 180	4 004	326	+ 3 777	+ 2 799	+ 2 147
Internal Rate of Return (per cent)					26.5	22	19.1

TABLE I.4.4 ECONOMIC ANALYSIS OF ONE ACRE CHINESE CARP SCHEME

Year	Net Revenue	Costs		Farmers labour	Net Cash flows		
		Capital	Operating		Excluding labour	Including labour at $3	Including labour at $5
	$	$	$	mandays	$	$	$
1	-	3 400	481	110	- 3 881	- 4 211	- 4 431
2	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
3	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
4	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
5	3 750	-	647	110	+ 3 103	+ 2 773	+ 2 553
6	-	-	732	35	- 732	- 837	- 907
7	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
8	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
9	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
10	3 750	-	647	110	+ 3 103	+ 2 773	+ 2 553
11	-	-	732	35	- 732	- 837	- 907
12	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
13	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
14	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
15	3 750	-	647	110	+ 3 103	+ 2 773	+ 2 553
16	-	-	732	35	- 732	- 837	- 907
17	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
18	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
19	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
20	3 750	-	732	35	+ 3 018	+ 2 913	+ 2 843
TOTAL	60 000	3 400	14 134	1 000	+42 466	+39 466	+37 466
N.P.V. at 10 per cent	26 691	3 400	6 486	505	+16 808	+15 291	+14 280
Internal Rate of Return (per cent)					› 50	› 50	› 50
HIGH COST: POND CONSTRUCTION COSTS							
TOTAL (20 years)	60 000	6 400	16 474	1 000	+37 126	+34 126	+32 126
N.P.V. at 10 per cent	26 691	6 400	7 527	505	+12 765	+11 249	+10 238
Internal Rate of Return (per cent)					37.1	33.1	30.5

TABLE I.4.5 ECONOMIC ANALYSIS OF SMALL SCALE TURTLE SCHEME

Year	Net Revenue	Costs			Net Cash flows		
		Capital	Operating	Farmers labour	Excluding labour	Including labour at $3	Including labour at $5
	$	$	$	mandays	$	$	$
1	50	219	42	26	- 211	- 289	- 341
2	250	-	200	37	+ 50	- 61	- 135
3	395	-	98	44	+ 297	+ 165	+ 77
4		-			+ 297	+ 165	+ 77
5		-			+ 297	+ 165	+ 77
6		-			+ 297	+ 165	+ 77
7		-			+ 297	+ 165	+ 77
8		-			+ 297	+ 165	+ 77
9		-	112		+ 283	+ 151	+ 63
10		-	112		+ 283	+ 151	+ 63
11		-	98		+ 297	+ 165	+ 77
12		-			+ 297	+ 165	+ 77
13		-			+ 297	+ 165	+ 77
14		-			+ 297	+ 165	+ 77
15		-			+ 297	+ 165	+ 77
16		-			+ 297	+ 165	+ 77
17		-			+ 297	+ 165	+ 77
18		-			+ 297	+ 165	+ 77
19		-	112		+ 283	+ 151	+ 63
20		-	112		+ 283	+ 151	+ 63
TOTAL	7 410	219	2 062	855	+ 5 129	+ 2 564	+ 854
N.P.V. at 10 per cent	3 222	219	934	388	+ 2 031	+ 868	+ 93
Internal Rate of Return (per cent)					50	36.1	13.1

TABLE I.4.6 ECONOMIC ACHIEVEMENTS OF AQUA-CULTURE SCHEMES

Scheme	Commercial rate of return	Internal rate of return	Return to labour	Return to land	Employment generated
	per cent	per cent	$ per manday	$ per acre	Full time job equi-velent per acre
One tenth acre local fish	31	42	10	792	.42
0.5 acre giant prawn with local fish	39	46	18	1 151	.24
0.5 acre chinese carp	38	46	18	1 132	.24
One acre chinese carp	750	750	33	1 795	.18
0.011 acre turtle scheme	13	36	5	869	1.40

TABLE I.4.7 SENSITIVITY OF ECONOMIC PERFORMANCE OF AQUA-CULTURE SCHEMES TO POND CONSTRUCTION COSTS

Scheme	Commercial rate of return		Internal rate of return	
	Average Cost	High Cost	Average Cost	High Cost
	%	%	%	%
One tenth acre local fish	31	10	42	15
0.5 acre giant prawn fish local fish	39	20	46	23
0.5 acre chinese carp	38	19	45	22
One acre chinese carp	> 50	31	> 50	33

The following observations may be made on the basis of the figures shown in Tables I.4.6 and I.4.7.

1. All schemes yield good economic returns and are commercially acceptable, those based on Chinese carp and giant prawns yield the highest returns.
2. The returns to labour even for the least profitable schemes are higher than those achieved by many other agricultural activities.
3. The profitability of schemes improves with increasing pond size therefore commercial projects should aim for the largest pond size subject to constraints of terrain, finance and labour resources.
4. All the schemes are sensitive to pond construction costs but the smaller schemes show a greater reduction in returns than those based on larger ponds.

APPENDIX II

APPENDIX II

ECONOMICS OF SMALL SCALE LIVESTOCK SCHEMES

II.1 INTRODUCTION

Poultry and pig production is traditionally undertaken on small scale units in the vicinity of the larger urban areas of Sarawak. It is clear that production will expand to meet increased demand as new settlements are established or existing centres expanded. The main advantage of these two enterprises is that they offer opportunities for gaining relatively quick returns compared to many cash crops. Their main disadvantage lies in the relatively high investment costs involved and the low unit profit margins which make them sensitive to changes in market prices or the costs of feed. Recent experience in Sarawak is indicative of the problems involved and the need for seeking local feed supplies to replace imported products which are both costly and subject to supply problems.

Small scale beef production is included here because it forms a possible development associated with the beef breeding schemes proposed in this Report. A unit based on growing-out weaners on a typical small holding is examined.

From the analyses which follow a potential producer would be able to review the prospects for each scheme and select that which suits his situation best according to the availability of land, labour and capital and the location of the holding in relation to markets.

A further purpose of this Appendix is to produce comprehensive financial and economic analyses which demonstrate the performance of the enterprises studied and to enable comparisons to be made with other agricultural activities.

The enterprises selected for study and which are analysed in the following pages are:

1. 1 000 bird poultry laying unit,
2. 1 000 bird broiler unit,
3. 10 sow pig breeding unit,
4. 15 acre small-holder beef growing-out unit.

Several case studies of poultry and pig operations were carried out in the Study Area to review the present situation and to provide background information for these analyses.

II.2 POULTRY PRODUCTION SCHEMES

Poultry schemes may aim to produce either eggs or table birds (broilers) and farmers frequently have both since they are partially complementary enterprises. A 1 000 bird unit has been selected for study since local experience indicates this to be a reasonable size consistent with local management ability and marketing factors.

II.2.1 Egg Production Unit

The enterprise is based on imported sexed day old chickens, housed in batteries under a simple timber frame and asbestos roofed shed. The birds are expected to lay for 18 months after a six month rearing period. New birds would be brought in to ensure continuous laying i.e. six months before the previous batch are finally culled. Culled birds would be sold for meat at the end of their laying cycle or when they failed to produce satisfactorily.

II.2.1.1 Buildings and Equipment

Separate housing is required for rearing chickens and housing the layers in batteries. To rear a thousand chickens a shed with dimensions 15 feet by 20 feet is adequate while for the adult birds an open shed with 3 500 square feet of floor space is required. Initial cost and maintenance are estimated as follows:

	Construction costs	Annual maintenance
Rearing shed	$ 300	$ 15
Laying shed	$3 000	$150

The buildings would be replaced after 10 years.

Equipment consists primarily of cages which are replaced every five years. The cost of these is $3.10 per bird.

A reliable supply of clean water is essential and unless piped water is available from an urban supply a pump costing $1 000 would be required to supply water from a nearby natural source. The annual operating costs of this equipment are estimated at $180 and it would be replaced after 10 years.

II.2.1.2 Stock

Sexed day-old chickens are imported from Singapore at present, but locally produced chickens should be available in future at a cost of about $1.00 each. For this study it is assumed that 1 060 chickens are purchased to rear the necessary birds to stock the unit. Batches of chickens are purchased six months before the last birds of the previous group are culled to ensure continuity of production.

II.2.1.3 Feed

An adequate supply of a well balanced feed is essential for high production of eggs and it is assumed that proprietary rations available in the Study Area would be fed as follows:-

<u>Pre-laying period</u>: (0 to 6 months)

Starter mash for 47 days
3.6 lbs per bird @ 25.5 cents per lb.

Grower mash for 61 days
11.0 lbs per bird @ 20.5 cents per lb.

Laying mash for 45 days
12.0 lbs per bird @ 20.5 cents per lb.

Total cost per bird $5.92

<u>Laying period</u>: (6 to 24 months)

Laying mash for 18 months at 3.5 to 4.5 ozs per bird per day @ 20.5 cents per lb.

II.2.1.4 Veterinary and Medicines

Vaccinations given during the rearing period are estimated to cost $40 per 1 000 birds.

II.2.1.5 Labour

The farmers own labour input is estimated as the basis of 2 000 birds per full time worker and is valued at $120 per month.

II.2.1.6 Mortality and Culling

Mortality is assumed to be five per cent during the rearing stage and three per cent during the laying period. Culling would commence after the first six months of laying and all remaining birds are assumed to be sold at the end of 18 months.

II.2.1.7 Production and Sales

Egg production is estimated at 360 per bird over 18 months (66 per cent laying efficiency). The average selling price of eggs ex-farm is 10 cents. While culled birds are assumed to fetch $4.20 each.

The average production phasing of a batch of birds is shown in Table II.2.1

TABLE II.2.1 PRODUCTION PHASING AND PERFORMANCE OF 1 000 BIRD LAYING UNIT

	Number birds			Number eggs produced	Number birds in flock at end of period
	Died	Culled	Laying		
Purchased					1 060
0- 6	53	-	-	-	1 007
6-12	10	-	1 002	121 571	997
12-18	-	169	907	110 019	818
18-24	-	169	728	88 306	639
24 months	-	639	-	-	
Total	63	977		319 896	

II.2.1.8 Financial and Economic Analysis

The overall cash flow of the laying unit is given in Table II.2.2. The total capital development cost, including land valued at $1 000, is estimated at $9 460 while operating costs account for $15 300 in the first year while income is $12 160. Thereafter total costs average about $21 100 and income $23 800.

The internal rate of return over a twenty year period is 23 per cent at market prices and 26 per cent at social prices.

II.2.2 Broiler Unit

Commercial broiler producers usually raise unsexed day old chicks from locally hatched eggs imported from Singapore and

TABLE II.2.2 CASH FLOW OF 1 000 BIRD LAYER SCHEME (DOLLARS)

Year	Development Costs				Operating Costs				Total costs	Income	Net Cash Flow	
	Land	Buildings and equipment	Water supply	Stock	Feed	Veterinary and medicines	Water and miscellaneous	Labour			at market prices	at social prices
1	1 000	6 400	1 000	1 060	14 362	40	180	720	24 762	12 160	-12 602	-12 312
2		165	180	1 060	19 469	40	180	720	21 814	23 930	2 116	2 406
3				-	15 404	-			16 649	23 870	7 221	7 511
4				1 060	20 239	40			22 584	23 670	1 086	1 376
5		3 265		1 060	19 469	40			24 914	23 930	- 984	- 694
6		165		-	15 404	-			16 649	23 870	7 221	7 511
7				1 060	20 239	40			22 584	23 670	1 086	1 376
8				1 060	19 469	40			21 814	23 930	2 116	2 406
9				-	15 404							
10		6 400	1 000	1 060	20 239	40			29 639	23 670	- 5 969	- 5 679
11		165	180	1 060	19 469	40			21 814	23 930	2 116	2 406
12				-	15 404	-			16 649	23 870	7 221	7 511
13				1 060	20 239	40			22 584	23 670	1 086	1 376
14				1 060	19 469	40			21 814	23 930	2 116	2 406
15		3 265		-	15 404	-			19 749	23 870	4 121	4 411
16		165		1 060	20 239	40			22 584	23 670	1 086	1 376
17				1 060	19 469	40			21 814	23 930	2 116	2 406
18				-	15 404	-			16 649	23 870	7 221	7 511
19				1 060	20 239	40			22 584	23 670	1 086	1 376
20				-	13 194	40			14 479	24 930*	10 451	10 741
Total	1 000	21 970	5 240	13 780	358 228	560	3 600	14 400	418 778	465 910	+47 132	52 932
N.P.V. at 10 per cent	1 000	13 356	2 853	7 037	167 001	265	1 532	6 130	199 130	211 667	+11 899	14 687

Note: * Includes $1 000 land value.

aim to turn out a bird of marketable size weighing about 3.5 katis (4.7 pounds) at 3.5 months. The unit analysed is geared to produce three batches of 333 birds per annum or 1 000 birds in all.

Birds are sold live either to middlemen or directly to larger institutions. There are no facilities for refrigeration of carcasses, nor does there appear to be a steady demand for frozen poultry meat in Sarawak at present.

II.2.2.1 Buildings and Equipment

The local climatic conditions permit broiler production to be operated under semi-free range conditions with simple timber frame sheds having wire or slatted floors and a range area enclosed by wire netting. The cost of this type of building allowing 1.2 square feet floor space per bird is estimated at \$475 for the whole unit.

Ancillary buildings and chicken rearing space are estimated to cost about \$225.

The useful life of these buildings is assumed to be 10 years and annual repairs and maintenance are estimated at five per cent of initial cost.

II.2.2.2 Stock

Unsexed day old chicks of suitable crosses are available in the Study Area from local hatcheries and are costed at 45 cents each for this analysis. This is somewhat below present prices but a decrease in price is expected because more hatcheries are coming into production.

Three batches of 333 chickens would be purchased each year commencing with two in the first year of operation.

II.2.2.3 Feed

Locally available proprietary mixed rations are assumed to be fed and an overall feed conversion ratio of 3.5:1 achieved. The following feeds and costs are budgeted per bird:-

Starter mash for 1.5 months,	2.7 lbs @ 25 cents
Grower mash for 2 months,	7.4 lbs @ 22 cents
Crushed maize	6.1 lbs @ 13.5 cents

Average cost per bird $3.10

II.2.2.4 Veterinary

Vaccinations to combat diseases are estimated to cost 12 cents per bird.

II.2.2.5 Labour

The farmers own labour would be adequate for handling the broiler unit and it is assumed that 1 000 birds would be a full time job for one man. The eight man days per month required for the unit are valued at $40 per month.

II.2.2.6 Mortality

Deaths are estimated to account for five per cent of birds.

II.2.2.7 Production and Sales

The number of birds sold in each year of the scheme rises to 950 after the first year when 633 are turned out. Prices at which table birds sell in the local markets vary somewhat and there has been a tendency to rise with increasing feed costs. This trend may be expected to be reversed as cheaper locally mixed feeds are produced.

The farm gate values used for this analysis assume a 20 cents per kati marketing margin and are based on an average bird weight of 3.5 katis (4.7 lbs) and the following market prices:-

	Market price $ per kati	Farm gate price $ per kati	Farm gate value per bird $
Pullets	1.90	1.70	5.95
Cockerels	1.70	1.50	5.25
Average			5.60

The proportion of cockerels to pullets is assumed to be equal i.e. 1:1.

TABLE II.2.3 1 000 BIRD BROILER ENTERPRISE CASH FLOW (DOLLARS)

Year	Development Costs		Operating Costs							Net Cash Flow	
	Land	Buildings and equipment	Stock	Feed	Veterinary and medicines	Water	Labour	Total costs	Income	at market prices	at social prices
1	300	700	300	2 610	80	40	480	4 510	3 543	- 967	- 846
2	-	35	450	3 920	120	60	480	5 065	5 320	255	375
3	-										
4											
5											
6											
7											
8											
9											
10		700						5 730		- 410	- 289
11		35						5 065		255	375
12											
13											
14											
15											
16											
17											
18											
19											
20											
Total	300	2 030	8 850	77 090	2 360	1 180	9 600	101 410	104 623	+3 213	+5 615
N.P.V.at 10 per cent	300	1 273	3 764	35 400	1 084	542	4 087	47 157	48 045	+ 885	2 009

The overall cash flow of the broiler unit is given in Table II.2.3. The capital development cost including land is estimated at $1 000 while operating costs amount to $2 580 and income to $3 540 during the first year of operation. Thereafter costs average about $4 550 and income $5 320.

The internal rate of return over a 20 year period is 24 per cent at market prices and 43 per cent at social prices.

II.3 PORK PRODUCTION SCHEME

The pork enterprise selected for evaluation is modelled on typical small farmer units operated in the vicinity of Miri, Marudi and Bintulu, and which are likely to be established in future near new settlements in the Study Area. A unit of this size would aim at having about 10 sows farrowing twice a year and would be geared to turn out small batches of porkers weighing about 180 katis (240 lbs) at about 30 weeks.

The unit is based on gilts and boars bought from local breeders. The gilts are assumed to produce eight litters over a four year productive life and boars are assumed to have a four year productive life.

II.3.1 Buildings and Equipment

For the number of sows and boars involved a timber frame shed with a floor area of 1 800 square feet sub-divided into 20 pens each 8 by 9 feet (72 square feet) arranged in two rows with a central passage 4.5 feet wide is required. The cost of constructing the shed and pens is estimated at $4 200 and they would be replaced after 10 years. Annual maintenance costs are budgeted at $490.

A supply of fresh water is essential for washing out the pens regularly and hosing down the animals themselves. A small motor and pump is budgeted at $1 500 and operating costs estimated at $400 per annum are included under item 3.6.

II.3.2 Breeding Stock

Gilts are assumed to be purchased in two batches of five each, the first batch three months after the start of the project and the second after six months. The current price of gilts at breeding age (eight months) is $200 each. The culled animals after their eighth litter are expected to have a residual value of $90. A boar would be purchased at the start of the scheme at a cost of $350. The culled animal, after four years, has no market value.

II.3.3 Performance Assumptions

The following assumptions summarise the performance parameters on which this analysis is based:

Average number litters per sow per annum	2
Average number piglets weaned per litter	8
Average age at weaning	30 days
Average porker mortality from weaning to sale	2 per cent
Average age of porkers at sale	30 weeks
Average weight of porkers at saleable age	240 lbs

II.3.4 Feeding

As with other small stock enterprises purchased feed is a major cost item and much of the success or failure of a scheme of this kind depends on:

- Feeding efficiency, which is expressed by the feed conversion ratio of stock being fattened.
- The availability of a reliable supply of feeds of suitable quality.

For this analysis it is assumed that currently available proprietary rations are utilised and are budgeted for as shown in Table II.3.1.

TABLE II.3.1 FEED REQUIREMENTS AND COSTS OF PIGS

Category	Type of feed	Average feeding rate per day pounds	Period fed days per annum	Price per pound (cents)
Boars	Breeder mash	6.0	365	17.4
Sows - suckling	Breeder mash	6.0	120	17.4
Sows - dry	Breeder mash	4.0	245	17.4
Porkers (feed	Pre-starter mash	2.0	30	30.7
conversion ratio	Starter mash	2.7	45	19.4
3.5:1)	Grower mash	4.3	135	18.5

The feed costs estimated on the above basis for the unit as a whole are:-

Year 1	$ 4 915
Year 2 onwards	$27 350

II.3.5 Veterinary and Medicines

Several different innoculations and medications are required during the production cycle the costs of which are estimated as follows:-

	Cost per animal	Cost per annum
Piglets to weaning	63 cents	$100
Porkers	7 cents	$ 12
Sows	97 cents	$ 10

II.3.6 Water and Other Costs

These costs are estimated to amount to $240 in the first year and $440 in following years.

II.3.7 Labour

For a unit of this size labour inputs are estimated as:

	Labour input	Cost
Year 1	135 man days	$675
Year 2 and onwards	180 man days	$900

II.3.8 Production and Sales

On the basis of the performance assumptions given under item 3.3 the unit will produce 79 porkers for sale from the second year of operation onwards and every five years 10 sows will be culled. The farm gate selling price of porkers is estimated at $0.90 per pound ($1.20 per kati). Output from the unit is valued at $34 128 per annum except when cull sows are disposed of when $35 038 would be received.

II.3.9 Financial and Economic Analysis

The overall cash flow of the pig unit over twenty years is given in Table II.3.2. Capital development costs, including land, amount to $11 400 while operating costs amount to $5 896 in the first year. There would be no income earned until the second year of operations. From the second year onwards costs amount to $29 300 and to $34 130. The internal rate of return over twenty years is 23 per cent at market prices and 26 per cent at social prices.

II.4 SMALL-HOLDER BEEF SCHEME

There are very few beef operations in the Study Area at the moment but units might be developed in future in connection with the large scale beef breeding and training schemes which are proposed in this Report.

The small holder scheme selected for evaluation is based on a mixed enterprise in which the farmer would be able to devote up to half his labour resources to beef i.e. 250 man days per annum. It is assumed that animals would be purchased as weaners from a central breeding scheme at about six months of age and sold back to a central marketing organisation at 18 to 24 months.

Fifteen acres of suitable land are assumed to be planted to pastures consisting of grazed and fodder species and capable of supporting up to 1.5 l.s.u.'s per acre over a seven year production period.

TABLE II.3.2 CASH FLOW OF 10 SOW PIG UNIT (DOLLARS)

Year	Development Costs			Operating Costs				Total costs	Income	Net Cash Flow	
	Land	Buildings and equipment	Breeding stock	Feed	Veterinary and medicines	Water and others	Labour			at market prices	at social prices
1	1 000	5 700	4 700	4 915	66	240	675	17 296	-	-17 296	-17 026
2		490	-	27 350	122	440	900	29 302	34 128	4 826	5 186
3	-	490	-					29 302	34 128	4 826	5 186
4	-	490	-					29 302	34 128	4 826	5 186
5		490	4 700					34 002	35 038	1 036	1 396
6		490	-					29 302	34 128	4 826	5 186
7		490	-					29 302	34 128	4 826	5 186
8		490	-					29 302	34 128	4 826	5 186
9		490	4 700					34 002	35 038	1 036	1 396
10		5 700	—					34 512	34 128	- 384	- 24
11		490	-					29 302	34 128	4 826	5 186
12			-					29 302	34 128	4 826	5 186
13			4 700					34 002	35 038	1 036	1 396
14			-					29 302	34 128	4 826	5 186
15			-					29 302	34 128	4 826	5 186
16			-					29 302	34 128	4 826	5 186
17			4 700					34 002	35 038	1 036	1 396
18			-					29 302	34 128	4 826	5 186
19			-					29 302	34 128	4 826	5 186
20			-					29 302	35 128*	12 361	12 721
TOTAL	1 000	20 220	23 500	518 030	2 384	8 600	17 775	591 509	653 072	61 563	68 673
N.P.V. at 10 per cent	1 000	12 007	12 624	232 626	1 087	3 921	8 204	271 439	287 145	15 705	18 986

Note: * Includes $1 000 land value.

II.4.1 Development and Operation Plan

The land required for the enterprise is assumed to be cleared to oil palm standards in the first year by a contractor and pastures established over two years thus:

10 acres in first year

5 acres in second year

The number of livestock introduced is related to the carrying capacity of the pasture which is assumed to be 0.5 l.s.u.'s per acre in the year of establishment increasing to the full carrying capacity in the second year. Carrying capacity of the unit is expected to increase from 1.0 l.s.u. per acre in the second year of operations to 1.5 l.s.u. per acre by the fifth year.

The overall development and phasing of operations is summarised in Table II.4.1.

TABLE II.4.1 PHASING OF SMALL HOLDER BEEF OPERATIONS

Year	Land cleared	Pasture planted	Carrying capacity	Potential stocking	Weaners purchased	Steers sold	Actual stocking
	acres	acres	LSU/acres	LSU	Animals	Animals	LSU
0	15	-	-	-	-	-	-
1	-	10	.75	7.5	7	-	5
2	-	5	1.00	12.5	7	7	12
3	-	-	1.25	18.75	9	7	16
4	-	-	1.25	18.75	20	9	19
5	-	-	1.50	20.5	10	15	20
6			1.50	20.5	10	15	20
7			1.50	20.5	20	10	20

II.4.2 Input Requirements and Costings

II.4.2.1 Land Clearing

The cost of land clearing by a contractor such as the SLDB is estimated to be $180 per acre. This would cover a limited amount of destumping if the land were secondary forest (temuda) at the time of clearing.

II.4.2.2 Stock

The number of weaners purchased each year are shown in Table II.4.1. They are estimated to cost $165 and weigh 270 to 280 lbs.

II.4.2.3 Pasture Costs

Pasture costs are based on grass/legume mixtures receiving annual dressings of NPK fertilisers. Ten per cent of the area is renovated annually commencing in the sixth year of operations.

Costs assumed for budgeting purposes are as follows:-

(a) New pasture establishment: $100 per acre,

(b) Old pasture renovation : $ 80 per acre,

(c) Annual pasture maintenance, fertilisers and chemicals: $ 30 per acre.

II.4.2.4 Fencing and Water

Sub-division into paddocks with a central watering trough is essential for effective pasture management and control of animals. The following assumptions and costs are the basis for budgeting:-

(a) Sub-division into two acre paddocks served by a farm road using four to five strand barbed or smooth wire fences. Fencing required estimated at 1.35 miles for 15 acres.

(b) Fencing erection cost estimated at $1 200 per mile and annual maintenance costs at 7.5 per cent of initial cost. Road levelled by manual means.

(c) Fencing erected over a four year period as the productivity of pastures and number of animals increase.

(d) Handling pens constructed at a central point at a cost of $200 for materials.

(e) Water is assumed to be available from a local stream supply and provision is made for a central watering trough and piping at $200.

II.4.2.5 Veterinary and Medicines

Innoculations and parasite control are estimated to cost $4 per head per annum.

II.4.2.6 Supplementary Feeding

There is little experience on which to base an estimate of the cost of feeds which might be given but it is likely that some feeds will be required during the last six to nine weeks of fattening. Salt would be required as a lick at all times. A cost of $10 per head is allowed to cover these items.

II.4.2.7 Small Tools and Equipment

A knapsack sprayer will be required for tick spraying and pasture maintenance. This together with other simple tools is estimated to cost \$100 initially and \$30 per annum thereafter.

II.4.2.8 Miscellaneous Costs

An amount of \$100 per annum is allowed to cover contingencies and miscellaneous items such as transport, farmer association fees, records and the like.

II.4.2.9 Labour Requirements

Labour inputs are estimated on the basis of the pasture and animal operations involved in the enterprise. All operations are assumed to be carried out by the farmer or members of his family and basic input requirements are shown in Table II.4.2.

TABLE II.4.2 LABOUR INPUT REQUIREMENTS FOR SMALL SCALE BEEF SCHEME
(mandays per acre)

		Including clearing	Excluding clearing	Renovation (from year 5)
1.	Pasture operations			
1.1	Establishment and renovation			
	Felling and clearing/remove old grass stand	10.0	-	5.0
	Collecting vegetative planting material	0.2	0.2	0.2
	Planting	3.0	3.0	3.0
	Road levelling	0.1	0.1	-
	Fencing	4.6	4.6	-
	Total	17.9	7.9	8.2

		Per round	No. rounds	Total per acre	No. rounds	Total per acre
1.2	Maintenance					
	Fertilising	0.3	2	0.60	2	0.60
	Weeding (spray)	0.3	2	0.60	3	0.90
	Slashing	0.5	4	2.00	4	2.00
	Fence and road maintenance	0.05	1	0.05	2	0.10
	Total	-	-	3.25	-	3.60

		Frequency	Time per operation	Total man days per acre pasture
2.	Stock handling operations			
	Crush inspection and tick spraying of animals	2 per month	10 minutes	0.5
	Moving animals	1 per week	0.5 man days per 15 acres	1.5
	Total	-	-	2.0

II.4.3 Production and Sales

For budgeting purposes the production and sales value of animals are calculated on the basis of the following estimated weights and farm gate prices:-

		Live weight lbs	Price per lb (live weight)	Price per animal
Weaners	- Average	275	60 cents	$165
	- Low price	275	55 cents	$150
Steers	- Average	800	50 cents	$400
	- High weight gain	900	50 cents	$450

The numbers of animals assumed to be sold in each year are given in Table II.4.1.

II.4.4 Financial and Economic Analysis

From the data presented in Sections II.4.1, and II.4.2 the cash flow over 25 years shown in Table II.4.3 was computed. The development costs of the enterprise total $6 400 while operating costs average $3 220 per annum. Income averages $5 300 per annum once the unit is fully productive from year five onwards.

At average prices the internal rate of return is 15 per cent at market prices and 18 per cent at social prices. If the higher weight gain of steers is achieved the return at market prices would be 22 per cent. These returns are acceptable for commercial operation.

The effect of possible lower buying prices and of high weight gains were tested at market prices and yielded the following internal rates of return:

(a) Lower weaner price: 17 per cent.

(b) Higher weight gain and lower weaner price 23 per cent.

For comparison with other agricultural enterprises, the following economic achievements are calculated (at social prices):

(a) Return to labour: $9.60 per man day.

(b) Return to land : $45.50 per acre per annum.

TABLE II.4.3 CASH FLOW OF 15 ACRE SMALL HOLDER BEEF GROWING OUT SCHEME (DOLLARS)

Year	Development Costs		Operating Costs											Net Cash Flow	
	Land clear-ing	Pasture establish-ment	Fencing and water and tools	Hand-ling pens	Pasture main-tenance	Pasture reno-vation	Veterinary and medicines	Small tools replace-ment	Stock pur-chase	Supplementary feeds and micellaneous	Total costs excluding labour	Labour man days	Income	at market prices	at social prices
0	1 350										1 350	-	-	-1 350	-1 350
1	1 350	1 000	750	200			20		1 155	50	4 525	131.5	-	-5 182	-4 842
2		500	450	20	300		48	30	1 155	170	2 673	102.0	2 800	- 383	- 118
3			400	20	450		64	30	1 485	170	2 619	78.75	2 800	- 213	- 10
4			400		450		76		3 300	190	4 466	78.75	3 600	-1 260	-1 056
5			128		405	120	80		1 650	250	2 683	91.0	6 000	2 862	3 080
6			128		405	120	80		1 650	250	2 683	90.9	6 000	2 862	3 080
7									3 300	200	4 283		4 000	- 737	- 520
8									1 650	250	2 683		6 000	2 862	3 080
9									1 650	250	2 683		6 000	2 862	3 080
10									3 300	200	4 283		4 000	- 737	- 520
11									1 650	250	2 683		6 000	2 862	3 080
12									1 650	250	2 683		6 000	2 862	3 080
13									3 300	200	4 283		4 000	- 737	- 520
14									1 650	250	2 683		6 000	2 862	3 080
15									1 650	250	2 683		6 000	2 862	3 080
16									3 300	200	4 283		4 000	- 737	- 520
17									1 650	250	2 683		6 000	2 862	3 080
18									1 650	250	2 683		6 000	2 862	3 080
19									3 300	200	4 283		4 000	- 737	- 520
20									1 650	250	2 683		6 000	2 862	3 080
21									1 650	250	2 683		6 000	2 862	3 080
22									3 300	200	4 283		4 000	- 737	- 520
23									1 650	250	2 683		6 000	2 862	3 080
24									1 650	250	2 683		6 000	2 862	3 080
25									-	200	983		4 000	2 562	2 780
Total	2 700	1 500	4 688	680	9 705	2 520	1 888	720	49 995	5 480	79 876	2 300	121 200	29 824	35 409
NPV at 10%	2 700	1 454	2 620	380	3 612	897	693	270	19 542	2 014	34 182	939	42 654	3 882	6 199

II.4.3 Production and Sales

For enterprise [illegible] the production and sales value of animals are [illegible] the following estimated weights and [illegible]:

	[illegible]	Price ([illegible] live weight)	Price per animal
Weaners - Average	275	60 cents	$165
- [illegible]		[illegible] cents	$150
Steers - Average	800	50 cents	$400
- High			
[illegible]	900	50 cents	$950

The numbers of animals assumed to be sold in each year are given in Table II.4.3.

II.4.4 Financial and Economic Analysis

From the data presented in Sections II.4.1 and II.4.2 the cash flow over [illegible] years shown in Table II.4.3 was computed. The development cost of the enterprise totals $6 [illegible] while operating costs average $3 220 per annum. Income averages $5 200 per annum once the unit is fully productive from year five onwards.

At average prices the internal rate of return is 15 per cent at market prices and 10 per cent at social prices. If the higher weight gain of steers is achieved the return at market prices would be 22 per cent. These returns are acceptable for commercial operation.

The effect of possible lower buying prices and of high weight gains were tested at market prices and yielded the following internal rates of return:

(a) Lower weaner price: 17 per cent.

(b) Higher weight gain and lower weaner price: [illegible] per cent.

For comparison with other agricultural enterprises the following economic achievements are calculated (at social prices):

(a) Return to labour: $9.60 per man day

(b) Return to land : $45.50 per acre per annum.

APPENDIX III

APPENDIX III.1 HERD BUILD-UP FOR FIRST TWO SHIPMENTS OF CATTLE*

Year	Opening Inventory: Breeding Cows	Opening Inventory: Calves 3-9 m F	Opening Inventory: Calves 3-9 m M	Opening Inventory: Stock 15-21 m F	Opening Inventory: Stock 15-21 m M	Changes during year: Calves born F	Changes during year: Calves born M	Changes during year: Cows dying	Changes during year: New calves dying F	Changes during year: New calves dying M	Changes during year: Previous years calves dying F	Changes during year: Previous years calves dying M	Changes during year: Sales: Bulls or Steers	Changes during year: Sales: Culls	Closing Inventory: Breeding Cows	Closing Inventory: Calves 3-9 m F	Closing Inventory: Calves 3-9 m M	Closing Inventory: Stock 15-21 m F	Closing Inventory: Stock 15-21 m M
1	580	-	-	-	-	261	261	12	13	13	-	-	-	-	568	248	248	-	-
2	568	248	248	-	-	184	185	11	9	9	5	5	-	56	501	175	176	243	243
3	501	175	176	243	243	260	261	15	13	13	3	4	243	50	679	247	248	172	172
4	679	247	248	172	172	298	298	17	15	15	5	5	172	75	759	283	283	242	243
5	759	283	283	242	243	376	375	20	19	19	5	6	243	83	898	357	356	278	277
6	898	357	356	278	277	447	447	24	14	13	4	3	277	108	1044	433	434	353	353

* Assumed that each shipment is of 290 in-calf heifers, and calving of first batch within 6 months of arrival. Assumed start of project is date of arrival of first load of cattle on the ranch.

APPENDIX III.2 HERD BUILD-UP FOR SHIPMENTS THREE AND FOUR*

Project Year	Opening Inventory: Breeding Cows	Opening Inventory: Calves 0-3 m F	Opening Inventory: Calves 0-3 m M	Opening Inventory: Stock 12-15 m F	Opening Inventory: Stock 12-15 m M	Opening Inventory: Stock 24-27 m F	Opening Inventory: Stock 24-27 m M	Changes during year: Calves born F	Changes during year: Calves born M	Changes during year: Cows dying	Changes during year: New calves dying F	Changes during year: New calves dying M	Changes during year: Previous years calves dying F	Changes during year: Previous years calves dying M	Changes during year: 2 years previous calves dying F	Changes during year: 2 years previous calves dying M	Changes during year: Sales: Steers	Changes during year: Sales: Culls	Closing Inventory: Breeding Cows	Closing Inventory: Calves 0-3 m F	Closing Inventory: Calves 0-3 m M	Closing Inventory: Stock 12-15 m F	Closing Inventory: Stock 12-15 m M	Closing Inventory: Stock 24-27 m F	Closing Inventory: Stock 24-27 m M
1	580	(purchased in net year)						261	261	6	5	5	-	-	-	-	-	-	574	256	256	-	-	-	-
2	574	256	256	-	-	-	-	186	187	11	4	4	8	8	-	-	-	-	563	182	183	248	248	-	-
3	563	182	183	248	248	-	-	197	197	11	4	4	5	5	5	5	-	56	496	193	193	177	178	143	143
4	496	193	193	177	178	243	243	259	258	15	5	5	9	9	3	4	243	55	669	254	253	184	184	174	174
5	669	254	253	184	184	174	174	316	316	17	6	6	10	10	3	4	174	74	752	310	310	244	243	181	180
6	752	310	310	244	243	181	180	354	355	19	4	4	13	13	2	2	423	90	824	350	351	297	297	241	-

* No provision in these figures for breeding bulls retained.

APPENDIX III.3 HERD BUILD-UP FOR SHIPMENTS FIVE AND SIX*

	Opening Inventory					Changes during year									Closing Inventory				
Year	Breeding Cows	Calves 3-9 m		Stock 15-21 m		New calves born		Cows dying	New calves dying		Last year's calves dying		Sales		Breeding Cows	Calves 3-9 m		Stock 15-21 m	
		F	M	F	M	F	M		F	M	F	M	Steers	Culls		F	M	F	M
2	-	-	-	-	-	261	261	12	13	13	-	-	-	-	568	248	248	-	-
3	568	248	248	-	-	199	199	11	10	10	5	5	-	56	501	189	189	243	243
4	501	189	189	243	243	260	261	15	13	13	4	4	243	55	674	247	248	185	185
5	674	247	248	185	185	322	322	17	16	16	5	5	185	74	768	306	306	242	243
6	768	306	306	242	243	384	384	20	12	11	3	3	243	92	898	372	373	303	303

APPENDIX III.4 HERD BUILD-UP FOR SHIPMENTS SEVEN AND EIGHT*

	Opening Inventory							Changes during year													Closing Inventory						
Year	Breeding Cows	Calves 0-3 m		Stock 12-15 m		Stock 24-27 m		New cows purchased	New calves born		Cows dying	New calves dying		Last year's calves dying		2 years ago stock dying		Sales		Breeding Cows	Calves 0-3 m		Stock 12-15 m		Stock 14-27 m	
		F	M	F	M	F	M		F	M		F	M	F	M	F	M	Steers	Culls		F	M	F	M	F	M
3	-	-	-	-	-	-	-	580	261	261	6	5	5	-	-	-	-	-	-	574	256	256	-	-	-	-
4	574	256	256	-	-	-	-	-	201	201	11	4	4	8	8	-	-	-	-	563	197	197	248	248		
5	563	197	197	248	248	-	-	-	211	211	11	4	4	6	6	5	5	-	56	496	207	207	191	191	243	243
6	496	207	207	191	191	243	243	-	281	281	15	3	3	2	2	2	2	434	60	664	278	278	205	205	189	-

* No provision for breeding bulls to be retained.

APPENDIX IV

APPENDIX IV

ECONOMIC AND FINANCIAL SCHEDULES

This appendix contains tables giving the details of the cost and output flows on which the economic analysis given in Chapter 17 are based. An overall summary of scheme development phasing, costs and income estimates are given in Tables IV.1, IV.2, IV.3, and IV.4. Details of the costs for various development, operations and management items follow with a breakdown of the physical inputs involved as appropriate.

Foreign exchange costs attributed to the scheme are given in Table Iv.6.

TABLE IV.1

PHASING OF DEVELOPMENT AND ANIMAL IMPORTS BY THREE MONTHLY PERIODS

ITEM / UNIT	1974				1975				1976				1977				1978 and following			
	1/4	2/4	3/4	4/4	1/4	2/4	3/4	4/4	1/4	2/4	3/4	4/4	1/4	2/4	3/4	4/4	1/4	2/4	3/4	4/4
	JAN	APRIL	JULY	OCT	JAN	APRIL	JULY	OCT	JAN	APRIL	JULY	OCT	JAN	APRIL	JULY	OCT	JAN	APRIL	JULY	OCT JAN
LAND CLEARANCE (net acres)	950				2 000				2 000											
PASTURES PLANTED (net acres)		950				2 000				2 000										
PASTURES GRAZED (net acres)					950	950	950	950	2950	2950	2950	2950	4950	4950	4950	4950	4950	4950	4950	4950
CATTLE IMPORTS (number of animals) -arrive in Sarawak				290	290	290	290	290	290					290	290					
-arrive on scheme					290	290	290	290	290	290					290	290				

TABLE IV.2 SUMMARY OF SCHEME COSTS - THOUSANDS DOLLARS (M$)

ITEM	YEARS 0 1974	1 1975	2 1976	3 1977	4 1978	5 1979	6 1980	7 1981	8 1982	9 1983	10 1984	11 1985	12 1986	13 1987	14 1988	15 1989	16 1990	17 1991	18 1992	19 1993	20 1994	21 1995	22 1996	23 1997	24 1998	25 1999	TOTAL
<u>Development costs</u>																											
Land clearing	235.6	486.3	486.3	-																							1 208.2
Pasture establishment	103.0	215.5	215.5	-																							534.0
Stock purchases	-	2 318.0	1 134.0	754.0																							4 206.0
Fencing	32.0	64.0	64.0																								160.0
Handling pens and shade	27.0	27.0	-	-																							54.0
Roads	54.0	28.0	28.0																								110.0
Machinery and vehicles	206.4	15.4																									221.8
Water supplies	8.0	16.0	16.0																								40.0
Houses and buildings	16.0	114.0	94.7	44.6																							269.3
Sub Total	682.0	3 284.2	2 038.5	798.6																							6 803.3
<u>Operating costs</u>																											
Pasture maintenance	-	39.9	122.8	205.7	205.7	185.1	185.1	185.1	185.1	185.1	185.1	185.1															4 461.2
Pasture renovation	-	-	-	-	-	57.7	57.7	57.7	57.7	57.7	57.7	57.7															1 211.7
Fencing maintenance	-	2.4	7.2	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0															285.6
Handling pens maintenance	-	1.4	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7															66.2
Roads maintenance	-	6.1	10.3	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5															349.9
Field machinery maintenance	11.5	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1															314.0
Water supply maintenance	-	0.2	0.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0															23.8
Labour	3.5	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9															176.0
Veterinary and medicines	-	8.5	18.5	29.4	38.3	45.5	50.4	55.0	57.5	56.9	56.2	61.8	61.8	61.8													1 343.2
Sub Total	15.0	77.5	181.1	284.3	293.2	337.5	342.4	347.0	349.5	348.9	348.2	353.8	353.8	353.8													8 231.6
<u>Management and overheads</u>																											
Staff salaries	98.4	188.3	146.8	135.0	138.9	138.9	138.9	138.9	138.9	138.9	138.9	138.9															3 624.3
Vehicles repairs and maintenance	5.1	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6															145.1
Vehicles and equipment replacements	-	-	-	-	4.4	4.4	20.5	-	103.4	4.4	-	59.5	35.9	4.4	-	-	103.4	4.4	20.5	-	4.4	4.4	59.5	11.0	103.4	-	547.9
Houses and buildings maintenance	-	5.9	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7															166.7
General running costs	10.3	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8															455.3
Sub Total	113.8	217.6	176.9	165.1	173.4	173.4	189.5	169.0	272.4	173.4	169.0	228.5	204.9	173.4	169.0	169.0	272.4	173.4	189.5	169.0	173.4	173.4	228.5	180.0	272.4	169.0	4 939.3
Total Costs	810.8	3 579.3	2 396.5	1 248.0	466.6	510.9	531.9	516.0	621.9	522.3	517.2	582.3	558.7	527.2	522.8	522.8	626.2	527.2	543.3	522.8	527.2	527.2	582.3	533.8	626.2	522.8	19 974.2

TABLE IV.3 INCOME FROM LIVESTOCK SALES
(At market prices)

Year	Steers	Cull cows	Cull bulls	Heifers	Total
	$	$	$	$	$
1974	-	-	-	-	-
1975	-	-	-	-	-
1976	-	22 400	-	-	22 400
1977	84 000	64 800	17 000	-	155 800
1978	248 640	74 000	10 000	-	332 640
1979	277 220	114 800	13 000	258 000	355 020
1980	660 000	148 750	15 000	347 400	1 066 750
1981	530 880	175 100	14 000	600 000	1 067 380
1982	654 720	194 225	12 000	600 000	1 460 945
1983	685 920	202 300	12 000	600 000	1 500 220
1984	683 520	212 500	12 000	540 600	1 508 020
1985 and following	860 220	289 800	11 000	540 600	1 701 620

TABLE IV.4 INCOME FROM LIVESTOCK SALES
(At social prices)

Year	Steers	Cull cows	Cull bulls	Heifers	Total
	$	$	$	$	$
1974	-	-	-	-	
1975	-	-	-	-	
1976	-	22 400		-	22 400
1977	84 000	64 800	7 000	-	155 800
1978	248 640	74 000	10 000	-	332 640
1979	277 220	114 800	13 000	258 000	355 020
1980	660 000	148 750	15 000	562 400	1 386 150
1981	630 880	175 100	14 000	889 500	1 609 480
1982	654 720	194 225	12 000	1 100 000	1 960 945
1983	685 920	202 300	12 000	1 100 000	2 000 220
1984	683 520	212 500	12 000	1 040 600	1 948 620
1985 and following	860 220	289 800	11 000	991 100	2 152 120

TABLE IV.5 MARKET PRICE ASSUMPTIONS FOR LIVESTOCK SALES - $ PER HEAD

Year	Steers	Cull cows	Cull bulls	Heifers
1976		400		
1977	420	400	500	
1978	420	400	500	
1979	420	400	500	
1980	480	425	500	600
1981	480	425	500	600
1982	480	425	500	600
1983	480	425	500	600
1984	480	425	500	600
1985 and following	540	450	500	600

TABLE IV.7 PHASING OF LAND CLEARING AND PASTURE ESTABLISHMENT COSTS

Year	Hand clearing: No destumping	Hand clearing: Partial destumping	Hand clearing: Full destumping	Pasture establishment: Legume + natural grass	Pasture establishment: Legume + guinea grass	Pasture establishment: Fodder	Pasture establishment: Total
Acreages:							
1974	400	400	150	400	400	150	950
1975	850	850	300	850	850	300	2 000
1976	850	850	300	850	850	300	2 000
Costs per acre: $							
	190	255	360	70	120	180	
Total costs: $							
1974	76 000	102 000	57 600	28 000	48 000	27 000	103 000
1975	161 500	216 750	108 000	59 500	102 000	54 000	215 500
1976	161 500	216 750	108 000	59 500	102 000	54 000	215 500

TABLE IV.6 FOREIGN EXCHANGE COSTS - $ THOUSAND

Year	Development								Operation							Management and Overheads			
	Land clear-ing	Pasture estab-lish-ment	Stock pur-chases	Fenc-ing	Roads	Machi-nery and vehicles	Water supp-lies	Sub total	Pasture main-tenance	Pasture renova-tion	Fencing main-tenance	Roads main-tenance	Field machi-nery	Machi-nery and medi-cines	Sub total	Vehicles repairs and main-tenance	Vehicles and equip-ment replace-ment	Sub total	Overall total
1974	84.8	54.5	-	12.8	5.4	165.1	1.6	324.2	-	-	-	-	9.2	-	9.2	4.1	-	4.1	337.5
1975	173.0	114.7	2 318	25.6	2.8	12.3	3.2	2 649.6	18.5	-	1.0	0.6	9.7	6.0	35.8	4.5	-	4.5	2 689.9
1976	173.0	114.7	1 134	25.6	2.8		3.2	1 453.3	57.1	-	2.9	1.0	9.7	13.0	83.7	4.5		4.5	1 541.5
1977			754					754	95.7	-	4.8	1.5	9.7	20.6	132.3	4.5	-	4.5	890.8
1978									95.7	-	4.8	1.5	9.7	26.8	138.5	4.5	3.5	8.0	146.5
1979									86.2	23.2	4.8	1.5	9.7	31.9	157.3	4.5	3.5	8.0	165.3
1980														35.3	160.7	4.5	16.4	20.9	181.6
1981														38.5	163.9	4.5	-	4.5	168.4
1982														40.3	165.7	4.5	82.7	87.2	252.9
1983														39.8	165.2	4.5	3.5	8.0	173.2
1984														39.3	164.7	4.5	-	4.5	169.2
1985														43.3	168.7	4.5	47.6	52.1	220.8
1986																	28.7	33.2	201.9
1987																	3.5	8.0	176.7
1988																	-	4.5	173.2
1989																	-	4.5	173.2
1990																	82.7	87.2	255.9
1991																	3.5	8.0	176.7
1992																	16.4	20.9	189.6
1993																	-	4.5	173.2
1994																	3.5	8.0	176.7
1995																	3.5	8.0	176.7
1996																	47.6	52.1	220.8
1997																	8.8	13.3	182.0
1998																	82.7	87.2	255.9
1999																	-	4.5	173.2
TOTAL	430.8	283.9	4 206	64.9	11.0	177.4	8.0	5 181.1	2 077.2	487.2	114.3	36.1	251.7	941.0	3 907.5	116.6	438.1	554.7	9 643.3

TABLE IV.8 PASTURE MAINTENANCE AND RENOVATION COSTS

Year	Acreages						Total Costs	
	Legumes + natural grass		Legumes + guinea		Fodder			
	Main-tenance	Renovated	Main-tenance	Renovated	Main-tenance	Renovated	Maintenance[(1)] $	Renovation[(2)] $
1975								
1976	400	-	400	-	150	-	39 850	-
1977	1 250	-	1 250	-	450	-	122 750	-
1978	2 100	-	2 100	-	750	-	205 650	-
1979	2 100	-	2 100	-	750	-	205 650	-
1980	1 890	210	1 890	210	675	75	185 085	57 735
1981 and following	1 890	210	1 890	210	675	75	185 085	57 735

Notes: (1) Costs of maintenance per acre:
Legumes + natural grass $32
Legumes + guinea $32

(2) Costs of renovation per acre:
Legumes + natural grass $77
Legumes + guinea $139
Fodder grasses $165

TABLE IV.9 FENCING, ROADS AND WATER SUPPLIES CONSTRUCTION AND MAINTENANCE COSTS

Item	1974	1975	1976	1977	1978 and following
	$	$	$	$	$
Construction costs					
Fencing	32 000	64 000	64 000	-	-
Handling pens and shade	27 000	27 000	-	-	-
Main roads	40 000	-	-	-	-
Tertiary roads	14 000	28 000	28 000	-	-
Water supplies	8 000	16 000	16 000	-	-
Total	121 000	135 000	108 000	-	-
Maintenance:					
Fencing	-	2 400	7 200	12 000	12 000
Handling pens	-	1 350	2 700	2 700	2 700
Roads	-	6 100	10 300	14 500	14 500
Water supplies	-	200	600	1 000	1 000
Total	-	10 050	20 800	30 200	30 200

TABLE IV.10 BREEDING STOCK PURCHASE COSTS

Year	Breeding cows		Bulls		Pure bred cows		Total cost
	Number	Cost(2)	Number	Cost(3)	Number	Cost(4)	
1974)(1) 1975)	1 110	1 443 000	78	780 000	50	95 000	2 318 000
1976	580	754 000	38	380 000	-	-	1 134 000
1977	580	754 000	-	-	-	-	754 000

Notes: (1) Costs for initial purchase of stock would be incurred over the two years 1974 and 1975 but would arrive on the ranch at the beginning of 1975 for budgeting purposes.

(2) Cost of 5/8 breeding cows \$ 1 300 each.

(3) Costs of pure bred bulls \$10 000 each.

(4) Costs of pure bred cows \$ 1 900 each.

TABLE IV.11 VETERINARY AND MEDICINES COSTS

Year	Number of Animals	Costs \$
1974	-	-
1975	1 420	8 520
1976	3 080	18 480
1977	4 900	29 400
1978	6 900	38 340
1979	7 580	45 480
1980	8 400	50 400
1981	9 160	54 960
1982	9 580	57 480
1983	9 480	56 880
1984	9 370	56 220
1985 and following	10 300	61 800

TABLE IV.12 SCHEME STAFF REQUIREMENTS AND COSTS

Category	1974	1975	1976	1977	1978	1979	1980 and following	Annual salary[3] $
Ranch Manager[1]	1	1	1	1	1	1	1	19 800
Assistant Manager	1*	1	1	1	1	1	1	12 100
Trainee Assistant Manager	-	1*	1	-	-	-	-	9 100
Stockmen[2]	2*	3	4	5	6	6	6	9 400
Trainee Stockmen	3*	3	2	1	-	-	-	6 000
Clerk Accountant	1*	1	1	1	1	1	1	9 400
Typist	1*	1	1	1	1	1	1	4 400
Mechanic	-	1	1	1	1	1	1	4 400
Drivers	2*	3	3	3	3	3	3	3 500
Hookmen	1*	2	2	2	2	2	2	1 900
Labourers	4*	4	4	4	4	4	4	1 500
Total number	16	21	21	20	20	20	20	
Total cost in dollars Salaries plus allowances	101 745	195 180	153 655	141 910	145 910	145 820	145 820	

Notes:
* Half year only.
(1) Expatriate manager employed years 1 to 3, salary and allowances $45 000 per annum.
(2) Expatriate stockmen employed during years 1 to 3, salary and allowances $22 000 per annum.
(3) For budgeting purposes, allowances and E.P.F. payments of 15 per cent included.

TABLE IV.13 HOUSING AND BUILDINGS PHASING AND COSTS

Category	Cost per unit	Number units and cost in years 1974	1975	1976	1977	TOTALS
		$	$	$	$	
Staff housing:						
Ranch Manager	40 000	-	(1) 40 000	-	-	40 000
Assist. Manager	30 000	-	(1) 30 000	-	-	30 000
Stockmen	15 000	-	-	(3) 45 000	(2) 30 000	75 000
Clerk/typist	15 000	-	-	(1) 15 000	-	15 000
Drivers	5 000	-	-	(2) 10 000	-	10 000
Labourers	3 500	-	-	(2) 7 000	(3) 10 500	17 500
Sub total		-	70 000	77 000	40 500	187 500
Scheme buildings:						
Office and store	30 000	-	30 000	-	-	30 000
Workshop	5 000	-	-	5 000	-	5 000
Implement shed	5 000	-	-	5 000	-	5 000
Sub total		-	30 000	10 000		40 000
Temporary buildings:						
Staff houses	3 500	(3) 10 500	-	-	-	10 500
Office cum-store	5 000	(1) 5 000	-	-	-	5 000
P.O.L. store	500	(1) 500	-	-	-	500
Sub total		16 000	-	-	-	16 000
Total buildings		16 000	100 000	87 000	40 500	243 500
Furniture and office equipment		-	14 000	7 700	4 050	25 750
Maintenance costs		-	-	5 910	7 125[1]	-

Note: (1) Maintenance costs continue in following years at the same level.

TABLE IV.14 VEHICLES AND EQUIPMENT: PURCHASE AND REPLACEMENT COSTS M$

Year	Management vehicles and transport				Ranch field equipment and tools					Overall total
	Four wheel drive	Lorry	Motor cycle	Sub-total	Tractors	Ancillary equipment	Ranch equipment	Power generator and workshop tools	Sub-total	
1974	36 000	27 000	4 400	67 400	36 000	42 000	11 000	50 000	139 000	206 400
1975	-	-	4 400	4 400	-	3 000	8 000	-	11 000	15 400
1976	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-	-	-
1978	-	-	4 400	4 400	-	-	-	-	-	4 400
1979	-	-	4 400	4 400	-	-	-	-	-	4 400
1980	-	-	-	-	-	20 500	-	-	20 500	20 500
1981	-	-	-	-	-	-	-	-	-	-
1982	36 000	27 000	4 400	67 400	36 000	-	-	-	36 000	103 400
1983	-	-	4 400	4 400	-	-	-	-	-	4 400
1984	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	16 500	8 000	35 000	59 500	59 500
1986	-	-	4 400	4 400	-	23 500	8 000	-	31 500	35 900
1987	-	-	4 400	4 400	-	-	-	-	-	4 400
1988	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-
1990	36 000	27 000	4 400	67 400	36 000	-	-	-	36 000	103 400
1991	-	-	4 400	4 400	-	-	-	-	-	4 400
1992	-	-	-	-	-	20 500	-	-	20 500	20 500
1993	-	-	-	-	-	-	-	-	-	-
1994	-	-	4 400	4 400	-	-	-	-	-	4 400
1995	-	-	4 400	4 400	-	-	-	-	-	4 400
1996	-	-	-	-	-	16 500	8 000	35 000	59 500	59 500
1997	-	-	-	-	-	3 000	8 000	-	11 000	11 000
1998	36 000	27 000	4 400	67 400	36 000	-	-	-	36 000	103 400
1999	-	-	-	-	-	-	-	-	-	-
TOTAL	144 000	108 000	57 200	309 200	144 000	145 500	51 000	120 000	460 500	769 700

TABLE IV.15 GENERAL ADMINISTRATION COSTS

Item	1974	1975 and following
	$	$
Stationary and postage	300	500
Telephone	250	500
Insurance	1 400	2 100
Books and periodicals	100	150
Staff transport and travelling	2 000	2 500
Entertainment	150	200
Accounting and audit	2 500	3 500
Bank charges	75	100
Electricity and water	450	900
Management vehicles operating	2 575	6 500
Miscellaneous	490	850
TOTAL	10 290	17 800

TABLE IV.16 SCHEME UNSKILLED LABOUR INPUTS (MAN DAYS)

Operation/Item	1974	1975	1976	1977	1978	1979	1980 and following
Land clearing:							
No destumping	4 120	8 755	8 755	-	-	-	-
Partial destumping	4 320	9 180	9 180	-	-	-	-
Full destumping	1 024	1 920	1 920	-	-	-	-
Pasture establishment:							
Grazed pastures	3 600	7 650	7 650	-	-	-	-
Fodder grasses	2 070	4 140	4 140	-	-	-	-
Pasture maintenance:							
Grazed pastures	-	1 600	5 000	8 400	8 400	7 560	7 560
Fodder grasses	-	645	1 935	3 225	3 225	2 902	2 902
Pasture renovation:							
Grazed pastures	-	-	-	-	-	2 016	2 016
Fodder grasses	-	-	-	-	-	1 013	1 013
Fencing:							
Construction	1 700	3 400	3 400	-	-	-	-
Maintenance	-	300	500	500	500	500	500
Handling pens & shade:							
Construction	750	750	-	-	-	-	-
Maintenance	-	125	250	250	250	250	250
Roads:							
Construction	200	400	400	-	-	-	-
Maintenance	-	150	300	750	750	750	750
General labour:	600	1 200	1 200	1 200	1 200	1 200	1 200
TOTAL	18 384	40 215	44 630	14 325	14 325	16 191	16 191

APPENDIX V

APPENDIX V

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